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Acknowledgements

The current issue of the Cruciferae Newsletter (vol. 37) is published online from the Brassica website (http://www.brassica.info/info/publications/cruciferae-newsletter.php). The present issue contains 6 contributions in three different topics: Agronomy and variety trial; Breeding strategies and General information on Brassica. Members of the editing board would like to acknowledge the authors for the quality of their contributions. For future issues, we would be gratefull if all the authors could read and follow carefully the author recommendations before submitting their manuscript, in order to facilitate the editing process. In particular, it is necessary to mention one of the listed topics that is the most relevant to the presented work (see the list at the end of the present issue).

Dr. Nathalie NESI on behalf of the editing group

Contact:

UMR 1349 INRA-Agrocampus Ouest-Univ. Rennes1

Institute for Genetics, Environment and Plant Protection

BP 35327, 35653 Le Rheu cedex, France

http://www6.rennes.inra.fr/igepp_eng/

email: cruciferaenewsletter@inra.fr (NEW EMAIL ADDRESS)

VARIABILITY OF SOME PRODUCTIVITY TRAITS UNDER THE CONDITION OF DIFFERENT DENSITY OF SOWING AT THE FALSE FLAX (*Camelina sativa* L. Crantz)

Yakovleva-Nosar' Svetlana*, Lyakh Viktor

Department of landscape industry and genetics, Biological Faculty Zaporizhzhia National University, Zaporizhzhia, Ukraine
*Corresponding author: krokus17.zp@gmail.com

Abstract

The relationship between the density of standing and the width of the rows, on the one hand, and, on the other hand, the variability in the number of fruits on the plant and the mass of 1000 pieces of seeds are analyzed of the three varieties of the spring-sowings false flax. It is established that the configuration and size of the feeding area are essential for the quantitative formation of fruits. There is a tendency to increase the mass of seeds in variants with a smaller number of formed fruits.

Keywords: *Camelina sativa* L. Crantz, number of fruits on the plant, weight 1000 pcs. seed, seeding density, row spacing

Introduction

Recently, the requirements for vegetable oils in Ukraine are provided by growing sunflower. But the development of food and other industries needs to expand the range of vegetable oils. One of the options for solving this problem is the unique fatty acid oil of the spring false flax. Its semi-drying oil is used in metallurgy, paint and varnish production, soap making, in the manufacture of cosmetics, and is also used as a medicine and a prophylactic and a dietary product (Kulakova, 2005).

The prospects for using this culture are determined by a number of its biological characteristics, in particular, resistance to drought and cold, pests and diseases (Komarova, 2001).

The yield of the spring false flax is connected, first of all, with productive branching (Voskresenskaya, 1949).

In connection with the above features of this culture, the aim of the work is to establish the optimal density of standing of the spring-sowing false flax to ensure high yields.

Material and methods

The object of the study was the plants of the spring-sowing false flax (*Camelina sativa* L. Crantz) of three varieties: Zeus, Prestige and Slavutich. Field research was conducted during the growing seasons of 2013-2015 at the experimental field of the Department of landscape industry and genetics at Zaporozhzhia National University. The schematic diagram of the laying of experiments was common to all analyzed varieties. Two density of plants - 200 and 400 pcs / m^2 with a row spacing of 15 and 30 cm were investigated:

- plant density 200 pcs / m^2 with a row spacing of 15 cm (30 plants / row, the area of feeding of one plant is 3.4 × 15 cm^2, or 51 cm^2);
- plant density 200 pcs / m^2 with a row spacing of 30 cm (60 plants / row, feeding area - 1.7 × 30 ^{cm2}, or 51 cm^2);
- plant density 400 pcs / m^2 with a row spacing of 15 cm (60 plants / row, feeding area - 1.7 × 15 cm^2, or 25.5 cm^2);
- plant density 400 pcs / m^2 with a row spacing of 30 cm (120 plants / row, feeding area - 0.8 × 30 cm^2, or 24 cm^2).

A total of 12 variants were analyzed. When studying the morphometric parameters, 30 plants of each variant were selected. The number of fruits on the plant and the weight of 1000 pieces seeds were determined. The data obtained are processed using statistical methods.

Results and Discussion

The obtained data testify to the absence of a significant difference in the number of fruits on the plant between variants with a density of standing of 200 and 400 pieces / m^2 (Table 1). In the varieties of Zeus and Prestige, only a tendency to increase this index was observed with a decrease in the number of plants per unit area with a row spacing of 15 cm. In the Slavutich variety, the number of fruits on the plant was significantly larger in variant 200/15 compared to variant 400/15.

Comparing the variants with different row spacing within a single density of standing, it is evident that at a row spacing of 15 cm, the number of fruits on the plant was much larger than at a distance of 30 cm between rows. In all three varieties, this pattern was observed at 200 plant standstill density / m^2, and in the Zeus variety - also at a density of standing 400 pcs / m^2.

It should be noted that in the 200/15 and 200/30 variants the feeding area of the same plant is the same (51 cm^2), however, these variants differ significantly in the configuration of this area. In the 200/30 variant, the feeding area has the shape of an elongated rectangle, whereas at a distance of 15 cm between the rows the rectangle becomes considerably shorter. Obviously, it is the configuration of the feeding area that enables plants to more effectively use the available resources (nutrients, water). An analysis of the results shows a significant increase in the number of fruits in plant varieties Zeus and Prestige in cases where the shape of the feeding area is close to the square.

We also estimated the variability of such an indicator as the mass of 1000 pcs seeds, with a different density of standing of spring-sowing false flax. There is a tendency to increase the value of this parameter due to a decrease in the number of fruits on the plant. This is due to the improvement in the supply of generative organs (fruits and hence seeds). This is especially evident in the Zeus variety against the background of a high density of plant standing.

Table 1 - Characteristics of the morphometric indices of the generative sphere of the false flax

Trait / Varient	The number of the seeds			Weight 1000 pcs. seed		
	Average value	Mean square deviation	Error of the average	Average value	Mean square deviation	Error of the average
Zeus variety						
400/30	25,87	8,63	1,58	0,86	0,15	0,03
400/15	48,63	21,29	3,89***	0,67	0,15	0,03***
200/30	29,30	13,48	2,46###	0,81	0,16	0,03##
200/15	56,83	26,75	4,88***	0,74	0,10	0,02
Prestige variety						
400/30	34,40	16,82	3,07	0,82	0,22	0,04
400/15	45,47	26,04	4,75	0,74	0,30	0,06
200/30	31,67	19,88	3,63#	0,79	0,30	0,05
200/15	56,20	28,99	5,29***	0,72	0,31	0,06
Slavutich variety						
400/30	42,53	30,08	5,49	0,75	0,17	0,03
400/15	36,27	17,99	3,28	0,64	0,16	0,03*
200/30	29,87	17,72	3,24	0,75	0,17	0,03#
200/15	113,87	67,21	12,27***,+++	0,72	0,12	0,02

Notes: *, *** - the differences between variants with different row spacing within a single density of standing are significant at P <0.05 and 0.001, respectively;

#, ##, ### - the differences between variants 200/30 and 400/15 are significant at P <0,05, 0,01 and 0,001;

+++ - the differences between variants with different density of standing with the same width of rows is essential for P <0.001

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Fatty acids composition of *Raphanus sativus var. oleifera* seed oil and analysis of breeding potential of this species as biodiesel source

Rostyslav Blume[1,2]*, Svitlana Rakhmetova[3], Dzhamal Rakhmetov[3], Yaroslav Blume[1]

[1]Institute of Food Biotechnology and Genomics of Natl. Acad. Sci. of Ukraine, 2a Osypovskogo str., Kyiv, 04123, Ukraine;

[2]Taras Shevchenko National University of Kyiv, Kyiv, 03022, Ukraine;

[3]M.M. Gryshko National Botanic Garden of Natl. Acad. Sci. of Ukraine, Tymiryazevska str., 1, Kyiv, 01014, Ukraine

*Corresponding author: blume.rostislav@gmail.com

Abstract

In sight of problem related to search of new plant oil sources for biodiesel production which mainly produced from rapeseed in Europe scientists renewed interest to less common oilseeds from *Brassicaceae* family. In our study oil radish (*Raphanus sativus var. oleifera*) breeding lines and cultivars, obtained in National Botanical Garden named M.M. Hryshko of National Aacademy of Sciences of Ukraine. According to comparison it was established that lipids of oil radish, especially of cultivar Kyyanochka, are most suitable for production light fraction of biodiesel due to high content of short-chained fatty acids – 70.31%, the highest of monounsaturated (65.36%) fatty acids, the lowest polyunsaturated/monounsaturated fatty acid ratio (PU/MU) - 0.38, desaturation ratio (DR) – 0.28, elongation ratio (ER) – 0.29, oleic desaturation ratio (ODR) –0.39, linoleic desaturation ratio (LDR) – 0.42. Other two highlighted plant that could be veryu perspective for future breeding work are form EORDOF-6 and variety Raiduha-FOL due to their high content of short-chained acids 72.46% (EORDOF-6) and 73.49% (Raiduha-FOL) and content of oleic (18:1) acid – over 37%.

Keywords: *Raphanus sativus var. oleifera*, oil radish, Ukrainian varieties, oil, fatty acids, breeding

Introduction

Increasing needs in fuels and depletion of traditional fossil fuel sources determined main problem of finding cheap and high-quality alternative fuels such as biodiesel and bioethanol [9, 13]. Many sources of oil for biodiesel production are offered now [2, 3], in particular oil of representatives of family *Brassicaceae*, especially from rapeseed. On the other hand some less common species such as oil radish (*Raphanus sativus var. oleifera*), ethiopian mustard (*Brassica carinata*), white mustard (*Sinapis alba*), false flax (*Cameilna sativa*), etc. obtained renewed interest due to their high seed productivity [12, 15, 18]. In previous articles [5-7] we evaluated oil quality of several uncommon cultures and now another high productive potential alternative plant species for oil production – oil radish (*R. sativus var. oleifera*) – became into focus of our interest. Therefore, the main goal of this research was to study fatty acid composition of main Ukrainian oil radish breeding lines and conduct out a comparative analysis of their fatty acid profiles.

Material and methods

Seed oil of high productive oil radish (*R. sativus var. oleifera*) forms (breeding lines) and cultivars of Ukrainian breeding was used for investigation. Forms EORDOFL-2, EORDOFL-3, EORDOF-4, EORDOF-5, EORDOF-6, EORDOF-7, EORDOF-8 as well as varieties Kyyanochka, Raiduha-FOL, Yamaika and Tambovchanka were obtained from the National Botanical Garden named M.M. Hryshko of Natl. Academy of Sciences of Ukraine (Kyiv) [4].

Oil extraction from respective seed samples was done using the manual press Prom-1 (Olis, Ukraine). Determination of the fatty acid composition of the seed oils of mentioned above forms and varieties was conducted out by the method of gas-liquid chromatography using chromatograph GC 2014 (Shimadzu, Japan). Identification of fatty acids was carried out by comparing the received chromatograms with chromatograms of such standard solutions as methyl esters of fatty acids C_6-C_{24}.

Formulas to calculate the basic ratios, which were used for the fatty acid composition analysis are presented in Fig. 1 and Fig. 2. Coefficients of ER (elongation ratio), DR (desaturation ratio), ODR (oleic desaturation ratio), LDR (linoleic desaturation ratio) were estimated by methods described by Velasco et al. [16] and Pleines and Friedt [14] . Fatty acid ratios were estimated according to Budin et al. [8].

$$\mathrm{ER} = \frac{\%\mathrm{C}20:1 + \%\mathrm{C}22:1}{\%\mathrm{C}20:1 + \%\mathrm{C}22:1 + \%\mathrm{C}18:1 + \%\mathrm{C}18:2 + \%\mathrm{C}18:3} \qquad \mathrm{ODR} = \frac{\%\mathrm{C}18:2 + \%\mathrm{C}18:3}{\%\mathrm{C}18:1 + \%\mathrm{C}18:2 + \%\mathrm{C}18:3}$$

$$\mathrm{DR} = \frac{\%\mathrm{C}18:2 + \%\mathrm{C}18:3}{\%\mathrm{C}20:1 + \%\mathrm{C}22:1 + \%\mathrm{C}18:1 + \%\mathrm{C}18:2 + \%\mathrm{C}18:3} \qquad \mathrm{LDR} = \frac{\%\mathrm{C}18:3}{\%\mathrm{C}18:2 + \%\mathrm{C}18:3}$$

Figure 1. Main coefficients using for analysis of fatty acid composition in different plant oil samples: ER - elongation ratio, DR - desaturation ratio, ODR - oleic desaturation ratio, LDR - linoleic desaturation ratio.

$$S/U = \frac{Saturated\ fatty\ acids}{Unsaturated\ fatty\ acids} \qquad PU/MU = \frac{Polyunsaturated\ fatty\ acids}{Monounsaturated\ fatty\ acids}$$

Figure 2. Main coefficients using for analysis of saturated and unsaturated fatty acid ratio in plant oil samples.

Results and Discussion

Due to results of the chromatographic analysis (Table 1) it was shown that seed of all forms and varieties of oil radish possess a high content of oleic (18:1), linoleic (18:2), linolenic (18:3), gondoic (20:1) and erucic (22:1) fatty acids. The majority of fatty acids are represented by short-chained acids (68.72-73.49%) and by monounsaturated acids (60.1-65.36%). Polyunsaturated linolenic (18:3) acid has been found in quantity from 10.07 to 12.74%, linoleic (18:2) – from 14.14 to 17.94% in the studied forms and varieties. The highest quantity of oleic (18:1) acid has been found in the oil of variety Kyyanochka (37.89%). Content of erucic (22:1) acid is also quite high – up to 17.3% in seed oil from form EORDOF-8. Content of gondoic (20:1) acid differs in range 9.18-10.36%. Total amount of unsaturated fatty acids (up to 91.61% in breeding form EORDOFL-3) even exceed this value in *Camelina sativa* oil [5].

Table 1. Oil fatty acid composition of different oil radish (*Raphanus sativus var. oleifera*) varieties (%)

№	Fatty acid name / Breeding form or variety	EORDOFL-2	EORDOFL-3	EORDOF-4	EORDOF-5	EORDOF-6	EORDOF-7	EORDOF-8	Kyyanochka	Raiduha-FOL	Tambovchanka	Yamaika
1	C 14:0	0.07	0.07	0.06	0.07	0.07	0.07	0.06	0.08	0.07	0.08	0.07
2	C 16:0	5.49	5.16	5.23	5.42	5.59	5.31	5.42	5.59	5.58	5.46	5.13
3	C 16:1	0.15	0.14	0.12	0.14	0.15	0.13	0.14	0.16	0.13	0.14	0.14
4	C 17:0	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.04	0.03
5	C 17:1	0.03	0.03	0.03	—	—	0.03	0.03	0.04	0.03	—	—
6	C 18:0	2.08	2.07	2.08	2.25	2.23	2.08	2	2.3	2.84	2.59	1.77
7	C 18:1	33.86	33.84	32.37	36.64	37.14	32.94	32.45	37.89	37.33	33.54	36.71
8	C 18:2	16.93	15.93	17.94	15.8	16.51	16.96	17.04	14.14	16.92	16.57	15.35
9	C 18:3	11.94	12.74	12.07	10.92	10.73	12.74	11.54	10.07	10.54	11.92	10.19
10	C 20:0	0.81	0.8	0.82	0.85	0.8	0.8	0.79	0.96	1.06	1.03	0.72
11	C 20:1	9.85	9.87	9.51	9.84	9.62	9.52	9.84	10.36	9.32	9.18	9.85
12	C 20:2	0.42	0.43	0.49	0.38	0.38	0.45	0.45	0.32	0.39	0.43	0.37
13	C 20:3	0.11	0.12	0.12	0.1	0.09	0.13	0.11	0.09	0.08	0.1	0.1
14	C 22:0	0.36	0.36	0.37	0.37	0.34	0.35	0.37	0.44	0.48	0.51	0.34
15	C 22:1	16.33	16.7	16.43	14.98	13.81	16.13	17.3	15.48	13.06	15.94	16.25
16	C 22:2	0.1	0.11	0.13	0.09	0.09	0.12	0.12	0.08	0.09	0.11	0.11
17	C 24:0	0.51	0.52	0.51	0.53	0.51	0.5	0.52	0.55	0.63	0.67	0.48
18	C 24:1	1.63	1.7	1.64	1.57	1.57	1.7	1.73	1.43	1.38	1.65	1.68
Total saturated		9.36	9.02	9.11	9.53	9.58	9.15	9.2	9.96	10.71	10.38	8.54
Monounsaturated		61.85	62.28	60.1	63.17	62.29	60.45	61.49	65.36	61.25	60.45	64.63
Polyunsaturated		29.5	29.33	30.75	27.29	27.8	30.4	29.26	24.7	28.02	29.13	26.12
Total unsaturated		91.35	91.61	90.85	90.46	90.09	90.85	90.75	90.06	89.27	89.58	90.75
Short-chained (C<18)		70.59	70.02	69.94	71.28	72.46	70.3	68.72	70.31	73.49	70.34	69.39

The content of different monounsaturated and polyunsaturated fatty acids esters in fuels can provide its higher resistance to low temperatures. Such fuels will have a lower cloud point [4]. The content of fatty acids esters, such as palmitoleic (16:1), oleic (18:1), linoleic (18:2), linolenic (18:3), eicosenoic (gondoic) (20:1), eicosadienoic (20:2), eicosatrienoic (20:3), erucic (22:1), docosadienoic (22:2), docosatrienoic (22:3), and nervonic (24:1), determines the quality of fuel that is needed to obtain. Biodiesel fuel could be divided into two groups: heavy and light (which could be used as additive to aviation fuel) type of fuel according to length of carbon chain. The most common among listed fatty acids in the composition seed oil of *Brassicaceae* plants are oleic (18:1), linoleic (18:2), linolenic (18:3), gondoic (20:1) and erucic (22:1) [15, 18].

The biggest difficulty of fatty acid composition assessment is large number of various fatty acids, each of which has specific properties. Obtained fuel from certain types of oil should have small carbon number (preferably not more than 18), therefore important is the contents of the mono- and polyunsaturated fatty acids with short chain (such as C18:2, C18:3). On the other hand very large amount of polyunsaturated fatty acids will significantly reduce oxidative stability of obtained fuel. Also, it is important to choose the most perspective genotype(s) for future work to obtain cultivar(s) with the high quality oil, which is a great problem because oil presents a mixture of a large number of different fatty acids. For this reason, some coefficients are using for more accurate assessment of the qualitative composition of different oil types: ER (elongation ratio), DR (desaturation ratio), ODR (oleic desaturation ratio), LDR (linoleic desaturation ratio) [1, 10-12, 17]. Mentioned ratios show relation between different groups of fatty acids with similar properties and probably could show activity of respective desaturase or elongase. Also to assess the results of the chromatographic analysis we used as indicators S/U (saturated fatty acids/unsaturated fatty acids) and PU/MU (polyunsaturated fatty acids/monounsaturated fatty acids) proportions [8].

Table 2. Main coefficients using for analysis of fatty acid composition of seed oil calculated for different varieties of oil radish (*Raphanus sativus var. oleifera*)

Parameter/ Breeding form or variety	EORDOFL-2	EORDOFL-3	EORDOF-4	EORDOF-5	EORDOF-6	EORDOF-7	EORDOF-8	Kyyanochka	Raiduha-FOL	Tambovchanka	Yamaika
ER	0.29	0.3	0.29	0.28	0.27	0.29	0.31	0.29	0.26	0.29	0.3
DR	0.32	0.32	0.34	0.3	0.31	0.34	0.32	0.28	0.32	0.33	0.29
ODR	0.46	0.46	0.48	0.42	0.42	0.47	0.47	0.39	0.42	0.46	0.41
LDR	0.41	0.44	0.4	0.41	0.39	0.43	0.4	0.42	0.38	0.42	0.4
S/U	0.1	0.1	0.1	0.11	0.11	0.1	0.1	0.11	0.12	0.12	0.09
PU/MU	0.48	0.47	0.51	0.43	0.45	0.5	0.48	0.38	0.46	0.48	0.4

We have calculated these values for studied plant genotypes (Table 2). The lowest S/U value was noted for cultivar Yamaika – 0.09, which is lower than in *Camelina sativa* oil [5]. Value of PU/MU range from 0.38 (in cultivar Kyyanochka) to 0.51 (in breeding form EORDOF-4). Oil radish is characterized by quite low ER value because of the small quantity of long-chained acids in oil. This value doesn't exceed 0.31 (EORDOF-8). The highest DR value was found in breeding forms EORDOF-4 and EORDOF-7 (up to 0.34). ODR value for oil radish reaches up to 0.47 in EORDOF-7 and EORDOF-8 forms. The highest index of LDR value has been found due to the highest content of linolenic acid (C18:3) what could indicate reduced oxidative stability. This value reaches only up to 0.44 (EORDOFL-3) which is very low comparing with *C. sativa*.

Taking into account the data obtained (Table 2) the oil radish variety Kyyanochka was chosen by us as the most perspective oil source for biodiesel production, especially for obtaining light type of fuel. Oil from this form is characterized by a high content of unsaturated fatty acids – 90.06% and monounsaturated fatty acids – 65.36%; the lowest PU/MU – 0.38, low ER – 0.29, low DR – 0.28, ODR – 0.39, LDR – 0.42. In view of this, the oil from Kyyanochka seeds and derived from it esters may be characterized by higher volatility, lower cloud, lower viscosity that enable to obtain mostly light fuel (with carbon chains of acids shorter than 18) with higher quality. In addition, according to [4] Kyyanochka cultivar exceed other studied plants by oil (42%) and seed yield (3440 kg/ha) productivity. Also, we can consider for future breeding form EORDOF-6 and lines that could be created basing on cultivar Raiduha-FOL. Both genotypes posses low ER – 0.26-0.27, low PU/MU ratio 0.45-0.46 and contain oleic (18:1) in large amount – over 37%. In addition, seed oil of both genotypes has the highest content of short-chained acids - 72.46% (EORDOF-6) and 73.49% (Raiduha-FOL) which looks very attractive in sight of production of light fuels.

Conclusions

According to comparison of oil radish forms (breeding lines) and cultivars breeded in the National Botanical Garden of Natl. Academy of Sciences of Ukraine it was established that the most suitable source for biodiesel production is variety Kyyanochka due to its fatty acids composition and several ratios. Oil from this form is characterized by high content of short-chained fatty acids – 70.31% and the highest of monounsaturated (65.36%) fatty acids, especially the highest value of oleic (18:1) acid - 37.89%. Polyunsaturated/monounsaturated fatty acid ratio (PU/MU) is the lowest - 0.38, so oxidative stability of this oil very high; desaturation ratio (DR) – 0.28, elongation ratio (ER) – 0.29, oleic desaturation ratio (ODR) –0.39, linoleic desaturation ratio (LDR) – 0.42. Chosen variety seed oil due to its fatty acids parameter could be used as a source for obtaining light types of fuel that have potential of usage as aviation fuel additive. Also, due to our calculations we highlighted two genotypes for future breeding (form EORDOF-6 and cultivar Raiduha-FOL) that have strong potential to be used as a source for light biodiesel fuel production which could be used as aviation fuel additive due to their high content of short-chained acids 72.46% (EORDOF-6) and 73.49% (Raiduha-FOL) and content of oleic (18:1) acid – over 37%.

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Evaluation of winter hardiness in some crucifer crops by microsatellite (SSR) markers

Ana Marjanović Jeromela[1]*, Dejana Saftić Panković[2], Dragana Miladinović[1], Aleksandra Dimitrijević[1], Aleksandar Mikić[1]

[1]Institute of Field and Vegetable Crops, Maksima Gorkog 30, 21000 Novi Sad, Serbia
[2]Educons University, Vojvode Putnika 87, 21208 Sremska Kamenica, Serbia
Corresponding author: ana.jeromela@ifvcns.ns.ac.rs

Introduction

In Serbia and other countries of the European Southeast, the autumn-sown grain and forage crucifer crops are traditionally dominant over those that are sown in spring (Marjanović Jeromela et al. 2017). Following the same trend on a global scale, rapeseed (*Brassica napus* L.) is the most important, with about 13,500 ha in 2016 (FAOSTAT 2017) and generally increasing over the years (Marinković et al. 2004). At the same time, fodder kale (*Brassica oleracea* L. var. *viridis* L.) is highly appreciated as the first fresh forage in the spring, with a beneficial effects in the nutrition of milk cows (Mikić et al. 2014). Due to its typical continental climate, with moderately cold winters and often unexpected dry springs, the breeding programme on grain and forage crucifers in the Institute of Field and Vegetable Crops (IFVCNS) in Novi Sad prefers developing the autumn-sown cultivars to the spring-sown ones, especially since the yields of both oil-rich grain and protein-abundant forage is significantly higher in the former (Marjanović Jeromela et al. 2012).

Apart from yield and its quality, one of the most significant goals in breeding autumn-sown crucifers is enhancing winter hardiness, that is, the overall tolerance to the duration and the intensity of low temperatures, which is shared with the research on autumn-sown annual legumes (Mikić et al. 2011). The screening methods allowing accurate and precise assessment of winter survival are critical for winter crop research programs. The most commonly used method is carried out by determining the ratio between the plant number before and after the winter, that is, the so-called winter survival percentage. The inherent difficulties in field trials constantly stimulate defining the improved tests complementing the screening in field conditions in contrasting environments (Rife 1996, Kole et al. 2002, Sun et al. 2007, Waalen et al. 2013).

The genetic variability of current rapeseed breeding material is narrow due to its limited geographic range and intensive breeding for specific oil and seed quality traits (Hasan et al. 2006). Many studies have demonstrated the suitability of molecular marker techniques for evaluation of genetic variation in rapeseed. Some of the breaking-through approaches to investigate the genetic distance in this crop were investigated by random amplification of polymorphic DNA (RAPD, Mailer et al. 1994), restriction fragment length polymorphism (RFLP, Diers et al. 1994) and sequence-related amplified polymorphisms (SRAP) (Riaz et al. 2001). Cluster analysis using microsatellite or simple sequence repeat (SSR) markers covering the whole rapeseed genome proves as quite suitable and precise to clearly differentiate winter and spring rapeseed from each other (Plieske & Struss 2001).

The goal of our study was to identify the heterotic groups in three crucifer crops for winter survival using SSR molecular markers considered close to quantitative trait loci (QTLs) relatd to this important agronomic characteristic.

Material and methods

The material for this pioneering investigation in our conditions was sampled from the 29 genotypes of three crucifer species, grown in the field conditions at the IFVCNS Experimental Field at Rimski Šančevi, in the vicinity of Novi Sad (Table 1). The genomic DNA was isolated from frozen leaves of each according to the procedure of Permingeat et al. (1998).

Table 1. The three crucifer crop genotypes used for a SSR analysis for winter hardiness and flowering time in the field conditions of Rimski Šančevi

Species/crop	Sowing season	Genotype	Winter survival (%)
Fodder kale	autumn	NS-Bikovo, K-357	
Rapeseed	autumn	JP 26, 57, 81, 149, 152, 232, 238, 303, 352, 373, 410, 412, 446, 449, 468	70-100
		JP 63, 298, 343, 357, 360	50-60
	spring	Galant, Global, Jasna, Pamnik, Ratnik	
Turnip	autumn	B. RAPA	

The investigation of genomic DNA polymorphism was done with SSR markers, positioned in QTL regions for winter survival (Kole et al. 2002), freezing tolerance and flowering time. Three out of nine used primers were unspecific, as shown by smear or superfluous bands, with remaining six primers giving 21 polymorphic fragments. The polymorphic markers were scored as dominant and used to calculate genetic distance between each pair of examined populations. The genetic distance was calculated according to the Jaccard index of genetic similarity (Staub et al. 2000). The pairwise distance matrix of genetic distances for cluster analysis was used by Unweighted Pair Group Method using Arithmetic averages (UPGMA; Statistica for Windows, v.5.0, StatSoft, USA).

Results

The number of polymorphic fragments per primer varied from two, in SSR Ol10 and Ol13, to six, in SSR NaRa2 E07, while its length ranged from 100 to 1000 bp, in SSR Ol10 (Table 2). Overall, 21 polymorphic fragments were generated and were screened for presence or absence in each pair of examined populations. The genetic distances among examined populations ranged from 0 to 88% (data not shown).

The genetic distances, analysed by UPMGA and presented in the form of a dendrogram, allowed the evaluation of probable relationships among the examined genotypes (Fig. 1). The accompanying cluster analysis revealed two main clusters, A and B, with a genetic distance of nearly 80%. The genotypes of fodder kale and turnip were placed in the cluster A. The cluster B branched in two subclusters at genetic distance of about 45%. One subcluster consisted of the spring rapeseed cultivars, while another comprised nearly all the autumn-sown rapeseed genotypes. Interestingly, two winter genotypes, namely OZ_GP357 and OZ_GP360, clustered with the spring ones. Though the genetic distance within the spring subcluster was low (≤ 22%), all the examined spring genotypes were differentiated. Fodder kale clustered with the autumn-sown rapeseed at a genetic distance of 35%. The genetic distance within the autumn-sown rapeseed subcluster was low (< 20%) and some of them could not be differentiated with the set of the used primers covering QTLs for winter survival.

Table 2. The primer name and sequence, linkage groups (LG), map position and number and length of polymorphic fragments used for a SSR analysis for winter hardiness and flowering time in three crucifer crops in the field conditions of Rimski Šančevi

Primer name	**Primer sequence in 5'-3' direction**	**LG**	**Map position (cM)**	**Number of polymorphic fragments**	**Length of polymorphic fragments (bp)**
SSR Ol10	TGCAACAAGGAGACGATGAG TTTGAAATCCGGGACGTAGT	N2	90.6	2	100-1000
SSR Ol11	ATGAAAACCAATCCAGTGCC GATAGCAGATGGAAGAGCCG	N19	2.9	5	150-200
		N10	0		
SSR Ol13	TTCGCAACTCCTCCTAGAATC AAGGTCTCACCACCGGAGTC	N2	68	2	150-250
SSR Ni2	TGCAACGAAAAAGGATCAGC TGCTAATTGAGCAATAGTGATTCC	N10	46.6	2	150-200
		N11	0		
SSR Bn Ol10	AATTGGCTTGGTAGCTGTCG ATAGGAATGGGATGCACAGG	N2	91	4	300-800
SSR Ra2 EO7	ATTGCTGAGATTGGCTCAGG CCTACACTTGCGATCTTCACC	N10	46.6	6	100-200
		N19	34,6		

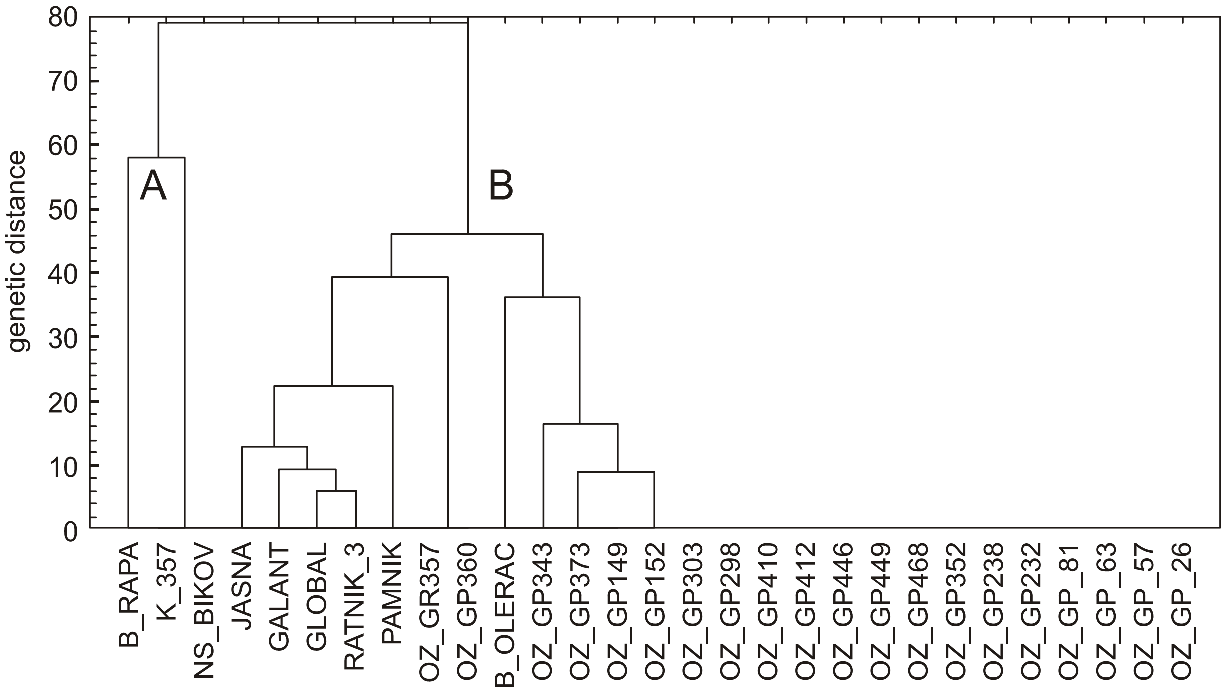

Figure 1. Cluster analysis of 29 genotypes of three crucifer crops using 21 polymorphic SSR fragments; the genetic distances between examined populations were calculated via Jaccard similarity coefficient.

Discussion

In one of the previous researches (Marinković et al. 2004),there have been clustered 402 lines, in S6 generation after an initial gene pool cross, in five clusters according to their winter survival. The clusters I-IV and the cluster V contained lines with the winter survival 70% - 100 % and 50% - 60 %, respectively. In our experiment, all the spring rapeseed cultivars clustered together, with addition of two autumn-sown rapeseed genotypes. These two, OZ_GP357 and OZ_GP360, had a value of winter survival of 50% - 60%. Since most of remaining genotypes had a winter survival values from 70% to 100%, this result is in correlation with the results of winter survival field test.

The differentiation between the winter and spring rapeseed genotypes was often revealed (Lombard et al, 2000, Plieske & Struss 2001, Bond et al., 2004). Plieske & Struss (2001) used 81 microsatellite markers spread over the whole genome, to separate 32 varietal rapeseed populations into winter and spring types. We have achieved such clear differentiation with significantly lower number of SSR markers, which indicates their suitability to supplement the winter survival field test data. The genetic distance between the winter and spring populations was about 45%, as found previously in a similar analysis with different genetic material (Plieske & Struss, 2001).

The fact that several autumn-sown rapeseed genotypes could not be differentiated can be explained by their recent common origin. In other words, they were in the S6 generation after an initial gene pool crossing, resulting in the fact that the genetic distance between them was even lower than the one in cultivated rapeseed (Seyis et al. 2003). Numerous cluster analysis show that cultivars bred by the same institute have the highest level of genetic similarity (Xu et al. 2008).

Both fodder kale and turnip were the most genetically diverse genotypes, with a genetic distance of almost 80%.

The use of novel genetic diversity for maximization of heterosis in hybrid may improve the heterotic potential of the rapeseed cultivars, but it could also lead to suffering from serious linkage drag for grain yield and quality traits (Basunanda et al. 2007). Therefore, as identified in our study, the use of diverse spring, such as PAMNIK, and winter genotypes, like OZ_GP357 or OZ_GP360, could be quite beneficial for increasing the heterotic potential in the future spring and autumn-sown rapeseed programmes.

In conclusion, the first steps in using SSR markers for developing new germplasm of rapeseed and other crucifer crops in the Southeast Europe may be rather encouraged to be carried on not solely in breeding, but also in various agronomic and phytopathological researches, such as nitrogen use efficiency and yield stability (Bouchet et al. 2016) and resistance to prevailing diseases, such as blackleg, caused by fungus *Leptosphaeria maculans* (Sowerby) P.Karst. (Fredua-Agyeman et al. 2014), in our region as well.

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Dedication

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FEW LINES FROM *LE ROBERT CRUCIFÈRE*: BOTANICAL, AGRONOMIC AND COMMON NAMES RELATING TO *BRASSICA NAPUS*

Ana Marjanović Jeromela, Aleksandar Mikić

Institute of Field and Vegetable Crops, Maksima Gorkog 30, 21000 Novi Sad, Serbia
Corresponding authors: ana.jeromela@ifvcns.ns.ac.rs; aleksandar.mikic@ifvcns.ns.ac.rs

Introduction: *Brassica napus*

The most significant contemporary cultivated species in the family *Brassicaceae* Burnett (syn. *Cruciferae* Juss.) is *Brassica napus* L., which is grown on 33,708,547 ha on a global scale, followed far behind by *B. oleracea* L. subtaxa and cultivar groups and mustards (*Brassica* spp. and *Sinapis* spp.), all together with slightly above 4,5 million ha, in 2016 (FAOSTAT 2017). Its primary centre of diversity is the Mediterranean (Zeven & Zhukovsky 1975), having widespread across the world and becoming most extensively produced in with Canada and China, with almost 18.5 t and more than 15 t, respectively (Chai et al. 2017, Phillips 2018). Resulting from the fusion of the whole genomes of *B. oleracea* (2*n* = 9) and *B. rapa* (2*n* = 10), *B. napus* is considered an amphidiploid (Li et al. 2017).

A considerable variability of morphological and quality traits may have caused a number of synonyms in various taxonomic classifications, such as *B. gongylodes* Mill., *B. napobrassica* Mill., *B. oleifera* Moench nom. illeg., *B. praecox* Kit. ex Hornem., *B. praecox* Waldst. & Kit. ex DC., *B. rutabaga* DC. ex H.Lév., *B. rutabaga* (DC.) Druce, *B. stricta* Nestl. ex DC. or *C. napus* E. H. L. Krause (The Plant List 2013). The Linnean species name, *nāpus* (Linnaeus 1753, Linnaeus 1758), is a Latin noun, which is derived from the Ancient Greek *nâpu*, denoting mustards. The synonym of the latter is *sínapi*, being, in its own turn, a borrowing of the Demotic *snwpt*, both referring to the same crops (Erichen 1954, Wiktionary 2018). Since the historical linguistic database of both Egyptian and Proto-Afroasiatic, its direct ancestor that was spoken at most 18,000 years ago, is rather abundant, there are many potential candidates for the ultimate origin of the modern scientific *sinapis*. One pair is the Egyptian *sm.w*, designating a cruciferous vegetable, and the Proto-Afroasiatic **sayam*, denoting grass, while another is the Egyptian *sn.w*, associated with a kind of ritual food, and the Proto-Afroasiatic **sVny/ʼ-*, referring to seed and corn (Militarev 2005, Militarev & Stolbova 2007).

This overview is aimed at presenting the subspecies, varieties, forms, cultivar groups and common names relating to *B. napus* (Porcher 2008, The Plant List 2013, Wiersema & León 2016, Erić et al. 2017, Kew Science 2017, Logos 2018, NPGS 2018, Wikipedia 2018, Wiktionary 2018).

B. napus subsp. *napus*

Brassica napus L. subsp. *napus*. As one of two subspecies of *B. napus*, it comprises two botanical varieties, which differ both in their above- and underground morphology and the way they are used (Chalhoub et al. 2014). The term *rapeseed* is the most widely used to denote not only this subspecies, but also the entire species *B. napus*, consisting of two segments, with *rape* derived from the Latin *rapa*, denoting a cruciferous plant with transformed root, and *seed*, associating that its most common use is for mature seeds. The vernacular names in the languages of the world are quite numerous and diverse (Table 1).

Table 1. Cultivar groups and common names relating to *Brassica napus* subsp. *napus*

Cultivar Group	Language	Name
Rapeseed	Afrikaans	koolzaad
	Albanian	kolzë
	Amharic	‘aša; zebībi
	Arabic	albjlm; alshljm;alsjlm; alsljm
	Armenian	sevuk
	Asturian	colza; nabu; raps
	Azerbaijani	raps
	Bashkir	kol'za; raps
	Basque	koltza
	Belarusian	raps
	Bengali	rā'isariṣā
	Bergamasque	raisù
	Bosniak	repica; uljana repica
	Breton	kolza
	Bulgarian	kanola; rapitsa
	Catalan	colea; colza
	Chinese (Cantonese)	yau choy
	Chinese (Mandarin)	ou zhou you cai; yang you cai; yóucài
	Chuvash	rapsă
	Corsican	colza
	Croatian	uljana repica
	Czech	brukev řepka; brukev řepka olejka; řepka olejka
	Danish	raps
	Dutch	koolzaad
	English	Argentine canola; canola; cole; colewort; colza; oilseed rape; rape
	Erzya	reps
	Esperanto	kolzo; napo
	Estonian	õlikaalikas; raps
	Finnish	kaalirapsi; rapsi
	Flemish	koolzoad
	Franco-Provençal (Forez)	crouéza
	French	chou colza; colza; navette
	Friulian	râf
	Frisian (West)	raps
	Galician	colza
	Georgian	rapsi
	German	Lewat; Raps; Reps
	Greek	elaiokrámvi; kramvogoungúlia; souidiká goungúlia
	Gujarati	balatkar
	Haitian Creole	kolza
	Hawaiian	ho‘opi‘i
	Hebrew	chrvv hnfvs; lefatit
	Hindi	balatkar; kainola
	Hungarian	repce
	Icelandic	repja
	Ido	nabeto
	Indonesian	canola; kanola; minyak rapa; rapa
	Irish	ráib
	Italian	cavolo colza; colza; navone; napo oleifera; ravizzone
	Japanese	seiyō-aburana
	Kannada	atyachar
	Kazakh	raps
	Kyrgyz	raps
	Korean	yuchae
	Lao	phad aepng
	Latvian	rapsis

	Lithuanian	rapsas; sėjamasis rapsas
	Lombard (Western)	ravetton; raviscion; ravuscion
	Maltese	kolza
	Manx	reap; napin Soolynagh
	Marathi	kōlā
	Mari (Hill)	şäpkə̈ n
	Mongolian	raps
	Norwegian (Bokmål)	raps
	Norwegian (Nynorsk)	raps
	Oléronese	colzat’
	Persian	k'lza
	Picard	colzå; coseu; cosså; cossas; cosso; cossas; golza; goza; gozå; gouza; gozeukosa; kolza; koseu; koso; koulza; kouseu; kouzo; sainse; sinse; navé; navioe; navyeu; navyo
	Polish	kapusta rzepak; rzepak
	Pont-Audemerese	chou; crambé; ravison
	Portuguese	colza; couve-nabiça
	Punjabi	kōlā
	Romagnol	colsàt
	Romanian	rapiţă
	Russian	kol'za; raps
	Samogitian	rapsos
	Sardinian (Campidanese)	raba; rava
	Scots	raps
	Seine-Maritime	cossar; cossard
	Serbian	kupusna uljana repica; uljana repica
	Sinhalese	kolāva
	Slovak	repka; repka olejná
	Slovenian	repna ogrščica; oljna ogrščica
	Sorbian (Upper)	rěpik
	Spanish	ajenabe; ajenabo; colinabo; colza; jenabe; jenable; jenape; jábena; mostaza negra; naba; nabestro; nabieyo; nabilla; nabillo; nabina; nabiza; nabizo; nabo; nabo agreste; nabo blanco de Granada; nabo colza; nabo común; nabo de Castilla; nabo de Fuencarral; nabo de comer; nabo forrajero; nabo gallego; nabo largo; nabo luengo y delgado; nabo prolongado; nabo silvestre; nabos blancos; nabresto; nabu; napo; ñabiza; ñabo; ñabu; rabanillo;raps
	Swedish	raps
	Tatar	raps
	Thai	P̄hạk kād k̂ān k̄hāw
	Tibetan	snum tshal
	Turkish	kanola; kolza
	Udmurt	raps
	Ukrainian	raps; ripak; svyripa
	Uzbek	raps
	Vietnamese	cải dầu
	Walloon	golzå
	Welsh	rêp; rêp had olew
	Yiddish	kanala

One of the most frequent vernacular names denoting *B. napus* subsp. *napus*, present in the Indo-European languages, such as Breton, English, French, Persian or Russian, are based upon the Dutch name referring to the same crop, *koolzaad*, and originally meaning *cabbage seed*. In more or less transformed form, it was borrowed by the Afroasiatic, with Maltese, the Altaic, with Turkish, and the Dené-Caucasian, with Basque, as well as in the creole, with Haitian Creole, and constructed languages, with Esperanto (Table 1). The first part of this complex Dutch word evolved from the Latin *caulis*, associated with aboveground shoots, stalks or stems, especially among the crucifers, as reported by the Roman historian and agriculturalist Cato the Elder (Lewis & Short 1879). The ultimate source of *caulis*, along with the Proto-Balto-Slavic *káu'las*, the Ancient Greek *kaulós* and the Sanskrit *kulyā*, is the Proto-Indo-European **kaw(ə)l* or **kowos*, meaning *pipe-like* or *tubular bone* (Nikolayev 2012, Wiktionary 2018).

The Chinese words in all its dialects are based upon the noun denoting simply a vegetable, such as the Cantonese *choy* and the Mandarin *cai*, with the exports in the neighbouring languages, as seen in Vietnamese (Table 1).

B. napus L. subsp. *napus* var. *napus*. The first variety of *B. napus* subsp. *napus* is cultivated exclusively for oil-rich seed production (Fig. 1, top row). Its common names in an extremely vast majority of the world languages and dialects are identical to those referring to the very subspecies (Table 1).

Brassica napus L. subsp. *napus* f. *annua* (Schübl. & G. Martens) Thell. The form with a growing season is considered annual because it lasts during one year (Koscielny et al. 2018) and is typical for both cooler and warmer temperate continental environments (Fig. 1, middle row, left). Its common names are, in fact, the same as those designating *subsp.* napus and var. *napus*, enriched with an adjective in local languages pointing that it is sown in spring or that it grows during summer (Table 2).

Table 2. Cultivar groups and common names relating to *B. napus* subsp. *napus* var. *napus* f. *annua*

Cultivar Group	Language	Name
Annual Rapeseed	Dutch	zomerkoolzaad
Annual Rapeseed	English	annual rape; summer rape
Annual Rapeseed	French	colza d'été; colza de printemps
Annual Rapeseed	German	Sommerraps
Annual Rapeseed	Indonesian	semusim rapa
Annual Rapeseed	Polish	rzepak jednoroczny
Annual Rapeseed	Russian	raps iarovoi
Annual Rapeseed	Serbian	jara uljana repica
Annual Rapeseed	Slovak	repka olejná jarná
Annual Rapeseed	Ukrainian	kol'za; ripak iaryi

B. napus L. subsp. *napus* var. *napus* f. *napus*. Another form of the variety *napus* is more present in the regions with cooler climate (Bouchet et al. 2014), although some breeding modifications may enable its reliable cultivation in warmer regions (Paridaen & Kirkegaard 2015; Fig. 1, middle row, right). Similarly to f. *annua*, the common names in diverse languages denoting f. *napus* are based on those referring to subsp. *napus* and the *napus* with the added adjectives referring to winter (Table 3). The English name for f. *napus* is distinct from those associated with another, but akin, species, *Brassica rapa* L.

Table 3. Cultivar groups and common names relating to *B. napus* subsp. *napus* var. *napus* f. *napus*

Cultivar Group	Language	Name
Biennial Rapeseed	Dutch	bladkool; winterkoolzaad
Biennial Rapeseed	English	swede rape
Biennial Rapeseed	Esperanto	kolzo
Biennial Rapeseed	French	colza d'hiver
Biennial Rapeseed	German	Winterraps
Biennial Rapeseed	Indonesian	dwimusim rapa

Biennial Rapeseed	Polish	rzepak dwuroczny
Biennial Rapeseed	Russian	raps ozimyi
Biennial Rapeseed	Serbian	ozima uljana repica
Biennial Rapeseed	Slovak	repka olejná ozimná
Biennial Rapeseed	Ukrainian	ripak ozymyi

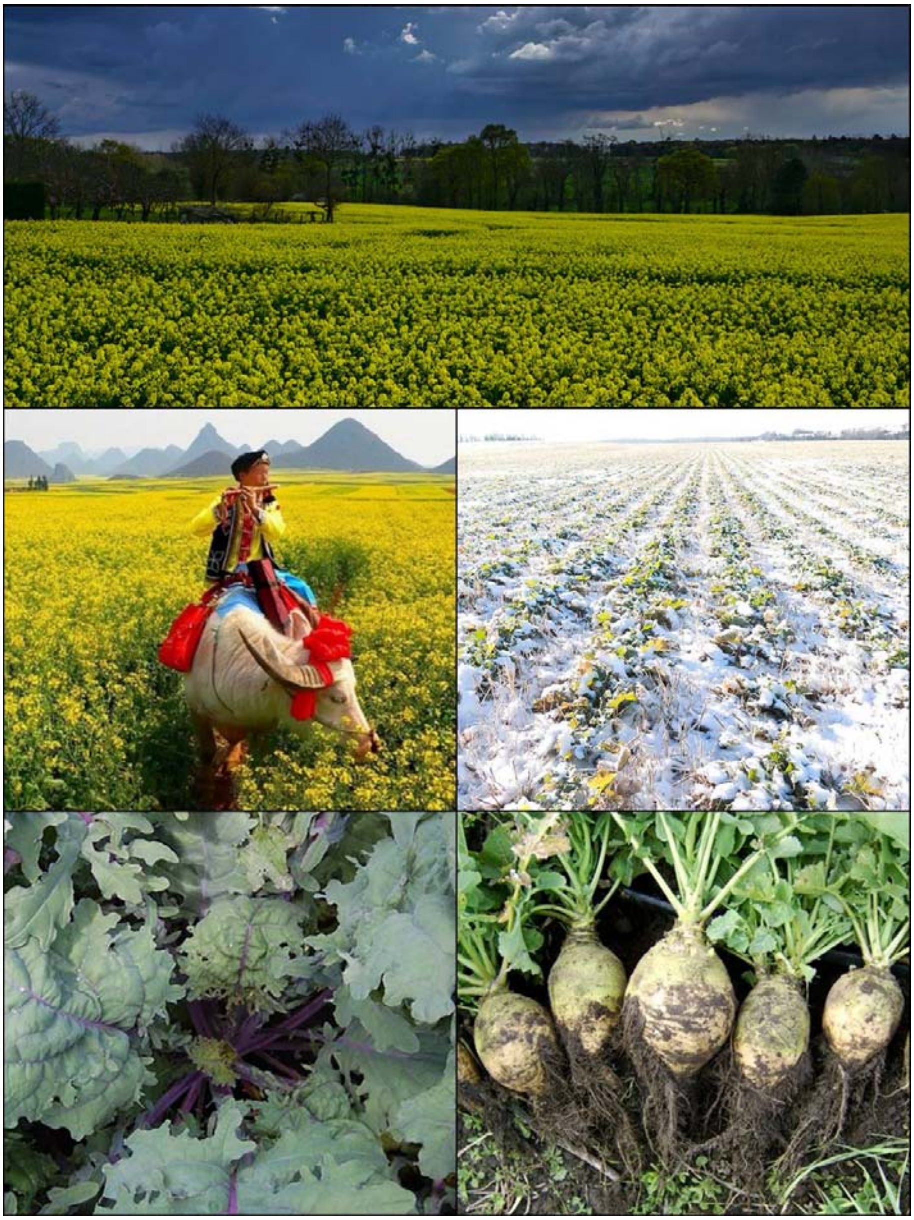

Figure 1. Cultivars groups *Brassica napus*: (upper row) rapessed in Le Rheu, Bretagne, France; (middle row, left) annual rapeseed in the county of Luoping, Yunnan, China; (middle row, right) biennial rapeseed in Philpot, Kentucky, USA; (lower row, left) kale in Monticello, New York, USA; (lower row, right), rutabaga in Dotnuva, Lithuania

B. *napus* L. subsp. *napus* var. *pabularia* (DC). Alef. This variety of subsp. *napus* is grown for fresh leaf production and the use in both human diets, as salad, and animal nutrition, in the form of forage. Recently, it has achieved a rapid increase in many regional markets, such as USA (Amsden et al. 2017). Its rare local common names associate this crop to a cruciferous plant, to some of its morphological peculiarities and similarities to other vegetables (Fig. 1, bottom row, left), to the act of cutting or mowing and to the cool climate geographic categories, such as Hanover or Siberia (Table 4).

Table 4. Cultivar groups and common names relating to *B. napus* subsp. *napus* var. *pabularia*

Cultivar Group	Language	Name
Kale	English	asparagus kale; Hanover-salad; hungry gap kale; rape kale; Siberian kale
Kale	French	chou à faucher
Kale	German	Schnittkohl
Kale	Polish	rzepa naciowa
Kale	Portuguese	couve-nabiça
Kale	Spanish	nabicol

B. napus subsp. *rapifera*

B. napus L. subsp. *rapifera* Metzg. is labelled by both breeders and agronomist as Rutabaga and is grown primarily for its rich and nutrient-rich roots, suitable to be used as a winter feed (Fig. 1, bottom row, right). This important crop, especially in northern climates, is also a novel source of antioxidants (Pasko et al. 2013).

The common name *rutabaga* has its origin in Västgötska, a dialect of Swedish language, spoken in the western parts of the country. More precisely, it is its complex word denoting subsp. *rutabaga*, which has a descriptive nature and literally means *baggy root*. In a more or less corrupted form, this word is present in many common names across the word, from Västergötland to Indonesia and from Haiti to Korea (Table 5).

Table 5. Cultivar groups and common names relating to *B. napus* subsp. *rapifera*

Cultivar Group	Language	Name
Rutabaga	Arabic	lft swidi
	Armenian	gongegh
	Asturian	colinabu; naba; nabicol; nabu forrajero; rutabaga
	Bashkir	brjukva
	Basque	arbi-aza
	Belarusian	bručka
	Breton	irvinenn-saoz
	Catalan	colinap
	Cheyenne	heóvemo'ôhta'e
	Chinese (Cantonese)	ruìdiăn dàtóucài
	Chinese (Mandarin)	da tou cai; man jing gan lan; wu jing gan lan
	Croatian	čepovača; podzemna koraba; stočna koraba; švedska repa
	Czech	brukev řepka tuřín; kolník
	Danish	kålrabi; kålroe
	Dutch	knolraap; koolraap
	English	rutabaga; swede; Swedish turnip; winter rape
	English, Ireland	swede
	English (Isle of Man)	moot
	English, Northern England	swede
	English, Scotland	swede
	English (USA)	rutabaga
	Esperanto	napo
	Estonian	kaalikas
	Finnish	lanttu
	French	chou-navet; navet de Suède; rutabaga
	French (Quebec)	navet jaune
	Frisian (Saterland)	Stäkräiwe
	Frisian (West)	güül rööw; kualrööw; böderrööw; steegrööw
	Friulian	verzerave
	German	Bodenkohlrabi; Butterrübe; Erdkohlrabi; Kohlrübe; Runke; Runkelrübe; Steckrübe; Schwedische Rübe; Unterkohlrabi
	German (Austria)	Dotsche
	Haitian Creole	rutabaga
	Hungary	karalábé; karórépa
	Icelandic	gulrófa; rófa
	Indonesian	rutabaga
	Irish	svaeid
	Italian	cavolo navone; navone; navone da forragio; rutabaga
	Japanese	rutabaga; suwhēden-kabu
	Jèrriais	saidiche; suidiche
	Jurassien	choux-rave
	Kashubian	wrëk
	Kazakh	asxanalıq tarna; tarna
	Komi	galanka
	Korean	lutabaga

	Kurdish (Northern)	şêlim
	Lithuanian	griežtis
	Low German	Wruke
	Mari (Hill)	uşman
	Mari (Meadow)	čuŋgəla
	Mongolian	manjin
	Navajo	tséyaa hataałí
	Norman	sudiche
	Norwegian (Bokmål)	kålrabi; kålrot
	Norwegian (Nynorsk)	kålrabi; kålrot
	Ossetian	urs cæxæra; urs khuymbyl; xydyr bulkh
	Persian	shlghm zrd
	Picard	chounavioe; patagå; tabagå
	Piedmontese	ratabach
	Polish	brukiew; karpiel
	Portuguese	couve-nabo; nabo; rutabaga
	Russian	briukva
	Samogitian	sietėnis; sietėnīs
	Scanian	rabba
	Scots	neep; swade
	Scots, Southern	tumshie
	Serbian	broskva; koraba; podzemna koraba
	Sorbian (Upper)	kulirěpa; prawa kulirěpa
	Spanish	colinabo; nabo; nabo de Suecia; nabo forrajero; nabo sueco; rutabaga
	Swedish	kålraps; kålrot
	Swiss German	Knutsche
	Tagalog	dilaw na singkamas; dilaw na turnip; rutabaga; singkamas ng Suwesya; Suwekong singkamas; Suwekong turnip; turnip ng Suwesya
	Tatar	bryukva
	Tuvan	briukva
	Udmurt	kaljaga
	Uzbek	bryukva
	Västgötska	rotabagge
	Vietnamese	cải củ Thụy Điển
	Welsh	rwden

It is noteworthy that numerous Slavic languages has almost identical vernacular names for this crop, such as in Belarusian, Czech or Serbian, as well as in the neighbouring non-Slavic languages, with the Altaic Bashkir, Tatar, Tuvan or Uzbek (Table 5). The etymology of the assumed initial form, **bruky*, is quite interesting (Vasmer 1953): it came from the Low German *wrŭke*, which, in its turn, is an outcome of the evolution of the Latin *brassica eruca*, today classified as *Eruca sativa* Mill. Originally, the Latin *eruca* is considered a name for a cruciferous plant used as a vegetable and has its definite origin in the Proto-Indo-European *$\acute{g}^{h}$*ers*, literally meaning *to bristle* and having a still insufficiently unexplained descriptive character (Wiktionary 2018).
The remaining common names denoting rutabaga are mainly based upon the aforementioned Latin terms *caulis*, *napus* and *rapa* (Table 5).

Conclusions

The existing variability of morphological characteristics of the taxa of the species *B. napus* may be regarded as rather broad. It offers two main directions of the crop improvement, one for grain production and oil extraction and another for animal nutrition and developing the varieties with fleshy roots of desirable chemical composition and other quality traits. Its added value is its role in the form of so-called *superfood* as a leafy vegetable. Studying the collected data considering common names denoting all these biological categories may both reveal more about its past and say a lot about its place in many local (agri)cultures of various linguistic ethnolinguistic families.

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Dedication

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FEW LINES FROM *LE ROBERT CRUCIFÈRE*: BOTANICAL, AGRONOMIC AND COMMON NAMES RELATING TO *BRASSICA RAPA*

Aleksandar Mikić, Ana Marjanović Jeromela

Institute of Field and Vegetable Crops, Maksima Gorkog 30, 21000 Novi Sad, Serbia
Corresponding authors: aleksandar.mikic@ifvcns.ns.ac.rs; ana.jeromela@ifvcns.ns.ac.rs

Introduction: *Brassica rapa*

The species scientifically labelled as *Brassica rapa* L. is one of the economically most significant crops within the tribe *Brassiceae* de Candolle and the family *Brassicaceae* Burnett (syn. *Cruciferae* Juss.) across the world (Mun et al. 2009), with a rarely remarkable variability of its morphological, agronomic and other characteristics. Apart from this aspect, it has been gaining an increasing application in model genomics and evolutional issues (Wang et al. 2011). The geographic origin of *B. rapa* is in the Mediterranean, encompassing West Asia, South Europe and North Africa, with additional diversity processes in East Asia (Guo et al. 2014). Unlike botanically close cultivated species, such as *B. napus* L. and *B. juncea* (L.) Czern., *B. rapa* is a typical diploid, developed 4.7 million years ago and with a chromosome number of 2*n* = 20, and is, in fact, one of the genome donors of the two aforementioned crops, what is estimated to occur about 7500 years ago (Kim et al. 2018).

An additional dissimilarity between *B. rapa*, on one side, and *B. juncea* and *B. napus*, on the other side, is its taxonomic classification history. The taxa of the former were placed solely in two categories above subspecies, namely the genus *Rapa* Mill. and the species *Brassica campestris,* while all the others shifted mainly between the levels of subspecies and varieties (The Plant List 2013). The species' name *rapa* is a Latin noun (Linnaeus 1753, Linnaeus 1758) corresponding to the Proto-Baltic **rā̃p-iã̄*, the Proto-Celtic **arbīno*, the Proto-Germanic **rēbṓ(n)*,**rōbiṓn*, **rōbṓn*, the Ancient Greek *rháphü-s*, *rhápü-s*, *rháphano-s* and the Proto-Slavic **rḗpā*, and each originating from the Proto-Indo-European **rāp-/-ē-* and all of which have the same meaning as today (Mikić et al. 2012, Nikolayev 2012). The same root is responsible for the Linnean name of *Raphanus* (Pokorny 1959).

The following paragraphs intend to offer a brief and combined botanical, agronomic and linguistic analysis of the names relating to *B. rapa* in these three research topics, as a testimony of an immense richness of forms and uses of this crop (Porcher 2008, The Plant List 2013, Wiersema & León 2016, Erić et al. 2017, Kew Science 2017, Logos 2018, NPGS 2018, Wikipedia 2018, Wiktionary 2018).

B. rapa subsp. *chinensis*

B. rapa L. subsp. *chinensis* (L.) Hanelt var. *chinensis*. This subspecies of *B. rapa* is a very popular vegetable with developed and cluster leaves (Fig. 1, first row, left). It has a great market value as both fresh and conserved product (Lu 2007). The name of the cultivar group comes from the Cantonese Chinese and is present in more or less transformed word morphology in most world languages, with an almost inevitable local adjectives referring to China, as its homeland (Table 1).

Table 1. Cultivar groups and common names relating to *Brassica rapa* subsp. *chinensis* var. *chinensis*

Cultivar Groups	Language	Name
Bok Choy	Arabic	mlfuf sini
	Basque	aza txinatarra
	Catalan	bleda xinesa; bok choy; choy sum; pak choi
	Chinese (Cantonese)	báicài zǐ; bok choy
	Chinese (Mandarin)	qing cai; Shànghǎi qīng; xiǎo báicài
	Croatian	kinesko zelje
	Czech	bok čoj zelí; čínské zelí; pak čoj zelí
	Dutch	pak-choi; paksoi
	English	bok-choy; celery cabbage; celery mustard; Chinese cabbage; Chinese mustard; Chinese white cabbage; mustard cabbage; pak choi; pak-choi; pok choi; white celery mustard
	Esperanto	ĉinia brasiko
	Finnish	bok choy; pak choi; paksoi tai; pak-soi; pinaattikiinankaali
	French	bok choy; chou chinois; chou de Chine; pak choï
	Galician	coia chinesa; col chinesa; repolo chinés
	German	Chinakohl; chinesischer Senf-Kohl; Pakchoi; Pak Choi; Pak Choy; Pok Choi
	Greek	bok tsói; bok tsóu; láchano tou Pekínou; kinéziko láchano
	Hebrew	chrvv sn
	Hungarian	kínai kel
	Icelandic	blaðkál
	Indonesian	bok choy; pakcoy; paksoi; pecai; sawi putih
	Italian	bok choy; cavolo cinese; cavolo sedano
	Japanese	chingensai; shaku-shina; tai-sai
	Javanese	sawi
	Kannada	bāy cāy
	Korean	cheong-gyeongchae
	Macedonian	bok choj; kinesko zelje; pak choj
	Malay	puhit; sawi putih
	Navajo	Bináá' Ádaałts'ózí bich'il łigaií
	Norwegian	bak choy; pak choy; paksoi; tai tsai
	Polish	bok choy; kapusta właściwa chińska; pakczoj; pak-choy
	Portuguese	bok choi; bok choy; chingensai; couve-chinesa; pak choi; pak choy; repolho-china; repolho-chinês
	Russian	bok-choi; kapusta kitaiskaia; kitaiskaia listovaia kapusta; pak-choi
	Serbian	kineski kelj; kineski kupus
	Sorbian (Upper)	prawy chinski kał
	Spanish	col de China; repollo chino
	Spanish (Filippines)	péchay
	Tagalog	petsay
	Tibetan	tshal dkar che ba
	Ukrainian	bok-choi; kytais'ka lystova kapusta
	Vietnamese	bạch giới tử; cải bẹ trắng; cải thìa

B. rapa L. subsp. *chinensis* (L.) Hanelt var. *parachinensis* (L. H. Bailey) Hanelt. The cultivar group Choy Sum, identical to one of three varieties of the subsp. *chinensis*, is used in the form of slender and broad leaves and small inflorescences (Fig. 1, first row, middle). It is widespread throughout Easte and Southeast Asian cuisines and has antioxidant effects (Kamarudin et al. 2014). This variety of *B. rapa* received its name from the transliterated Cantonese Chinese, which was embraced by various languages with attributes relating to leaf, such as in Esperanto, to inflorescences, such as in English, or to mustard crops, such as in Indonesian and Malay (Table 2).

Table 2. Cultivar groups and common names relating to *Brassica rapa* subsp. *chinensis* var. *parachinensis*

Cultivar Groups	Language	Name
Choy Sum	Chinese (Cantonese)	cài xīn; choy sum
	Chinese (Mandarin)	cài xīn
	Dutch	choisam
	English	Chinese flowering cabbage; Cain Xin; caisin; choi sum; choisum; choy sum; false pak-choi; flowering white cabbage; mock pak-choi
	Esperanto	ĉina folibrasiko
	German	Choisum; Tsoi-sum
	Indonesian	bok choy; pakcoy; sawi hijau; sawi kembang
	Japanese	saishin
	Korean	chaesim
	Malay	sawi bunga

B. rapa L. subsp. *chinensis* (L.) Hanelt var. *purpuraria* (L. H. Bailey) Kitam. The third variety of subsp. *chinensis* is widely cultivated in southern China for many millennia (Cai et al. 2017) for its purple stems and leaves (Fig. 1, first row, right). Its common names are associated with vegetables, such as in Chinese, and to purple colour and mustard crops, such as in English (Table 3).

Table 3. Cultivar groups and common names relating to *Brassica rapa* subsp. *chinensis* var. *purpuraria*

Cultivar Groups	Language	Name
Purple Choy	Chinese	zi cai tai
	English	purple-stem mustard; saishin

Brassica rapa subsp. *dichotoma*

Brassica rapa L. subsp. *dichotoma* (Roxb.) Hanelt. This subspecies of *B. rapa* is a valuable leafy vegetable ingredient in many traditional dishes in India and other South Asian countries (Fig. 1, second row, left). In some countries, such as Pakistan, there are recent advances in breeding subsp. *dichotoma* and studies on its agronomic characteristics (Nasim et al. 2014), while, in India, there are interesting and useful accounts on its intercropping with legumes, such as peanut (*Ararchis hypogaea* L.) (Das et al. 2017). The origin of the Indo-Aryan name denoting subsp. *dichotoma*, imported in other languages, such as English (Table 4), is still insufficiently clarified, although some Proto-Indo-European root like **sas-*, referring to cereals, may be candidate for solving this issue, via the Old Indo-Aryan **sasyá-*, associated with grain (Nikolayev 2012).

Table 4. Cultivar groups and common names relating to *B. rapa* subsp. *dichotoma*

Cultivar Groups	Language	Name
Brown Sarson	English	brown sarson; Indian rape; toria
	German	indischer Kohl
	Hindi	sarsõ
	Sanskrit	sarshapa

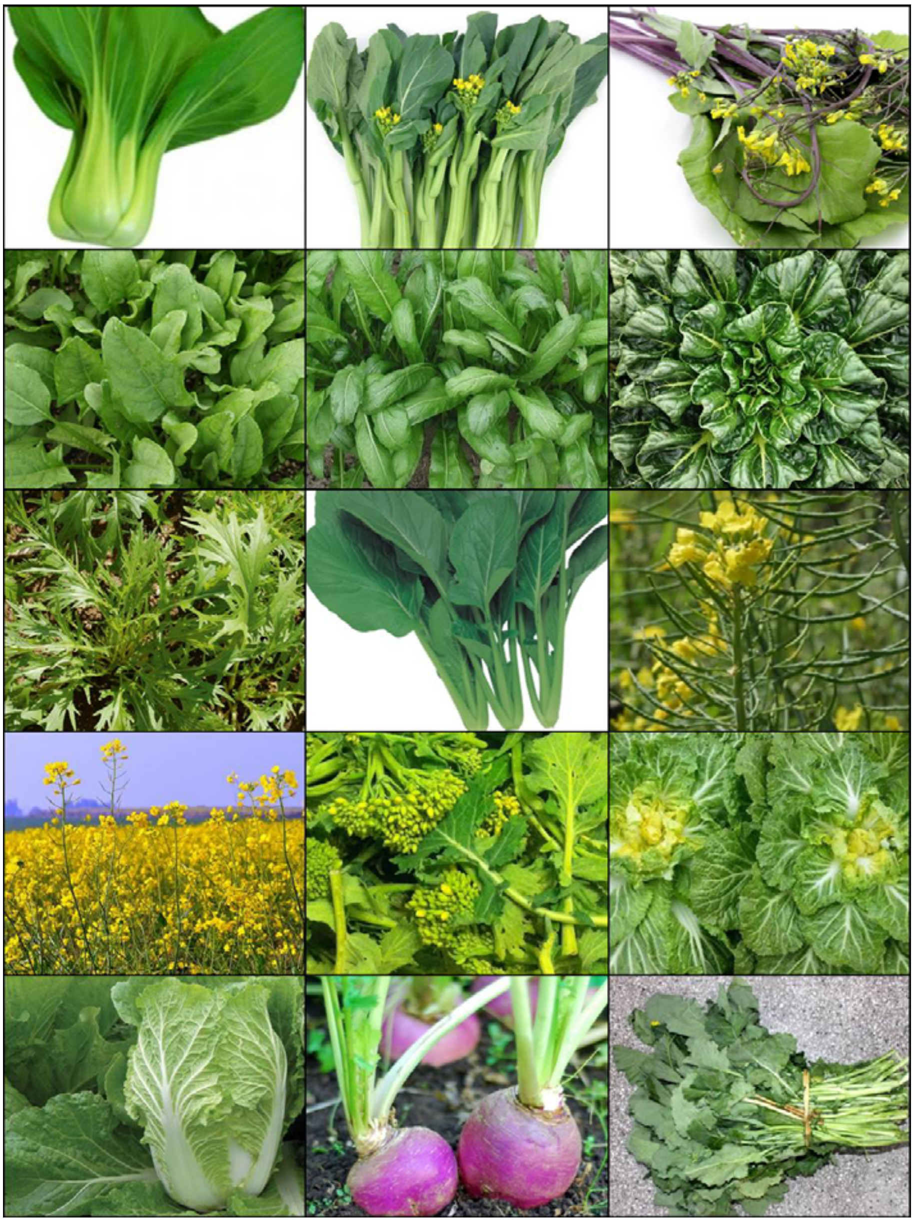

Figure 1. Cultivars groups and subgroups of *Brassica rapa*: (from left to right and from top to bottom) book choy, choy sum, purple choy, brown sarson, mibuna, tatsoi, mizuna, komatsuna, annual mustard, biennial mustard, ruvo, bomdong, napa, turnip, yellow sarson

B. rapa* subsp. *japonica

B. rapa L. subsp. *japonica* Shebalina. This subspecies of *B. rapa* is common in Japanese and other East Asian cuisines and is appreciated for its leaf rosettes (Fig. 1, second row, middle). Known by its native Japanese name (Table 5), mibuna has a potential for improving certain quality properties of *B. napus* through hybridisation (Zhang et al. 2015).

Table 5. Cultivar groups and common names relating to *Brassica rapa* subsp. *japonica*

Cultivar Groups	Language	Name
Mibuna	English	Japanese rape; mibuna
	Japanese	mibuna

Brassica rapa* L. subsp. *narinosa

B. rapa L. subsp. *narinosa* (L. H. Bailey) Hanelt. The cultivar group Tatsoi originated in China and have become widespread throughout various temperate regions, where it is grown for abundant leaf rosettes (Fig. 1, second row, right), rich in vitamins and other nutrients (Xiao et al. 2016). It has a considerable tolerance to low temperatures (Creasy 1999). The common names of subsp. *narinosa* are mostly based upon its Chinese names, with adjectives relating to leaves, leaf rosettes, morphological similarity to spinach (*Spinacia oleracea* L.) and China (Table 6).

Table 6. Cultivar groups and common names relating to *Brassica rapa* subsp. *narinosa*

Cultivar Groups	Language	Name
Tatsoi	Chinese (Cantonese)	tā kē cài
	Chinese (Mandarin)	tat choy; tat soi; wu ta cai
	English	broad-beak mustard; broadbeaked mustard; Chinese flat cabbage; Chinese savoy; rosette pakchoi; spinach mustard; spoon mustard; tatsoi
	German	Rosetten-Bok-Choi; Rosetten-Pak-Choi; Tatsoi
	Japanese	kisaragina; tāsai
	Spanish	col china plana; rosetón pakchoi; mostaza ancha; mostaza de cucharón; mostaza espinaca; tatsoi

Brassica rapa* subsp. *nipposinica

B. rapa L. subsp. *nipposinica* (L. H. Bailey) Hanelt var. *nipposinica*. As its breeding colloquial name designates, subsp. *nipposinica* is a leafy vegetable with quite peculiar leaf shape, dissected in many lobes and pointed ends (Fig. 1, third row, left). Thus, it is no wonder that its common names are identical to a morphologically rather similar and eponymous taxon within *B. juncea* (Table 7) and that they are often not easily distinguishable between each other (Açıkgöz et al. 2012).

Table 7. Cultivar groups and common names relating to *Brassica rapa* subsp. *nipposinica* var. *nipposinica*

Cultivar Groups	Language	Name
Mizuna	English	mizuna
	Indonesian	mizuna
	Japanese	kyōna; mibuna; mizuna

B. rapa L. subsp. *nipposinica* (L. H. Bailey) Hanelt var. *perviridis* L. H. Bailey. This variety of subsp. *nipposinica* is another among numerous East and South Asian leafy vegetable crucifers, with large leaflets without indentation (Fig. 1, third row, middle) and abundant in calcium and other nutrients. Its cultivar group label and many vernacular names in different languages are based upon the name of the Japanese village of Komatsugawa (Horie 2007), while some also include references to mustard and spinach crops (Table 8).

Table 8. Cultivar groups and common names relating to *Brassica rapa* subsp. *nipposinica* var. *perviridis*

Cultivar Groups	Language	Name
Komatsuna	Chinese	komatsuna
	Dutch	raapsteeltjes
	English	Japanese mustard spinach; kabuna; komatsuna; spinach mustard; tendergreen; turnip green; zairainatane
	Esperanto	komacuno; sinapa spinaco
	French	komatsuna; moutarde épinard
	German	Japanischer Senfspinat; Komatsuna; Mosterdspinat; Senfspinat
	Icelandic	spínatkál
	Italian	senape spinacio
	Japanese	komatsuna
	Lithuanian	komacuna; tamsusis kopūstas
	Persian	kumatsuna

	Spanish	espinaca japonesa; komatsuna; mostaza espinaca
	Vietnamese	cải bó xôi Nhật Bản; komatsuna

Brassica rapa* subsp. *oleifera

B. rapa L. subsp. *oleifera* (DC.) Metzg. var. *oleifera*. With a generally similar growth habit to *B. juncea* and *B. napus* (Fig. 1, third row, right, and fourth row, left), this subspecies and this variety of *B. rapa* is cultivated for oil-rich seed production, with diverse approaches in both basic and applied research aimed at enhancing oil chemical composition and yield (Tanhuanpää & Schulman 2002). Akin to both *B.* juncea and *B. napus*, the variety *oleifera* of *B. rapa* store synthesised lipids in the so-called oil bodies, that is, the organelles with a lipid core and protein layer, and, along with these two *Brassica* oil crops, has its own place in contemporary and fast-advancing steps in complex proteomic issues related to this cell structures (Jolivet et al. 2013). There is a vast majority of the common names relating to this variety, that is, the cultivar group labelled as mustard, is associated with various cruciferous crops, such as *B. juncea*, *B. napus*, *B. oleracea* L. or spinach (Table 9).

Table 9. Cultivar groups and common names relating to *Brassica rapa* subsp. *oleifera* var. *oleifera*

Cultivar Groups	Language	Name
Mustard	Catalan	mostassa de Menorca; nabina
	Chinese (Wu)	yóu báicài
	Czech	řepák olejný
	Dutch	raapzaad
	English	bird rape; canola; colza; field mustard; keblock; Polish canola; turnip rape; wild turnip
	French	navette; navette d'hiver; quesse améliorée
	German	Ölrübsen; Rübsaat; Rübsamen; Rübsen
	Hungarian	mezei mustár; réparepce; vad-káposztarepce; vad-réparepce
	Ido	kolzo
	Indonesian	aburana
	Italian	ravizzone
	Latvian	ripsis
	Lithuanian	aliejinė ropė
	Norwegian	rybs
	Romanian	muştar de câmp
	Russian	kapusta polevaia; repa; surepica
	Scots	baggie
	Serbian	poljska ogrštica; poljska uljana repica; uljana repa
	Spanish	mostacilla; mostarda bravanabina; mostarda silvestre; nabo; nabo de invierno; nabo de verano; nabo salvaje; nabo silvestre
	Swedish	åkerkål; rybs
	Turkish	aburana
	Ukrainian	ripa
	Veps	kopreh
	Vietnamese	mù tạt đồng

B. rapa L. subsp. *oleifera* (DC.) Metzg. var. *oleifera* f. *annua* (Metzg.) Thell. and *B. rapa* L. subsp. *oleifera* (DC.) Metzg. var. *oleifera* f. *biennis* (Metzg.) Thell. An essential difference between the spring- (Fig. 1, third row, right) and autumn-sown (Fig. 1, fourth row, left) forms of var. *oleifera* is the time of sowing, which is specific for moderate environments, while their morphology and other traits are basically identical (Liu et al. 2017, Yao et al. 2017). By this reason, the common names are the same as those that denote var. *oleifera* with the adjectives referring to the sowing season (Tables 10 and 11).

Table 10. Cultivar groups and common names relating to *Brassica rapa* subsp. *oleifera* var. *oleifera* f. *annua*

Cultivar Groups	Language	Name
Annual Mustard	English	annual turnip rape; summer turnip rape
	French	navette d'été
	German	Sommerrübsen
	Spanish	nabo de verano

Table 11. Cultivar groups and common names relating to *Brassica rapa* subsp. *oleifera* var. *oleifera* f. *biennis*

Cultivar Groups	Language	Name
Biennial Mustard	English	biennial turnip rape; winter turnip rape
	French	navette d'hiver
	German	Winterrübsen
	Spanish	nabo de invierno

B. rapa L. subsp. *oleifera* (DC.) Metzg. var. *ruvo* (L. H. Bailey) Gladis & K. Hammer. This variety of subsp. *oleifera* is a recently distinguished taxon within the complex species *B. rapa* (Hammer & Gladis 2014). Its main morphological peculiarity are abundant inflorescences (Fig. 1, fourth row, middle), which are used together with leaves. Ruvo is extremely popular in Italian cuisine, especially in its southern regions, as witnessed by numerous vernacular names in local speeches across the Apennine Peninsula (Table 12).

Table 12. Cultivar groups and common names relating to *Brassica rapa* subsp. *oleifera* var. *ruvo*

Cultivar Groups	Language	Name
Ruvo	Asturian	grelo
	Basque	arbi-gara; grelo
	Catalan	grelos
	Dutch	bladmoes; raapstelen
	English	Italian turnip; Italian turnip broccoli; nabana; raap; rapini; ruvo kale; saishin
	English (Chicago)	Italian broccoli
	English (USA)	broccoli raab; broccoli rabe
	Esperanto	grelo
	French	brocoli-rave; rapini
	Galician	grelo
	German	Rübstiel
	Barese	cime di rapa
	Italian	broccoletto
	Japanese	nanohana
	Neapolitan	friarielle
	Portuguese	grelo
	Romanesco	broccoletti
	Salentino	rapa salentina
	Spanish	grelo
	Tuscan	rapini

Brassica rapa* subsp. *pekinensis

B. rapa L. subsp. *pekinensis* (Lour.) Hanelt. This subspecies of *B. rapa* has two cultivar groups, which are simply two outcomes of regional breeding activities. The first one, named after its local Bomdong (Table 13), was developed from the Korean genepools (Jang et al. 2015) and is easily recognised for its bushy leaf rosette and dense flower buds (Fig. 1, fourth row, right).

Another cultivar group, Napa, originated in a wider region of Beijing and now is widely distributed and used in the form of compact oval leafy vegetable (Fig. 1, fifth row, left). Apart from its role in human diets, Napa draws a growing attention in most basic genomic research, especially in the light of its evolutionary link to the first model plant, *Arabidopsis thaliana* (L.) Heynh. (Song & Hou 2013). The diversity of the common names referring to Napa may be considered remarkable and is mainly based upon the corrupted Cantonese Chinese name, such as in English dialects, as well as upon the resemblance to *B. oleracea*, such as in French, Lithuanian, Polish or Russian, and to mustard, vegetable in general and China and Beijing, such as in Indonesian, in Czech and in German, respectively (Table 13).

Table 13. Cultivar groups and common names relating to *Brassica rapa* subsp. *pekinensis*

Cultivar Groups	Language	Name
Bomdong	English	bomdong; Korean napa cabbage
	Korean	bomdong

Napa	Catalan	col pequinesa; col xinesa
	Chinese (Cantonese)	shào cài; wong ah bahk
	Chinese (Mandarin)	dàbáicài
	Czech	napa; nappa zelí; Pekingské zelí
	Danish	kinakål; kinesisk kål
	Dutch	chinese kool
	English	napa; napa cabbage; pe-tsai; petsai
	English (Australia)	wombok
	English (New Zealand)	won bok; wong bok
	English (UK)	Chinese leaf
	English (USA)	celery cabbage; Chinese cabbage; sui choy
	Esperanto	ĉina brasiko; Pecajo; pekina brasiko
	Filipino	pechay baguio; wombok
	Finnish	kiinankaali; salaattikiinankaali
	French	chou chinois; chou de Pékin; pe-tsaï
	German	Chinakohl; Japankohl; Pekingkohl; Selleriekohl
	Greek	kinéziko láchano
	Indonesian	sawi cina; sawi putih
	Italian	cavolo di Pechino
	Japanese	hakusai
	Korean	baechu
	Lithuanian	pekininis kopūstas
	Malay	kubis cina; ong king; sayur putih
	Norwegian	napakål
	Persian	kax'ui tcini
	Polish	kapusta pekińska; kapusta właściwa pekińska
	Russian	kitaiiskaia kapusta; kitaiskii salat; pekinskaia kapusta; petsai; salatnaia kapusta
	Serbian	pekinški kupus
	Spanish	col china; repollo chino
	Swedish	kinakål; kinesisk kål; salladskål
	Tagalog	pechay; petsay
	Thai	Phạk kād k̄hāw
	Ukrainian	pekins'ka kapusta; petsai
	Vietnamese	bắp cải tây; cải bao; cải cuốn; cải thảo

Brassica rapa* subsp. *rapa

B. rapa L. subsp. *rapa*. The Linnean name for this *Brassica* species and one its subspecies has its ultimate origin in the aforementioned elaborated Proto-Indo-European root **rāp-/-ē-* (Table 14), denoting an old crop distinctive for its round shaped taproot (Fig. 1, fifth row, middle). Genotypes with smaller and tenderer roots are used as low-input and staple food in many regions of the world, while cultivars with larger and more robust roots are widespread as appreciated feed, mainly during the colder months of the year. Extensive research efforts on the turnip breeding and agronomy have been carried out for decades and are still being carried on (Türk et al. 2009, Aisha et al. 2014).

The English name *turnip*, embraced by many languages across the globe, may be a complex word, consisting of the verb *to turn* and the Middle English *neep*, where the latter is derived from the Latin noun *nāpus*, denoting mustards and via the Old English *næp*, while the former is most likely a later addition, which describes the movements of turning or twisting the plant stems while harvesting the roots by hand (Wiktionary 2018).

Some common names in the Semitic branch of the Afroasiatic ethnolinguistic family share the same origin, as may be seen in Arabic, Akkadian, Hebrew and Syriac, where they have a primeval meaning of the action of pulling up, in this case, the turnip root from the soil.

There is a curious glimpse of another Proto-Indo-European root, **geng*, **gong*, initially denoting lump (Pokorny 1959), which gradually acquired various meanings, among which are the Ancient Greek *gongylís* and the Western Punjabi *gonglu*, both denoting turnip (Table 14), and the Armenian *gongegh*, referring to *B. napus* subsp. *rapifera*.

It may be noted that there is a great number of vernacular names in the languages spoken in Asia, belonging to different etholinguistic communities, which have origin in the Middle Persian **šalgam* (Sokoloff 2009). Beside the modern Persian, among such are the Afroasiatic Arabic and Aramaic, the Altaic Azerbaijani, Bashkir, Kazakh, Tatar and Turkish and the Indo-European Armenian, Bengali, Bhojpuri, Gujarati, Hindi, Central Kurdish, Marathi, Mazanderani, Eastern Punjabi, Tajik and Urdu (Table 14).

Some words associated with turnip in the Uralic family, such as Estonian, Finnish and Sami languages, evolved from the Proto-Finnic **nakris*, with the same meaning ()

Table 14. Cultivar groups and common names relating to *Brassica rapa* subsp. *rapa*

Cultivar Groups	Language	Name
Turnip	Afrikaans	raap; witraap
	Akkadian	laptu, liptu
	Albanian	repë
	Amharic	k’eyiri
	Arabic	chaljam; left
	Aragonese	napo
	Aramaic	shalg(ə)ma(’)
	Armenian	shaghgamy
	Asturian	berza; colza; naba; raba; rabu
	Azerbaijani (North)	şalğam
	Azerbaijani (South)	shalgham
	Bashkir	shalqan; turneps
	Basque	arbi
	Belarusian	karmavaja rjepa; rjepa; turneps
	Bengali	śālagama; shaalgom
	Bhojpuri	shalajam
	Bosniak	repa
	Breton	irvin
	Bulgarian	ryapa
	Calabrian	rapa
	Catalan	nap; rave
	Chichewa	masamba
	Chinese (Cantonese)	dàtóucài
	Chinese (Mandarin)	dàtóucài; jié tóu cài; màn jīng; wújīng; yuán cài tóu
	Chinese (Xinjiang)	pán cài qià mă gŭ
	Chinese (Yunnan)	yuán gēn
	Corsican	navone; navonu
	Croatian	repa
	Czech	brukev řepák vodnice; vodnice
	Danish	höstoe; majroe
	Dutch	majroe; meiraap; raap; roeve; stopelknol
	English	Italian kale; ravini; seven-top turnip; turnip; white turnip
	English, Cornwall	summer turnip
	English, Scotland	white turnip
	Esperanto	kampobrasiko; rapo
	Estonian	naeris
	Filipino	singkamas
	Finnish	nauris
	Franco-Provençal	râva
	French	bulbe de racine; chou-navet; navet; rapum; rave
	Frisian	raap
	Friulian	râf; râv
	Galician	rabo
	Georgian	sak’vebi talgami; t’urnepsi
	German	Bayerische Rübe; Gatower Kugel; Herbstrübe; Mairübe; Pfatterer Rübe; Rübsen; Speiserübe; Stoppelrübe; Teltower Rübchen; Wasserrübe; weiße Rübe
	Greek	gongýli
	Greek, Ancient	buniás; rháphē
	Guarani	karatĩrana
	Gujarati	salagami
	Haitian Creole	navè
	Hebrew	lépheth
	High German, Old	ruoba
	Hindi	salgam; shalajam
	Hmong	qos
	Hungarian	tarlórépa
	Icelandic	fóðurnæpa; hvítrófa; næpa; næpukál
	Ido	napo
	Ingrian	nagris
	Irish	tornapa
	Italian	navone; rapa
	Japanese	kabu

	Kannada	ṭarnip
	Karelian	nakris; nagris
	Kazakh	şalqan
	Khmer	spaimeum
	Korean	sunmu
	Kurdish (Central)	sh'lm
	Kurdish (Northern)	çelem
	Kyrgyz	çımgır
	Lao	phakkad hua
	Latin, Classical	rāpum
	Latvian	turnepsis
	Ligurian	rava
	Limburgish	reub
	Lithuanian	ropė
	Livonian	na'ggõrz
	Livvi-Karelian	nagris; nagriš
	Ludic	nagriž
	Luxembourgish	Greipe
	Macedonian	repka
	Malayalam	madhuramuḷḷaṅki
	Maltese	nevew
	Manx	napin; napin bane; turnyr
	Marathi	shalgam
	Mari, Hill	revəə; turneps
	Mari, Meadow	reve; turneps
	Mazanderani	shalham
	Min, Southern	duâi-tàu-chái
	Mongolian	sarmag
	Myanmar	mone lar ny war
	Navajo	niłtsínii bikétł'óól dijoolí
	Norwegian (Bokmål)	vanlig nepe
	Norwegian (Nynorsk)	nepe
	Occitan	bulb de raiç; caulet; nap; rava
	Old Church Slavonic	repa
	Ossetian	fosy bulkh
	Otomi, Nortwestern	nabo
	Pashto	nubti
	Persian	šamlağ; šamlax; šalam; shalgham
	Pitmatic	baigie; snadgie; snagger
	Polish	kapusta właściwa typowa; rzepą; rzepa właściwa typowa
	Portuguese	rábano; rabo
	Portuguese (Brazil)	nabo
	Punjabi (Eastern)	śalagama
	Punjabi (Western)	gonglu
	Romagnol	reva
	Romanian	nap; gulie
	Russian	kormovaia repa; repa; turneps
	Sami, Inari	naavrâs
	Sami, Kildin	noavras
	Sami, Lule	návraj
	Sami, Northern	návrraš
	Sami, Skolt	náurraš
	Sami, Ume	naura
	Samogitian	ruopė
	Sanskrit	gṛñjanam
	Sardinian	arraba; raba; rava
	Scots	neep; tumshie
	Scottish Gaelic	snèapan
	Serbian	repa; repa ugarnjača; postrna repa; stočna repa; turnips
	Sicilian	rapa
	Sindhi	gug'u
	Sinhalese	rābu
	Slovak	kŕmna repa; repa
	Slovenian	repa
	Somali	dabocase
	Spanish	berza; colza; naba; nabo; nabo colza; nabo forrajero; raba; rabo
	Swedish	majrova; rova
	Syriac	laftā
	Tagalog	pulang singkamas; pulang turnip; singkamas; turnip
	Tajik	şalgham
	Tamil	cikappu muḷḷaṅki
	Tatar	şalkan; turneps
	Thai	h̄ạw p̄hạk kād
	Tibetan	nyung ma

	Turkish	şalgam
	Udmurt	sjartčy; turneps
	Urdu	shalgham
	Uzbek	sholg'om
	Valencian	nap
	Venetian	rava; ravo
	Veps	nagriž
	Vietnamese	cải củ turnip
	Võro	naaris; nakri; nakõr'
	Votic	nagriz
	Welsh	erfinen; meipen
	Yiddish	brukve

Brassica rapa* subsp. *trilocularis

B. rapa L. subsp. *trilocularis* (Roxb.) Hanelt. Morphologically, this subspecies of *B. rapa* is rather similar to the varieties *parachinensis* and *purpuraria*, except with the lobed leaves (Fig. 1, fifth row, right). It is grown mostly in eastern India as a leafy vegetable component in traditional dishes, but is also important for understanding the evolution and impacts of man-driven selection (Yadava et al. 2014). The common names denoting to subsp. *trilocularis* are similar to those referring to subsp. *dichotoma*, especially by associating it with India as its homeland (Table 15).

Table 15. Cultivar groups and common names relating to *Brassica rapa* subsp. *trilocularis*

Cultivar Groups	Language	Name
Yellow Sarson	Bengali	sarisan
	English	Indian colza; yellow sarson
	German	indischer Rübsen
	Hindi	sarson

Conclusions

The authors hope that the presented botanical, agronomic and linguistic treasury of the species *B. rapa* was able to succeed, at least a bit, at both reminding the crucifer research community about its remarkable diversity and demonstrating one of the viewpoints regarding its systematic and breeding classifications. Along with the extensive lexicological databases, supported by corresponding etymologies, this modest contribution may hopefully encourage both basic and applied science in relation to this ancient and yet always contemporary and useful multipurpose crop.

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Dedication

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FEW LINES FROM *LE ROBERT CRUCIFÈRE*: BOTANICAL, AGRONOMIC AND COMMON NAMES RELATING TO *BRASSICA JUNCEA*

Aleksandar Mikić, Ana Marjanović Jeromela

Institute of Field and Vegetable Crops, Maksima Gorkog 30, 21000 Novi Sad, Serbia
Corresponding authors: aleksandar.mikic@ifvcns.ns.ac.rs; ana.jeromela@ifvcns.ns.ac.rs

Introduction: *Brassica juncea*

The species *Brassica juncea* (L.) Czern. is one of the economically most important mustard species in the world (Rakow 2004). It belongs to the genus *Brassica* L., the tribe *Brassiceae* de Candolle and the family *Brassicaceae* Burnett (syn. *Cruciferae* Juss.). This species originated in the African centre of diversity, from which it subsequently spread to East and South Asia and East Europe (Zeven & Zhukovsky 1975), having, in the end, become naturalised elsewhere, as far as Oceania (Wilcox 2003). According to the theory known as the *U Triangle*, *B. juncea* is, in fact, a result of the amphidiploidisation, with the chromosome number of $2n = 36$ and comprising the whole genomes of *Brassica napus* L., $2n = 20$, and *Brassica nigra* (L.) W. J. D. Koch, $2n = 16$ (Koh et al. 2017).

Apart from the most widely designation of *B. juncea*, there is a rather vast number of its synonyms in plant taxonomy. We may mention the following few, which witness how wide is its intraspecific variation, ultimately leading to its positioning in several different genera: *Crucifera juncea* E. H. L. Krause, *Raphanus junceus* (L.) Crantz, *Rhamphosermum volgense* Andrz. ex Rupr., *Sinabraca juncea* (L.) G. H. Loos and *Sinapis juncea* L. (The Plant List 2013). The adjective *juncea* (Linnaeus 1753, Linnaeus 1758) means *juncus-like* and is based upon the Latin noun *iuncus*, denoting rushes or reeds, and has an ultimate origin in the Proto-Italic **joinikos* and the Proto-Indo-European **yoy-ni-*, referring to the same (Nikolayev 2012, Wiktionary 2018).

This variability of diverse morphological traits has led to the development of mutually rather contrasting cultivar types, as a consequence of the goals of local breeding programmes adapting to the traditional uses and consumers preferences of a specific region. The goal of this paper is to offer a hopefully comprehensive and useful guide through the treasury of botanical, agronomic and common names relating to *B. juncea*. In order to carry out this intention, the following paragraphs are designed in a hierarchical fashion, with the widely recognised botanical categories within this species (The Plant List 2013, NPGS 2018) as the primary, the agronomic types as the secondary (Porcher 2008) and the common names in diverse world's languages as the third level (Kew Science 2017, Logos 2018, Wiersema & León 2016, Wikipedia 2018, Wiktionary 2018).

B. juncea* subsp. *integrifolia

B. juncea (L.) Czern. subsp. *integrifolia* (H. West) Thell. This supspecies is extremely rich in botanical varieties and cultivar groups and subgroups. Despite its rather complex morphological diversity, it may be said that all its botanical and agronomic members are used dominantly in the form of leaves of a whole range of diverse shapes of leaflets and peduncles, mostly as vegetable in numerous local cuisines. The subspecies *integrifolia* is also a source of an antifungal protein juncin (Wong et al. 2010).

B. juncea (L.) Czern. subsp. *integrifolia* (H. West) Thell. var. *crispifolia* L. H. Bailey. This taxon and the cultivars developed within it are most recognisable for a very prominent curliness of the leaflet edges (Fig. 1, first row, left). In the countries, where *crispifolia* is a popular food, there are certain advances in transgenic breeding (Dai et al. 2011). The common names in various European and Asian languages consist mostly of the native name denoting mustard combined with an adjective pointing out the aforementioned morphological characteristic of *integrifolia* (Table 1).

Table 1. Cultivar groups and common names relating to *Brassica juncea* subsp. *integrifolia* var. *crispifolia*

Cultivar groups and subgroups		Language	Common names
Curled Mustards	Curled-Leaf Mustards	Chinese	juan bian ye jie cai; měiguó-zhòuyè-jiècài; yang jie cai
		Dutch	krulmosterd
		English	American mustard; curled mustard; curly-leaved mustard; cut-leaf mustard; dissected-leaf mustard; green mustard cabbage; ostrich-plume; southern giant curled mustard; southern curled mustard; southern mustard; Texas mustard
		French	moutarde frisée; moutarde plume
		German	Krausblättriche-Senf
		Japanese	hagoromo karashina
		Korean	gyeoja-ip
		Latvian	lapu sinepe

B. juncea (L.) Czern. subsp. *integrifolia* (H. West) Thell. var. *integrifolia* (H. West) Sinskaya. The variety is cultivated mainly for its leaves. A whole range of shapes, colours and dimensions serves as an abundant basis for developing several distinctive cultivar subgroups (Fig. 1, first row, middle and right, and the whole second row). The common names are mostly of descriptive nature, linking var. *integrifolia* with other crops of similar habit, use or taste, such as garlic (*Allium sativum* L.) or common bamboo (*Bambusa vulgaris* Schrad. ex J. C. Wendl.). They may also contain, in some European names a clear reference to the Asian countries and cities, such as *Swatow* or modern-day Shantou, where these agronomic types were introduced from or, more generally, the adjectives related to their leaf size, shape and colour (Table 2). It is noteworthy that the pigment anthocyanin, present in many of the cultivar groups of var. *integrifolia*, is also active as an antioxidant (Cheigh 2003).

Table 2. Cultivar groups and common names relating to *B. juncea* subsp. *integrifolia* var. *integrifolia*

Cultivar groups and subgroups		Language	Common names
Leaf Mustards	Garlic Mustards	English	garlic mustard; hedge garlic; jack-by-the-hedge; sauce-alone
	Japanese Giant Red Mustards	English	giant-leafed mustard; Japanese mustard
		Japanese	takana
		Latvian	japāņu sinepes
	Korean Red Mustards	English	Korean red mustard
		Korean	jeogkat
	Leaf Mustards	Bengali	laaii
		Chinese (Cantonese)	chiu chau taai kaai ts'oi
		Chinese (Mandarin)	bao xin jie cai; chang jiao jie cai; chao zhou da jie cai; da jie cai; da xin jie cai; da wang jie; kuan ye jie cai; xiǎo jiè cài
		English	bamboo mustard; broad-leaved mustard; cabbage leaf mustard; heading leaf mustard; leaf mustard; mustard cabbage; small gai choy; Swatow mustard

		Filipino	mustasa
		French	moutarde à feuilles larges; moutarde chou
		German	Breitblättrige-Senf
		Hindi	baralaaii; pahaadii raaii; raaii
		Japanese	setsuriko
		Korean	gat
	Narrow-leaf mustards	Chinese	sheng cai; shui cai
		English	Japanese water cabbage

B. juncea (L.) Czern. subsp. *integrifolia* (H. West) Thell. var. *japonica* (Thunb.) L. H. Bailey. This variety of subsp. *integrifolia* is easily recognisable because of its highly dissected leaflets (Fig. 1, third row, left) and is one of the most popular micgrogreens in local East Asian cuisines and most minimally processed vegetables (Able et al. 2003). It is also one of the plant sources of beneficial phytochemicals in treating chronic and serious illnesses as cancer and cardiovascular disease (Schreiner 2007). One of the Japanese names for var. *japonica* is *mizuna*, meaning *water greens* or *water vegetable*, because of high content of water when cut and used as a fresh salad. This name entered some of the European languages (Table 3), while other common names denoting this variety often incorporate a geographical reference to Japan as its native country and cabbage (*Brassica oleracea* L.) and mustards as the plants it is most akin to.

Table 3. Cultivar groups and common names relating to *B. juncea* subsp. *integrifolia* var. *japonica*

Cultivar groups and subgroups		Language	Common names
Cut-Leaf Mustards	Mizuna Mustards	Chinese	qian jing shui cai; rìběn wújīng; shui cai
		English	cut-leaf mustard; dissected-leaf mustard; Japanese mustard greens; mizuna; spider mustard
		Finnish	mizuna
		French	mizuna; moutarde des rizières
		Icelandic	mizunakál
		Japanese	irana; kyōna; mibuna; mizuna
		Lithuanian	japoninis kopūstas; mizuna
		Spanish	berro japonés; mostaza araña; mostaza de hoja; mostaza Japonesa; pimienta de California

B. juncea (L.) Czern. subsp. *integrifolia* (H. West) Thell. var. *longidens* L. H. Bailey. Known in English as *hakka mustard*, this variety got its name after the Hakka people, who speak Hakka, a variety of Chinese language, and live prevailingly in southern regions of China's mainland and islands, including Taiwan, and neighbouring countries (Fig. 1, third row, middle). The variety *longidens* is one of the extensively used ingredients of the distinguished Hakka cuisine, fresh, salted, pickled and preserved (Anusasananan 2012) and used in popular traditional meals like *fu-tsai* and *suan-tsai* (Chao et al. 2009).

Figure 1. Cultivars groups and subgroups of *Brassica juncea*: (from left to right and from top to bottom) curled-leaf mustard, garlic mustard, Japanese giant red mustard, Korean red mustard, leaf mustard, narrow-leaf mustard, mizuna mustard, hakka mustard, head mustard, horned mustard, hornless mustard, snow mustard, canola mustard, root mustard and zha cai mustard

B. juncea (L.) Czern. subsp. *integrifolia* (H. West) Thell. var. *rugosa* (Roxb.) M. Tsen & S. H. Lee. This variety of subsp. *integrifolia* is highly appreciated in the local cuisines of moderate environments of South and East Asia, not only because of its chemical composition and culinary properties, but also due to a rather rapid growth of leaves, forming a head-like rosette, much smaller than those in cabbage (Fig. 1, third row, right), non-demanding agronomic efforts and generally low input (Rauniyar & Bhattarai 2017). All these attributes may be found in various common names, such as to cabbage in Chinese, head- or heart-like shaped form in English, Chine as its homeland in French or a great closeness to the soil in Spanish (Table 4).

Table 4. Cultivar groups and common names relating to *B. juncea* subsp. *integrifolia* var. *rugosa*

Cultivar groups and subgroups		Language	Common names
Head Mustards	Head Mustards	Chinese	dai gai choy

		English	head mustard; heart mustard; Swatow mustard; wedge-shape leaved mustard
		French	moutarde de Chine
		Nepalese	rayo
		Spanish	mostaza de la tierra

B. juncea (L.) Czern. subsp. *integrifolia* (H. West) Thell. var. *strumata* M. Tsen & S. H. Lee. With its two cultivar types, var. *strumata* is also one of the traditional vegetables cultivated across the China's mainland, which is becoming more and more popular in healthy, light and vitamin-rich meals providing good prevention from diverse chronic diseases across the globe. The variety's chief characteristic is a very wide and water-rich and delicious petiole, edible together with its leaflet, which as are used as cut or chopped pieces and other forms (Table 5). Its diversity among the Chinese native populations is considerable and gives a solid base for advanced breeding and enhancing various desirable traits according to the market demands (Fu et al. 2006). The cultivar types with a tooth-like formation in the middle of the petiole is classified under a name of *horned mustards* (Fig. 1, fourth row, left), with identical way of cultivation and use in comparison to the so-called *common* or *non-horned mustards* (Fig. 1, fourth row, middle).

Table 5. Cultivar groups and common names relating to *B. juncea* subsp. *integrifolia* var. *strumata*

Cultivar groups and subgroups		Language	Common names
Large-Petiole Mustards	Horned Mustards	Chinese	bao bao qing cai
		English	chopped mustard; horned mustard; large-petiole mustard; Szechuan mustard
		Japanese	unzen-kobu-takana
	Hornless Mustards	Chinese	dàjiècài
		English	large-petiole mustard

Brassica juncea (L.) Czern. subsp. *integrifolia* (H. West) Thell. var. *subintegrifolia* Sinskaya. Although primarily used in the form of leaves prepared in various ways (Fig. 1, fourth row, right), there are certain morphological characteristics and genetic traits that make this variety not identical to the var. *integrifolia*. It is a popular as a cool season vegetable, especially in China and Japan (Table 6). An addition value of this variety is a high potential of accumulating heavy metals, especially cadmium (Cd) and nickel (Ni), and thus may play an important role in environment-friendly roles and phytoremediation (Cao 2008).

Table 6. Cultivar groups and common names relating to *B. juncea* subsp. *integrifolia* var. subintegrifolia

Cultivar groups and subgroups		Language	Common names
Leaf Mustards	Snow Mustards	Chinese	xuělǐhóng
		English	green-in-snow mustard; hsueh li hung; red-in-snow mustard; snow mustard
		Japanese	setsuriko

B. juncea* subsp. *juncea

This subspecies is economically the most important taxon within the species *B. juncea*. Among its numerous synonyms are *Brassica cernua* (Thunb.) F. B. Forbes & Hemsl., *Brassica juncea* var. *gracilis* M. Tsen & S. H. Lee, *Brassica juncea* var. *multisecta* L. H. Bailey, *Brassica juncea* var. *oleifera* Prain, *Sinapis cernua* Thunb. or *Sinapis juncea* L. Apart from its traditional use as spice in contrasting Asian cuisines (Oram et al. 2005), the subsp. *juncea* is cultivated mostly for mature grain, remarkably rich in oil (Fig. 1, fifth row, left). This is the reason why its cultivar groups and agronomic types, grown for oil extraction, are named *canola mustards*, thus corresponding to the worldwide-known types with an identical use in its close botanical relatives, such as *Brassica napus* L. (Marjanović Jeromela et al. 2007) and *Brassica rapa* L. subsp. *oleifera* (DC.) Metzg (Nesi et al. 2008).

Table 7. Cultivar groups and common names relating to *B. juncea* subsp. *juncea*

Cultivar groups and subgroups		Language	Common names
Oil-seed mustard	Canola mustards	Arabic	khardal hindiin
		Assamese	jatilai
		Azerbaijani (Azerbaijan)	Sarept xardalı
		Azerbaijani (Iran)	Sarpat ghardali
		Bengali	sarsapa
		Bulgarian	sarepska gorchitsa
		Catalan	mostassa bruna
		Chinese (Cantonese)	jiècài
		Chinese (Mandarin)	dà jiè, dà cài, dāngnián cài, gai cai; jiè cài, jièzǐ; tien jie cai
		Croatian	indijska gorušica; smeđa gorušica
		Czech	brukev sítinovitá; hořčice černá sitinovitá
		Dutch	Indische bruine mosterd; junceamosterd; Sareptamosterd
		English	brown mustard, Chinese mustard, India mustard; Indian mustard, leaf mustard, oriental mustard, vegetable mustard
		Esperanto	bruna sinapo; ĉina sinapo
		Finnish	Mustasinappi; Sareptansinappi
		French	chou des Indes; chou faux jonc; moutarde brune; moutarde chinoise; moutarde de Chine; moutarde de Sarepta; moutarde frisée; moutarde indienne; moutarde jonciforme
		Frisian (North)	brün senep
		Georgian	sarep’t’is mdogvi
		German	Braune Senf; brauner Senf; Chinesischer Senf; Indischer Senf; Ruten-Kohl; Sarepta-Senf; Sareptasenf
		Gujarati	rāyaḍō
		Hindi	sarason; sarson
		Hungarian	barna mustárnak, indiai mustárnak, indiairépa; oroszrépa; szareptai mustár
		Icelandic	sinnepskál
		Indonesian	atau sesawi sayur; mustar coklat; mustar india; sawi; sesawi india; tergantung pemanfaatannya
		Italian	senape bruna; senape indiana
		Japanese	karashi-na; seiyou karashi-na
		Kannada	saasive; sarshspa; sāsive giḍa hū
		Kazakh	dalalıq qışa, kögildir qışa, kögiltim qışa, sarept kapwsta; sarept qışası
		Khmer	khat naa
		Korean	gas
		Kusunda	jing
		Lao	kaad khièw
		Latvian	Sareptas sinepe; zilganā sinepe
		Lithuanian	indiška garstyčia; sareptinis bastutis
		Malay	biji sawi; kai choy; sawi; sawi pahit
		Malayalam	Sarshapam
		Maldivian	muši revi
		Marathi	mohari
		Min (Eastern)	gái-chái
		Min (Southern)	kòa-chhài
		Mingrelian	sarep’t’ish dongi
		Mongolian	gaimuu baitsaa
		Nepali	asal raaii; rāyō; laahaa
		Newar	tukaṁ
		Norwegian	Sareptasennep
		Odia	sōriṣa
		Pashto	sh'shm
		Persian	xrdl tcini
		Polish	gorczycą sarepską; kapustą sarepską; kapustą sitowata
		Portuguese (Brazil)	mostarda-indiana; mostarda-marrom; mostarda-vermelha
		Portuguese (Portugal)	mostarda-castanha; mostarda-chinesa; mostarda-da-índia; mostarda-oriental
		Punjabi (Eastern)	rā'ī
		Punjabi (Western)	toria
		Russian	gorchitsa; gorchitsa russkaia; gorchitsa sareptskaia; gorchitsa sizaia; kapusta sareptskaia
		Sanskrit	rajika; sarshapa; sarshapah

		Serbian	indijska gorušica; sareptska gorušica; smeđa gorušica
		Sicilian	sinapi
		Sindhi	srnx'n
		Spanish	mostaza castaña, mostaza china, mostaza de hoja; mostaza de la China; mostaza de la India; mostaza hindu; mostaza india
		Swahili	haradali; mastadi
		Swedish	Sareptasenap
		Tagalog	mustasa
		Tamil	kadugu; katuku; kaṭukuk kīrai
		Telugu	bhāratīya āvālu; sarsapamu; sasuvulu
		Thai	phakkat khiao, phakkat khieo, phakkat khieo pli
		Turkish	yaprak hardal
		Ukrainian	hirchytsia salatna; hirchytsia sarepts'ka
		Urdu	sarson
		Vietnamese	cải bẹ xanh; cải canh; cải cay; cải xanh; giới tử; mù tạc ấn độ; mù tạc nâu
		Welsh	mwstard tsieina
		Zhuang	byaekgat

There is one attested root in the large and old Afroasiatic family, which is responsible for the modern common names denoting *B. juncea* subsp. *juncea* in its modern descendants, but also in the languages of the peoples that, in various historical epochs, were influenced by Arabic and, later, Turkish Ottoman, cultures, such as the Altaic Azerbaijani, the Indo-European Bulgarian and Persian or the Niger-Congo Swahili (Table 7). It is **xarw-* or **xary-*, generally denoting edible grain, seed and kernel, with the direct derivatives in Proto-Berber **hawr-an*, Proto-Chadic **x'r*, Proto-Egyptian **'ıvry* Proto-Omotic **yār-* and Proto-Semitic **harw-*, with identical or very close meanings (Militarev and Stolbova 2007).

The common names denoting *B. juncea* subsp. *juncea* in some modern Indo-European ethnolinguistic family are derived from several Proto-Indo-European roots. The Slavic languages are almost mutually uniform in their common names, all of which owe their genesis to the Proto-Slavic verb *gorěti* and the Proto-Indo-European root **gwher[e]-*, **gwhrē-*, both meaning *to burn*, *to heat* (Vasmer 1959, Mikić 2018). The common names in various Germanic and Romance Italic languages, as well as in the languages of other families that borrowed them by imperial colonisation and trade, have their origin in the Latin adjective *mustus* and, ultimately, in the Proto-Indo-European **meus-*, **mūs-*, referring to a plant preferring wet habitats (Nikolayev 2012). From the Vulgar Latin forms, this root began to designate mustards in general, in the form of the Old French *moustarde*, evolving into its modern forms in English, French and many other languages and dialects (Table 7).

The attribute *sarepta* is directly based upon the name of Old Sarepta, today a district of modern Volgograd, Russia, which was established by the Moravian German colonists in mid-18th century (Kohls 1993). The settlement has eventually become a primary centre of mustard production in the country, where the first Russian cultivars were developed by the producer Conrad Nietz, using existing British and French varieties and abundance of local wild populations (Rudukhina 2015). The name *Sarepta* was used by these Protestant community in memory of the ancient Phoenician city of the same name, mentioned in the first Book of Kings the Old Testament, as a place where the prophet Elijah multiplied the meal and, interestingly, oil (17:8-24): whether made from olive (*Olea europaea* L.) or mustard, we cannot know, but it seems that there is a thin and millennia-long line linking two Sareptas.

B. juncea subsp. *napiformis*

B. juncea (L.) Czern. subsp. *napiformis* (Pailleux & Bois) Gladis. Among the synonyms of this taxon *Brassica juncea* var. *megarrhiza* M. Tsen & S. H. Lee, *Brassica juncea* var. *napiformis* (Pailleux & Bois) Kitam., *Brassica napiformis* (Pailleux & Bois) L. H. Bailey and *Sinapis juncea* var. *napiformis* Pailleux & Bois. This subspecies of *B. juncea* is characterised with largely developed tuber-like roots, accumulating starch and other nutrients (Tarakanov & Wang 2009; Fig. 1, fifth row, middle). According to literary sources, it has been cultivated in China for at least 2500 years, where it is still considered a delicious and low-input food and feed, in the form of both leaves and root (Bonjean 2016). This country is also one of the leaders of the recent advances of applying various omics in order to improve the genetic base of var. *napiformis* for developing new and improved cultivars (Xiaonan et al. 2017). The common names of this variety mostly refer to its root, as well as to a resemblance to *Brassica rapa* L. subsp. *rapa* and its homeland of China (Table 8).

Table 8. Cultivar groups and common names relating to *B. juncea* subsp. *napiformis*

Cultivar groups and subgroups		Language	Common names
Root Mustards	Root Mustards	Chinese	da tou cai; jie cai ge da; jing yong jie cai
		English	large-root mustard; Pailleux's large-rooted mustard; root mustard; Sichuan large-rooted mustard; tuberous-root mustard; turnip-root mustard; turnip-rooted mustard
		French	moutarde tubéreuse; moutarde tubéreuse de Chine

B. juncea subsp. *tsatsai*

With its two varieties, the subspecies *tsatsai* comprises local landraces and advanced cultivars that are traditionally grown as vegetable in Chinese cuisine (Wiersema & León 2016), where it is an ingredient of numerous delicious meals.

B. juncea (L.) Czern. subsp. *tsatsai* (T. L. Mao) Gladis, nom. nud.? var. *multiceps* M. Tsen & S. H. Lee. This variety is morphologically distinctive for its numerous stems per one plant, what is, with a popular term of *shoot*, a part of almost all collected common names (Table 9). Its main use in human diets is as a vegetable (Steward 2002), while one of its significant scientific roles is as one of the plants with the most-rapid cycles, useful in basic research, such as genetics and physiology (Williams & Hill 1988).

Table 9. Cultivar groups and common names relating to *Brassica juncea* subsp. *tsatsai* var. *multiceps*

Cultivar groups and subgroups		Language	Common names
Multishoot Mustards	Multishoot Mustards	Chinese (Cantonese)	hsueh li hung; ngan sz kaai; suet lui hungts'in kan ts'oi
		Chinese (Mandarin)	duo lie jie; duo lie ye jie; jin si jie; qian jin cai; xue li hong; yin si jie; zha cai
		English	chicken mustard; cut-leaved green in snow; multishoot mustard; nine-head mustard; silverthread mustard; thousand nerved cabbage
		French	moutarde de Chine à mille têtes

B. juncea (L.) Czern. subsp. *tsatsai* (T. L. Mao) Gladis, nom. nud.? var. *tumida* M. Tsen & S. H. Lee. The variety *tumida* is one of the most easily recognisable taxa within the species *B. juncea*, due to a large number of the stem, which consists of hypertrophic tissue. This anatomical and morphological anomaly, unofficially referred to as *swollen* or *tumorous* stems, is present in the form of knob-like and fist-sized stems (Wu & Zeng 2011; Fig. 1, fifth row, right). It is usually used fresh or as a pickle, predominantly in China, Japan and Korea (Niu et al. 2012). Its common name in Chinese means *pressed cabbage*, *pressed greens* or *pressed vegetable* (Table 10). The European languages, spoken in the countries where the products of this variety are imported, mainly preserved and more or less adapted its original name, while the English language contains associations with China and its southwest province of Sichuan.

Table 10. Cultivar groups and common names relating to *Brassica juncea* subsp. *tsatsai* var. *tumida*

Cultivar groups and subgroups		Language	Common names
Multishoot Mustards	Zha Cai Mustards	Catalan	zha cai
		Chinese (Cantonese)	cha tsoi; ja choi; ja choy; jar choi; jar choy
		Chinese	cha tsai; tsa tsai; zhàcài

		(Mandarin)	
		Dutch	tsa tsai
		English	big-stem mustard; Chinese pickled vegetable; Sichuan pickling mustard; Sichuan swollen stem mustard; Sichuan vegetable; swollen-stem mustard; Szechwan vegetable; Yangtze river mustard
		French	moutarde à pied renflé
		German	Tsa Tsai
		Japanese	zazai; zazei
		Korean	jachai
		Norwegian	zhacai
		Polish	zha cai
		Spanish	zha cai
		Swedish	inlagd sichuangrönsak; sichuangrönsak; zhacai

Conclusions

The presented taxonomic diversity within the species *B. juncea*, with peculiar anatomical, morphological, physiological and agronomic characteristics, demonstrates a very wide basis and, thus, quite desirable genepool for present and future breeding efforts and developing the cultivar types with enhanced yield, quality and other requirements. The botanical variation is, on the other hand, recognised by a rather wide variation of the common names in diverse languages, contributing all together to a more articulated need for preventing this cruciferous species from neglection and underutilisation.

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CRUCIFERAE NEWSLETTER Nr. 38
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The next issue of the Cruciferae Newsletter (vol. 37) will be published online during Spring 2018 from the Brassica website (http://www.brassica.info/info/publications/cruciferae-newsletter.php). Online process will ensure rapid publication of your contribution. Therefore, we should be grateful if you would, please, follow the instructions below.

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3- As previously contributions must not exceed **2 pages**, including tables, figures and photographs. **Arial 10** character is expected with single spacing (**please use the submission form below**).

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Table 1. Title

Figure 1. Title