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Acknowledgements

The current issue of the Cruciferae Newsletter (vol. 34) is published online from the Brassica website (http://www.brassica.info/info/publications/cruciferae-newsletter.php). We apologize for being so late to publish this issue. The present issue contains 9 contributions. 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).

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In this issue

Author contributions

Section 1: Genetic resources

Section 2: Agronomy and variety trials

Section 3: General information on Brassica

Appearance of some morphological and physiological traits in interspecific hybrids of honesty

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Abstract
The inheritance of some morphological and physiological traits in interspecific hybrids of honesty was studied. F_1 reciprocal hybrids between *L. annua* and *L. rediviva* species were compared with parents. The leaf tip shape of hybrids was sharper than that one in perennial species, but rounder than in annual sample. The both hybrids were characterized by intermediate appearance of leaf outgrowths. The positive heterosis for width and length of leaves was observed. The dominance of perennial development type over annual type was revealed.

Key words: *Lunaria*, interspecific hybrid, leaf morphology, plant development type, dominance level, true heterosis, inheritance

Introduction
Honesty (*Lunaria* L.) is unexplored crop which only recently attracted the attention of researchers. This plant is known for its ornamentality. It is widely used as dried flowers and flower bed plant. (RHS A-Z encyclopedia of garden plants, 2008). But especially valuable is fatty acid composition of honesty oil that can be used in pharmacology for creation of medicines (Cook et al., 1998). Broadening the genetic variability through interspecific hybridization can intensify honesty use in various industries.
Now the genetics of this crop remains poorly understood. The inheritance nature of different characters in honesty is not almost investigated and nothing is known about interspecific hybrids as well.
The aim was to study the inheritance of some morphological and physiological traits in reciprocal hybrids obtained by crossing annual and perennial species of honesty.

Material and methods
Annual (*Lunaria annua* L.) and perennial (*Lunaria rediviva* L.) species of honesty, as well as interspecific hybrids between them in reciprocal combinations, produced in Zaporizhzhya National University in 2009 (Boyka, 2014), were used as the material. Seeds of the parents and F_1 hybrids were sowed at the same time in a phytotron. After formation of the second pair of true leaves, the leaf tip shape, shape of the leaf base (leaf wings), leaf wide and leaf length were analyzed. The dominance degree of studied traits in F_1 was determined by G.M. Beil and R.E. Atkins (Beil and Atkins, 1965). The resulting figures were interpreted as follows: $0 < h_p <|$

1 | - intermediate dominance (halfdominance); h_p > | 1 | - superdominance; h_p = | 1 | - complete dominance; h_p = 0 - intermediate inheritance. True heterosis was calculated according to F.C. Petr and K.J. Frey (Petr and Frey, 1966). To determine the type of development the interval from sowing to flowering in parental species and interspecific hybrids was compared.

Significance of differences was determined using Student's t-test.

Results and Discussion

According to the literature, the leaves of *Lunaria* genus have heart-shape look. However, in *Lunaria annua* they are characterized by lanceolate shape of leaf tip and small wings while *Lunaria rediviva* has a round tip of the leaf and large distinct outgrowths (Coombes, 2012).

Table 1 presents data on the leaf morphology of the interspecific hybrids in comparison with the original species.

F_1 hybrids of ♀ *L. annua* × ♂ *L. rediviva* cross-combination have narrow triangular shape of leaf tip in contrast to the rounded and sharp tips in parents. Hybrids of reciprocal crossing combination were also characterized by triangular leaf tip shape, but it was less expressed than in the F_1 ♀ *L. annua* × ♂ *L. rediviva* and *Lunaria annua*. However, the leaf tip shape of both reciprocal hybrids was sharper than that of perennial species. The both hybrids are characterized by intermediate appearance of leaf outgrowths as compared to the initial species.

As for the width and length of leaves, in the ♀ *L. annua* × ♂ *L. rediviva* F_1 hybrid there was superdominance of greater leaf width and greater leaf length, that is, a positive heterosis was observed. In this case, the superiority of the hybrid over the best parent (true heterosis) was 18.4% for the trait of leaf width and 10.5% for leaf length. In hybrids of reciprocal combination the positive heterosis for leaf width and length was also observed. This heterosis for the leaf length trait was 5.3%, and for leaf width - 9.6%. For this reason the hybrid plants of both combinations were much more powerful than two parental species.

It is well known that the plants of *Lunaria annua* bloom at the first year after sowing in early spring as opposed to plants of *Lunaria rediviva*, which bloom at the second year of life (Coombes, 2012). As you can see in Figure 1, interspecific F_1 hybrids of both crossing combinations, as well as a perennial species, did not bloom in a phytotron during flowering time of annual species. A similar pattern was observed in the field conditions. Thus the dominance of perennial development type over annual type was observed.

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Table 1. Leaf morphology of interspecific hybrids of honesty and their parental species.

Genotype	Leaf tip shape	Leaf wings, points	Leaf wide, sm	Leaf length, sm
Lunaria annua	Sharp	1 (small)	10,2 ± 0.22	9,5 ± 0.14
Lunaria rediviva	Round	3 (large)	11,4 ± 0.14	9,0 ± 0.12
♀ ***Lunaria annua* × ♂ *Lunaria rediviva***	Narrow triangle	2 (medium)	13,5 ± 0.30[a,b]	10,5 ± 0.22[a,b]
♀ ***Lunaria rediviva* × ♂ *Lunaria annua***	Wide triangle	2 (medium)	12,5 ± 0.12[a,b]	10,0 ± 0.24[b]

[a,b] – differences from *L. annua* (a) and *L. rediviva* (b) are significant at P < 0,05

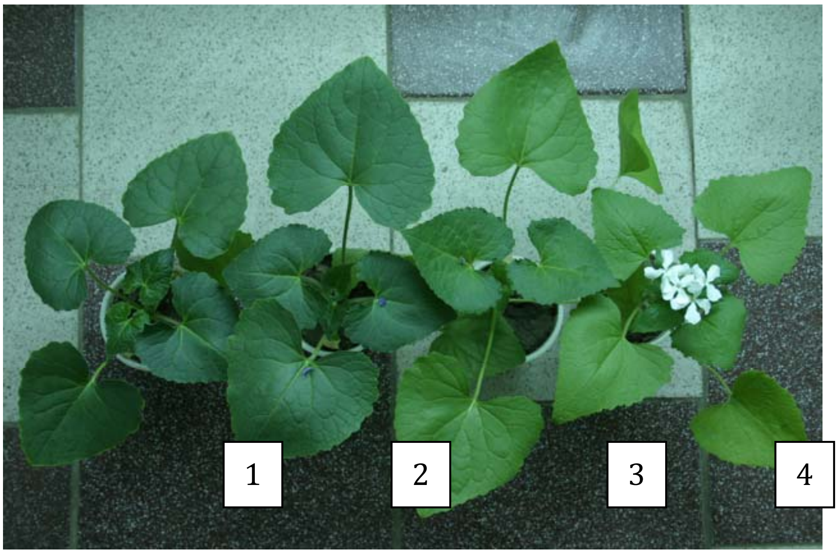

Figure 1. Interspecific hybrids of *Lunaria* and their parents at the first year of life in phytotron:
1 – *L. rediviva*; 2 – *L. rediviva* × *L. annua*; 3 – *L. annua* × *L. rediviva*; 4 – *L. annua*

Intercropping spring-sown brassicas with annual legumes for green manure

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Introduction

Numerous spring-sown brassica crops, especially rapeseed (*Brassica napus* L.) and white mustard (*Sinapis alba* L.), are usually counted among the most desirable components of diverse crop rotations and various farming systems, mostly due to rather short growing-season and an ability to produce abundant aboveground biomass rich in nitrogen (Erić et al. 2007). In that way and if cut in mid-spring, they provide a timely sowing of some of the most important spring-sown field crops, such as soybean (*Glycine max* (L.) Merr.), sunflower (*Helianthus annuus* L.) or maize (*Zea mays* L.).

The available literature on intercropping brassicas with legumes is almost extremely scarce. Some recent results have shown numerous benefits for a brassica component, with an emphasis on much easier uptake of less available nutrients provided by a positive influence of its legume companion (Cortés-Mora et al. 2010). It is still hypothesised that, if used as green manure, such intercrops of spring-sown forage brassicas and annual legumes may have a positive impact on both quantity and quality of the nutrients in the soil.

This aim of this research was to assess the potential of intercrops of spring-sown brassicas and legumes for aboveground biomass nitrogen yield and their application as green manure.

Material and methods

A small-plot trial was conducted during 2011 and 2012 at the Experimental Field of the Institute of Field and Vegetable Crops at Rimski Šančevi, including the sole crops and eight intercrops of two spring-sown brassicas and four spring-sown annual legumes. Since their well-known excellent standing ability, the rapeseed cv. Jovana and the white mustard cv. NS Gorica acted as the supporting crops for the pea (*Pisum sativum* L.) cv. Jantar, the common vetch (*Vicia sativa* L.) cv. Perla, the Narbonne vetch (*Vicia narbonensis* L.) line NG 01 and the grass pea (*Lathyrus sativus* L.) cv. Sitnica, all rather prone to lodging and thus considered supported crops. In both growing seasons, all six sole crops and their eight intercrops sown in the first decade of March, at a double reduced rate in the intercrops than those in the sole crops: 20 viable seeds m^{-2} for rapeseed and white mustard, 50 viable seeds m^{-2} for pea and grass pea and 60 viable seeds m^{-2} for common and Narbonne vetches.

The sole crops of the brassicas were cut in full budding and the very beginning of flowering, while the sole crops of the annual legumes were cut in the stages of full bloom and first pods. The intercrops were cut when either a brassica or an annual legume component first reached these optimum stages for cutting.

Based upon aboveground biomass dry matter yield and aboveground biomass dry matter nitrogen proportion, determined with the standard method by Kjeldahl, aboveground biomass nitrogen yield (kg ha^{-1}) was calculated in all six sole crops and their eight intercrops. The land equivalent ratio (LER) for aboveground biomass nitrogen yield was calculated by means of the following formula (Mikić et al. 2014):

$$LER = B_{IC} / B_{SC} + L_{IC} / L_{SC},$$

with B_{IC} as the aboveground biomass nitrogen yield of a brassica component in an intercrop, B_{SC} as the aboveground biomass nitrogen yield of a brassica component in its sole crop, L_{IC} as the aboveground biomass nitrogen yield of a legume component in an intercrop and L_{SC} as the aboveground biomass nitrogen yield of a brassica component in its sole crop.

The obtained results were processed by analysis of variance (ANOVA) applying the Least Significant Difference (LSD) test.

Results and Discussion

Numerous significant differences in two-year average aboveground biomass nitrogen yield in both intercrops and sole crops, as well as in the two-year average values of LER, were observed (Table 1).

In the sole crops of spring-sown forage brassicas and annual legumes, the highest two-year average aboveground biomass nitrogen yield varied between 171 kg ha^{-1} in both rapeseed and Narbonne vetch and 327 kg ha^{-1} in grass pea. The white mustard cultivar NS Gorica had much better performance in comparison to the results of a preliminary testing of a series of forage white mustard lines in the same agroecological conditions, with an average aboveground biomass nitrogen yield of 90 kg ha^{-1} (Krstić et al. 2010).

The average two-year average values of total aboveground biomass nitrogen yield in the intercrops of spring-sown forage brassicas and annual legumes ranged from 178 kg ha^{-1} in the intercrop of white mustard and Narbonne vetch and 352 kg ha^{-1} in the intercrop of white mustard and grass pea. The components of this intercrop had the highest and the lowest two-year average individual contribution to the total aboveground biomass nitrogen, with 306 kg ha^{-1} in grass pea and 46 kg ha^{-1} in white mustard, respectively.

All eight intercrops of spring-sown forage brassicas and annual legumes had the average two-year values of LER higher than 1, thus proving their economic reliability, especially in the cases of intercropping rapeseed with pea and rapeseed with common vetch (both 1.23).

Conclusion

It was clearly demonstrated that the spring-sown intercrops of forage brassicas with annual legumes have a considerable ability to produce high aboveground biomass nitrogen yield in a relatively brief period, confirming their place in various crop rotations. The presented results also offer a solid basis for considering a possibility of developing cultivars of forage brassicas specifically for green manure.

Acknowledgements

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Table 1. Two-year average values of aboveground biomass nitrogen yield (kg ha^{-1}) and its land equivalent ratio (LER) in the sole crops and intercrops of spring-sown brassicas and legumes at Rimski Šančevi for 2011 and 2012.

Sole crop / Intercrop	Brassica aboveground biomass nitrogen yield	Legume aboveground biomass nitrogen yield	Total aboveground biomass nitrogen yield	LER
Rapeseed	171	-	-	-
White mustard	186	-	-	-
Pea	-	240	-	-
Common vetch	-	217	-	-
Narbonne vetch	-	171	-	-
Grass pea	-	327	-	-
Rapeseed + pea	101	156	257	1.23
Rapeseed + common vetch	104	128	232	1.23
Rapeseed + Narbonne vetch	93	109	202	1.15
Rapeseed + grass pea	84	218	302	1.15
White mustard + pea	61	184	245	1.09
White mustard + common vetch	75	140	216	1.04
White mustard + Narbonne vetch	75	103	178	1.00
White mustard + grass pea	46	306	352	1.16
$LSD_{0.05}$	21	41	44	0.06

Intercropping autumn-sown brassicas with annual legumes for green manure

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Introduction

Autumn-sown brassica crops, such as fodder kale (*Brassica oleracea* L. var. *viridis* L.) and rapeseed (*Brassica napus* L.), are well-known forage crops with a remarkable ability to fit into various crop rotations and farming systems, mostly due to their rather satisfactory winter hardiness in many temperate climates of the northern hemisphere and prominent earliness. They may be sown after the harvest of mid- or even late-autumn crops, such as soybean (*Glycine max* (L.) Merr.), sunflower (*Helianthus annuus* L.) or maize (*Zea mays* L.) and yet cut in mid-spring, allowing the regular sowing of main spring crops, such as sorghum (*Sorghum bicolor* (L.) Moench.) (Ćupina et al. 2011).

Our knowledge on the intercrops of autumn-sown forage barssicas with annual forage legumes is quite limited. Certain analyses suggest that such a practice is beneficial for both components, especially for the brassica one, since the legume one provides it with more available nitrogen (Mikić et al. 2012). It is to be anticipated that such intercrops, if used as green manure, may increase the soil fertility due to a rather abundant aboveground biomass of both components rich in nitrogen.

This study was aimed at examining the potential of the intercrops of autumn-sown brassicas and legumes for aboveground biomass nitrogen yield and the use in a form of green manure.

Material and methods

A small-plot trial was carried out in the growing seasons of 2010/2011 and 2011/2012 at the Experimental Field of the Institute of Field and Vegetable Crops at Rimski Šančevi. It included eight intercrops of two autumn-sown brassicas and four autumn-sown annual legumes, as well as their sole crops. Regarding the good lodging tolerance in the brasssicas and the poor standing ability in annual legumes, the fodder kale cv. Perast and the rapeseed cv. Zorica played the role of supporting crops, while the pea (*Pisum sativum* L.) cv. NS Krmni, the common vetch (*Vicia sativa* L.) cv. NS Tisa, the Hungarian vetch (*Vicia pannonica* Crantz) cv. Panonka and the hairy vetch (*Vicia villosa* Roth) cv. NS Viloza were supported crops.

During both trial years, all eight intercrops and six sole crops were sown in mid-October, at a double reduced rate in the intercrops in comparison to those in the sole crops: 25 viable seeds m^{-2} for fodder kale, 15 viable seeds m^{-2} for rapeseed, 60 viable seeds m^{-2} for pea and 75 viable seeds m^{-2} for common, Hungarian and hairy vetches.

The sole crops of the brassicas were cut in full budding and the very beginning of flowering, while the sole crops of the annual legumes were cut in the stages of full bloom and first pods. The intercrops were cut when either a brassica or an annual legume component first reached these optimum stages for cutting.

Aboveground biomass nitrogen yield (kg ha^{-1}) was calculated in all six sole crops and eight intercrops on the basis of aboveground biomass dry matter yield and aboveground biomass dry matter nitrogen proportion determined with the standard method by Kjeldahl. The land equivalent ratio (LER) for aboveground biomass nitrogen yield was calculated according to the following formula (Ćupina et al. 2014):

$$LER = B_{IC} / B_{SC} + L_{IC} / L_{SC},$$

where B_{IC} is the aboveground biomass nitrogen yield of a brassica component in an intercrop, B_{SC} is the aboveground biomass nitrogen yield of a brassica component in its sole crop, L_{IC} is the aboveground biomass nitrogen yield of a legume component in an intercrop and L_{SC} is the aboveground biomass nitrogen yield of a brassica component in its sole crop.

The results of the research were processed by analysis of variance (ANOVA) with the Least Significant Difference (LSD) test applied.

Results and Discussion

In both sole crops and intercrops of autumn-sown forage brassicas and annual legumes, there were significant differences in two-year average values of aboveground biomass nitrogen yield and LER (Table 1).

The highest two-year average aboveground biomass nitrogen yield in the sole crops of autumn-sown forage brassicas and annual legumes ranged from 189 kg ha^{-1} in rapeseed to 307 kg ha^{-1} in hairy vetch. The two-year average aboveground biomass nitrogen yield in the sole crop of the fodder kale cultivar Perast was somewhat higher than in a previously conducted trial with ten fodder kale cultivars and lines in the same environment, with 183 kg ha^{-1} (Ćupina et al. 2010).

Among the intercrops of autumn-sown forage brassicas and annual legumes, the average two-year values of total aboveground biomass nitrogen yield varied between 162 kg ha^{-1} in the intercrop of rapeseed and Hungarian vetch and 319 kg ha^{-1} in the intercrop of rapeseed and hairy vetch. The highest two-year average individual contribution to the total aboveground biomass nitrogen yield was in hairy vetch (253 kg ha^{-1}), when intercropped with rapeseed, while the lowest two-year average individual contribution to the total aboveground biomass nitrogen yield was in rapeseed (67 kg ha^{-1}), when intercropped with hairy vetch.

Not all the intercrops had the average two-year values of LER higher than 1, with the intercrops of rapeseed and hairy vetch (1.18) and fodder kale with hairy vetch (1.13) as the most economically reliable.

Conclusion

Certain autumn-sown intercrops of forage brassicas with annual legumes have a good potential for producing high and economically reliable yield of aboveground biomass nitrogen and thus, if timely cut and ploughed in, may have a beneficial effect on the soil fertility. Among the next steps in this research may be an analysis of the degradation rate of each intercrop in the soil and a detailed examination of its impact on the nutrients quantity and mobility.

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Table 1. Two-year average values of aboveground biomass nitrogen yield (kg ha^{-1}) and its land equivalent ratio (LER) in the sole crops and intercrops of autumn-sown brassicas and legumes at Rimski Šančevi for 2010/2011 and 2011/2012.

Sole crop / Intercrop	Brassica aboveground biomass nitrogen yield	Legume aboveground biomass nitrogen yield	Total aboveground biomass nitrogen yield	LER
Fodder kale	199	-	-	-
Rapeseed	189	-	-	-
Pea	-	275	-	-
Common vetch	-	258	-	-
Hungarian vetch	-	214	-	-
Hairy vetch	-	307	-	-
Fodder kale + pea	101	153	254	1.07
Fodder kale + common vetch	104	134	238	1.05
Fodder kale + Hungarian vetch	104	94	198	0.96
Fodder kale + hairy vetch	81	222	303	1.13
Rapeseed + pea	93	150	242	1.03
Rapeseed + common vetch	98	115	214	0.97
Rapeseed + Hungarian vetch	84	78	162	0.81
Rapeseed + hairy vetch	67	253	319	1.18
$LSD_{0.05}$	18	34	31	0.07

Potential of turnip rape (*Brassica rapa* subsp. *oleifera*) as a green manure crop

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Introduction

Many crops belonging to the family *Brassicaceae* Burnett, widely referred to simply as *brassicas*, are cultivated mostly for their oil- and protein-rich seeds, such as rapeseed (*Brassica napus* L. var. *napus*) and white mustard (*Sinapis alba* L.), or for forage, such as fodder kale (*Brassica oleracea* L. var. *viridis* L.).

Among the economically significant brassica crops is also turnip rape (*Brassica rapa* L. subsp. *oleifera* (DC.) Metzg.), with a primary application in oil industry (Tanhuanpää & Schulman 2002) and various side uses, such as vegetable (Padilla et al. 2007). There are rare reports on its non-food uses, such as mulch or green manure, with a beneficial effect on a succeeding crop through biological control of soil-borne diseases (Larkin & Griffin 2007).

The goal of our study was to assess the potential of turnip rape as a green manure crop.

Material and methods

A small-plot trial has been conducted in the growing seasons of 2010 and 2011 at the Experimental Field of the Institute of Field and Vegetable Crops at Rimski Šančevi. It included ten spring-sown turnip rape lines developed at the Institute of Field and Vegetable Crops, namely BRO 01, BRO 02, BRO 03, BRO 04, BRO 05, BRO 06, BRO 07, BRO 07, BRO 08, BRO 09 and BRO 10.

In both 2010 AND 2011, all ten lines were sown in the first week of March, at a rate of 70 viable seeds m^{-2}, with a plot size of 5 m^{-2} and with three replicates, and were cut in the stages of full budding and the very beginning of flowering (Antanasović et al. 2012).

Three main yield parameters relating to green manure were monitored, namely fresh aboveground biomass yield (t ha^{-1}), dry aboveground biomass yield (t ha^{-1}) and aboveground biomass nitrogen yield (kg ha^{-1}).

The results of the research were processed by analysis of variance (ANOVA), applying the Least Significant Difference (LSD) test.

Results and Discussion

There existed significant differences in the two-year average values of all three followed parameters (Table 1).

The two-year average fresh aboveground biomass yield in ten spring-sown tested turnip rape lines ranged between 30.0 t ha^{-1} and 30.1 t ha^{-1} in the lines BRO 06 and BRO 03, respectively, and 54.7 t ha-1 in the line BRO 08. The lines BRO 03 and BRO 06 both had the lowest two-year average dry aboveground biomass yield (2.7 t ha^{-1}), while the lines BRO 08 and BRO 09 had the highest two-year average dry aboveground biomass yield (4.9 t ha^{-1} and 4.7 t ha^{-1}). In comparison to the results that the other forage brassicas achieved in the same agroecological conditions, turnip rape had poorer overall performance in comparison to fodder kale (Ćupina et al. 2010).

The highest two-year average aboveground biomass nitrogen yield in ten spring-sown tested turnip rape lines was in the lines BRO 08 (137 kg ha^{-1}) and BRO 09 (130 kg ha^{-1}), while two lowest two-year average aboveground biomass nitrogen yield in ten spring-sown tested turnip rape lines was in the lines BRO 03 and BRO 06 (both 75 kg ha^{-1}) and BRO 07 (77 kg ha^{-1}). On average, the aboveground biomass nitrogen yield in turnip rape was rather similar to the one produced by brown mustard (*Brassica juncea* (L.) Czern.) in the same environment, with 103 kg ha^{-1} (Mihailović et al. 2013).

Conclusions

On the basis of the obtained results, it may be claimed that turnip rape generally has a promising potential for using as green manure, with a strong anticipation that certain of the ten tested lines may be developed into cultivars specifically for this environment-friendly purpose.

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Table 1. Two-year average values of fresh aboveground biomass yield, dry aboveground biomass yield and aboveground biomass nitrogen yield in brown mustard lines at Rimski Šančevi for 2011 and 2012.

Genotype	Fresh aboveground biomass yield (t ha^{-1})	Dry aboveground biomass yield (t ha^{-1})	Aboveground biomass nitrogen yield (kg ha^{-1})
BRO 01	47.3	4.3	118
BRO 02	34.2	3.1	86
BRO 03	30.1	2.7	75
BRO 04	47.5	4.3	119
BRO 05	41.4	3.7	104
BRO 06	30.0	2.7	75
BRO 07	32.8	3.0	82
BRO 08	54.7	4.9	137
BRO 09	52.1	4.7	130
BRO 10	30.8	2.8	77
Average	40.1	3.6	100

Forage dry matter crude protein yield in the intercrops of spring-sown brassicas with cereals

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Introduction

Intercropping is one of the most ancient farming designs worldwide and is often regarded as growing two or more different crops or one species' cultivars at the same place and the same time (Mikić et al. 2015). In numerous environments with contrasting climates, intercropping is widely present, either for forage or grain production, as well as for green manure. Intercropping cereals, such as barley (*Hordeum vulgare* L.), rye (*Secale cereale* L.) or common wheat (*Triticum aestivum* L. subsp. *aestivum*), and annual legumes, such as pea (*Pisum sativum* L.) or common wheat (*Vicia sativa* L.) represents one of the most traditional ways of cultivating field crops (Šarūnaitė et al. 2013).

Currently, most research on intercropping brassica crops with cereals is done in Canada, regarding its leading position on a global level in producing canola, a market type of rapeseed (*Brassica napus* L.). In a field trial of the Canadian Province of Alberta, it was shown that increasing the proportion of canola in its intercrop with common wheat may decrease the infestation of various cereal pathogens (Hummel et al. 2009).

The aim of our study was to assess the potential of intercropping spring-sown brassicas with cereals for forage dry matter crude protein yield.

Material and methods

A small-plot trial was conducted in the trial years of 2012 and 2013 at the Experimental Field of the Institute of Field and Vegetable Crops at Rimski Šančevi. It included six intercrops of two spring-sown brassicas, namely rapeseed and white mustard (*Sinapis alba* L.), with three cereals, namely oat (*Avena sativa* L.), barley and common wheat. Each of eight intercrop components was also sown as a a sole crop.

In both growing seasons, all six intercrops and five sole crops were sown in early March, at a double reduced rate in the intercrops than those in their sole crops. The trial plots with both sole crops and intercrops were cut when either the brassicas were in the stages of full budding and the very beginning of flowering or the cereals were just about to release spikes or racemes.

On the basis of the values of forage dry matter yield (kg ha^{-1}) and forage dry matter crude protein content (g kg^{-1}), forage dry matter crude protein yield (kg ha^{-1}) was determined in all the intercrops and sole crops.

The land equivalent ratio (LER) for forage dry matter crude protein yield was calculated according to the following formula (Mihailović et al. 2011):

$LER = B_{IC} / B_{SC} + C_{IC} / C_{SC}$,

where B_{IC} is the forage dry matter crude protein yield of a brassica component in an intercrop with cereals, B_{SC} is the forage dry matter crude protein yield of a brassica component in its sole crop, C_{IC} is the forage dry matter crude protein yield of a cereal component in an intercrop and C_{SC} is the forage dry matter crude protein yield of a cereal component in its sole crop.

The obtained results were processed by analysis of variance (ANOVA) with the Least Significant Difference (LSD) test.

Results and Discussion

There were significant differences in the two-year average forage dry matter crude protein yield in both intercrops of spring-sown brassicas and cereals and their sole crops. The same was determined in the two-year average values of LER (Table 1).

Among the sole crops of spring-sown brassicas and cereals, the highest two-year average forage dry matter crude protein yield was in oat (1322 kg ha^{-1}), while the lowest two-year average forage dry matter crude protein yield was in rapeseed (1067 kg ha^{-1}). In the intercrops of spring-sown forage brassicas and annual legumes, the average two-year average values of forage dry matter crude protein yield varied between 1114 kg ha^{-1} in the intercrop of white mustard and common wheat and 1531 kg ha^{-1} in the intercrop of white mustard and oat. Most of both sole crops and intercrops of spring-sown forage brassicas and cereals had lower two-year average forage dry matter crude protein yield than in the sole crops and intercrops of spring-sown forage brassicas and annual legumes, where certain combinations, such as white mustard and grass pea (*Lathyrus sativus* L.) produced more than 2000 kg ha^{-1} (Ćupina et al. 2014).

Apart from the intercrop of white mustard and common wheat, all other tested intercrops of spring-sown forage brassicas and cereals had the average two-year values of LER significantly higher than 1, thus proving economically reliable.

Conclusions

The intercrops of spring-sown forage brassicas with cereals demonstrated an ability to represent a protein-rich source of fresh forage in feeding ruminants. Among the next steps in the research on this form of intercropping may be an assessment of the potential influence of genotype within each intercrop component.

Acknowledgements

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Table 1. Two-year average values of forage dry matter crude protein yield (kg ha^{-1}) and its land equivalent ratio (LER) in pure stands and intercrops of spring-sown brassicas and cereals at Rimski Šančevi for 2012 and 2013.

Sole crop / Intercrop	Brassica forage dry matter crude protein yield	Cereal forage dry matter crude protein yield	Total forage dry matter crude protein yield	LER
Rapeseed	1067	-	-	-
White mustard	1183	-	-	-
Barley	-	1089	-	-
Common wheat	-	1276	-	-
Oat	-	1322	-	-
Rapeseed + barley	652	688	1340	1.24
Rapeseed + common wheat	579	745	1324	1.13
Rapeseed + oat	615	777	1392	1.16
White mustard + barley	471	878	1348	1.20
White mustard + common wheat	471	644	1114	0.90
White mustard + oat	380	1151	1531	1.19
$LSD_{0.05}$	117	99	110	0.05

Forage dry matter crude protein yield in the intercrops of autumn-sown brassicas with cereals

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Introduction

Intercropping or, as defined by numerous authors, may be defined as a practice of cultivating at least two different plant species at the same place and the same time and is most likely one of the oldest agricultural practices in the world (Ćupina et al. 2011). One of the most traditional ways of intercropping annual species in the temperate regions of Asia, Europe and North America includes cereals, such as barley (*Hordeum vulgare* L.), triticale (×*Triticosecale* spp.) or common wheat (*Triticum aestivum* L. subsp. *aestivum*), and annual legumes, such as pea (*Pisum sativum* L.) or vetches (*Vicia* spp.) (Mihailović et al. 2004).

Generally, intercropping brassica crops, especially the forage ones, with cereals is insufficiently studied. Those available mostly demonstrate the positive influence of such practice on both components and their environment. The results of certain research on intercropping rapeseed (*Brassica napus* L.) with wheat showed that it may have beneficial effects of yield components and yield itself in wheat (Khan et al. 2005).

This study was aimed at examining the potential of intercropping autumn-sown brassicas with cereals for forage dry matter crude protein yield.

Material and methods

A small-plot trial was carried out in the growing seasons of 2011/2012 and 2012/2013 at the Experimental Field of the Institute of Field and Vegetable Crops at Rimski Šančevi. It included eight intercrops of two autumn-sown forage brassicas, namely fodder kale (*Brassica oleracea* L. var. *viridis* L.) and rapeseed, with four autumn-sown cereals, namely oat (*Avena sativa* L.), barley, triticale and common wheat, as well as the sole crops of each intercrop component.

During both trial years, all eight intercrops and six sole crops were sown in early October, at a double reduced sowing rate in the intercrops in comparison to those in the sole crops. In both sole crops and intercrops, the brassicas were cut in full budding and the very beginning of flowering, while the cereals were cut just prior to the appearance of spikes or racemes.

In all the sole crops and intercrops, forage dry matter crude protein yield (kg ha^{-1}) was determined on the basis of the values of forage dry matter yield (kg ha^{-1}) and forage dry matter crude protein content (g kg^{-1}).

The land equivalent ratio (LER) for forage dry matter crude protein yield was calculated according to the following formula (Mihailović et al. 2011):

$LER = B_{IC} / B_{SC} + C_{IC} / C_{SC}$,

where B_{IC} is the forage dry matter crude protein yield of a brassica component in an intercrop with cereals, B_{SC} is the forage dry matter crude protein yield of a brassica component in its sole crop, C_{IC} is the forage dry matter crude protein yield of a cereal component in an intercrop and C_{SC} is the forage dry matter crude protein yield of a cereal component in its sole crop.

The results of the research were processed by analysis of variance (ANOVA) with the Least Significant Difference (LSD) test.

Results and Discussion

The two-year average values of both forage dry matter crude protein yield in both intercrops and sole crops significantly and LER significantly differed among each other in most cases (Table 1).

In the sole crops of autumn-sown forage brassicas and cereals, the highest forage dry matter crude protein yield was in fodder kale (1242 kg ha^{-1}), while the lowest forage dry matter crude protein yield was in barley (955 kg ha^{-1}). Among the intercrops of autumn-sown forage brassicas and cereals, the average two-year average values of forage dry matter crude protein yield varied between 1148 kg ha^{-1} in the intercrop of rapeseed and common vetch and 1475 kg ha^{-1} in the intercrop of fodder kale and triticale.

Overall, it may be said that the majority of both sole crops and the intercrops of autumn-sown forage brassicas and cereals had lower average forage dry matter crude protein yield in comparison to the average values of the intercrops of autumn-sown forage brassicas and annual legumes in the same environment, with more than 1500 kg ha^{-1} in several cases (Mikić et al. 2014). This might be anticipated, since the higher forage dry matter yield in annual legumes than in forage brassicas.

Nearly all the intercrops of autumn-sown forage brassicas and cereals had the average two-year values of LER much higher than 1, except those including common wheat, and thus proved to be economically reliable.

Conclusions

Intercropping autumn-sown forage brassicas with cereals showed a good potential for relatively high forage dry matter crude protein yield. By this reason, such mixtures may be considered a quality source of fresh forage in feeding ruminants. The next step in examining all the aspects of this form of intercropping should assess the optimal sowing ratio between the intercrop components.

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Table 1. Two-year average values of forage dry matter crude protein yield (kg ha^{-1}) and its land equivalent ratio (LER) in pure stands and intercrops of autumn-sown brassicas and cereals at Rimski Šančevi for 2011/2012 and 2012/2013.

Sole crop / Intercrop	Brassica forage dry matter crude protein yield	Cereal forage dry matter crude protein yield	Total forage dry matter crude protein yield	LER
Fodder kale	1242	-	-	-
Rapeseed	1183	-	-	-
Barley	-	955	-	-
Common wheat	-	1122	-	-
Oat	-	1055	-	-
Triticale	-	1187	-	-
Fodder kale + barley	652	688	1340	1.25
Fodder kale + common wheat	507	745	1252	1.07
Fodder kale + oat	634	798	1432	1.27
Fodder kale + triticale	652	823	1475	1.22
Rapeseed + barley	615	644	1259	1.19
Rapeseed + common wheat	416	732	1148	1.00
Rapeseed + oat	579	723	1302	1.17
Rapeseed + triticale	525	804	1329	1.12
$LSD_{0.05}$	87	112	99	0.06

Fresh forage yield and its components in turnip rape (*Brassica rapa* subsp. *oleifera*)

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Introduction

Turnip rape (*Brassica rapa* L. subsp. *oleifera* (DC.) Metzg.) is one of the economically significant oil crops throughout the world, while among its side uses is forage production and green manure. Certain molecular analyses using amplified fragment length polymorphism (AFLP) suggest that this crop could be domesticated independently in Europe and East Asia with primitive breeding efforts in both regions that are responsible for its present biodiversity (Zhao et al. 2005).

In Serbia and neighbouring Southeast European countries, turnip rape is little known and a heavily neglected and underutilised crop. The fact that it shares many desirable characteristics with other brassicas, especially prominent earliness, denotes it as one of the best components in many contemporary farming systems and crop rotations (Mikić et al. 2014).

The aim of this study was to assess the genetic variability and the mutual relationship of fresh forage yield and its components in spring-sown turnip rape lines.

Material and methods

A small-plot trial was conducted during the trial years of 2011 and 2012 at the Experimental Field of the Institute of Field and Vegetable Crops at Rimski Šančevi in the vicinity of Novi Sad, northern Serbia. It included eight spring-sown turnip rape lines of various geographic origin, namely TR 01, TR 02, TR 03, TR 04, TR 05, TR 06, TR 07 and TR 08.

During both trial growing seasons, all eight lines of turnip rape were sown in early March, at a sowing rate of 60 viable seeds m^{-2}, with a plot size of 5 m^2 and with three replicates. Each tested line was cut in the stages of full budding and the very beginning of flowering, considered the optimal moment for fresh forage production.

There were monitored main stem length (cm), number of lateral branches ($plant^{-1}$), number of fresh leaves ($plant^{-1}$), fresh stem yield (g $plant^{-1}$), fresh leaf yield (g $plant^{-1}$) and fresh forage yield (g $plant^{-1}$), as the resultant of all its components.

The obtained results were processed by analysis of variance (ANOVA) with the Least Significant Difference (*LSD*) test applied and the simple correlation coefficients (*r*) between each of the monitored characteristics calculated.

Results and Discussion

There were significant differences among the two-year average values of all monitored characteristics in eight tested turnip rape lines (Table 1).

The two-year average value of main stem length varied between 66 cm and 67 cm in the lines TR 07 and TR 05, respectively, and 98 cm in the line TR 08. The line TR 06 had the greatest two-year average number of lateral branches (5 plant^{-1}), while the line TR 03 had the smallest two-year average number of lateral branches (2 plant^{-1}). The line TR 08 had the highest two-year average values of number of fresh leaves (30 plant^{-1}) and fresh stem yield (44.32 g plant^{-1}). The lines TR 05 and TR 07 had the lowest two-year average number of fresh leaves (14 plant^{-1} in both), while the line TR 07 also had the lowest two-year average fresh stem yield (22.21 g plant^{-1}). The two-year average fresh leaves yield ranged from 34.96 g plant^{-1} in TR 02 to 71.63 g plant^{-1} in TR 04.

The lines TR 04 and TR 08 produced the highest two-year average fresh forage yield (109.40 g plant^{-1} and 109.16 plant^{-1}), while the line TR 07 was characterised with the lowest two-year average fresh forage yield (62.59 g plant^{-1}). Although the fresh forage yield in turnip rape was lower than in autumn-sown fodder kale (*Brassica oleracea* L. var. *viridis* L.), the most significant forage brassica in the Balkans, with a two-year average of 102.48 g plant^{-1} in the same agroecological conditions (Mihailović et al. 2009), it may be generally said that several tested turnip rape lines achieved rather promising results.

Main stem length, number of fresh leaves and fresh stem yield all were mutually and positively correlated at a level of 0.05, with r = 0.980, r = 0.986 and r = 0.978, respectively (Table 2). Apart from number of lateral branches, fresh forage yield per plant was positively correlated with all its components, especially with fresh leaf mass (r = 0.941) and similarly to other forage brassicas, such as autumn-sown rapeseed (Marjanović-Jeromela et al. 2010).

Conclusions

High values of fresh forage yield per plant in most tested lines demonstrate that spring-sown turnip rape may be used as a forage crop. At the same time, the attested high positive correlation among fresh forage yield components enables developing turnip rape cultivars specifically for forage production and provides a solid basis for launching relating breeding programmes.

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Table 1. Average values of fresh forage yield and its components spring-sown turnip rape lines for 2011 and 2012 at Rimski Šančevi.

Line	Main stem height (cm)	Number of lateral branches ($plant^{-1}$)	Number of leaves ($plant^{-1}$)	Fresh stem yield ($plant^{-1}$)	Fresh leaf yield ($plant^{-1}$)	Fresh forage yield (g $plant^{-1}$)
TR 01	75	3	15	26.67	41.72	68.39
TR 02	87	4	22	36.75	34.96	71.71
TR 03	93	2	26	39.76	50.58	90.34
TR 04	91	4	25	37.77	71.63	109.40
TR 05	67	4	14	25.44	38.90	64.34
TR 06	73	5	15	28.89	56.84	85.73
TR 07	66	3	14	22.21	40.38	62.59
TR 08	98	3	30	44.32	64.84	109.16
Average	82	4	21	33.59	51.16	84.75
$LSD_{0.05}$	14	2	5	15.43	14.05	29.48

Table 2. Simple correlation coefficients (*r*) among fresh forage yield components including fresh forage yield in spring-sown turnip rape lines.

r	Number of lateral branches	Number of fresh leaves	Fresh stem yield	Fresh leaf yield	Fresh forage yield per plant
Main stem length	-0.334	0.980**	0.986**	0.584	0.818*
Number of lateral branches		-0.374	-0.251	0.100	-0.034
Number of fresh leaves			0.978**	0.605	0.830*
Fresh stem mass				0.581	0.822*
Fresh leaf mass					0.941**

* - significant at 0.05; ** - significant at 0.01

NS Gorica - The first Serbian forage white mustard cultivar

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Introduction

For decades, the only institution in Serbia that carries out a breeding programme on forage brassicas is the Institute of Field and Vegetable Crops (IFVCNS) in Novi Sad. In comparison to the breeding programmes on other and, especially, economically more significant field crops, this one is comparatively small, but sufficient enough to answer the needs required by animal husbandry for providing ruminants with quality voluminous feed (Mihailović et al. 2008).

Breeding forage brassicas at IFVCNS is based upon a long-term evaluation of agronomic performance in field conditions and quality aspects of a collection consisting of several crops, with fodder kale (*Brassica oleracea* L. var. *viridis* L.) as the most important and followed by rapeseed (*Brassica napus* L.), white (*Sinapis alba* L.) and brown (*Brassica juncea* (L.) Czern.) mustards and turnip rape (*Brassica rapa* L. subsp. *oleifera* (DC.) Metzg.). The evaluated characteristics of the accessions of the IFVCNS forage brassicas collection are usually fresh forage yield components, such as main stem length (cm), number of lateral branches main stem length (cm), number of lateral branches (plant^{-1}), number of fresh leaves (plant^{-1}), fresh stem yield (g plant^{-1}), fresh leaf yield (g plant^{-1}) and fresh forage yield (both g plant^{-1})and t ha^{-1}). Also, there are collected the records on the length of growing season, the number of days from sowing and emergence to full budding and, in the autumn-sown accessions, percentage of the plants surviving winter, as an indicator of winter hardiness.

So far, the only two results of the breeding programme on forage brassicas at IFVCNS were two winter fodder kale cultivar NS-Bikovo, registered in 1983, and Perast, registered in 2007 (Mikić et al. 2014). During the past decade, Perast successfully replaced NS-Bikovo in a wide production, not only in Serbia, but also in the neighbouring countries, such as Bosnia and Herzegovina.

In 2009, the newly developed line of spring-sown forage white mustard was applied for registering to the Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia under the code 320-04-00835/2010-11.

Material and methods

An official state small-plot trial was conducted by the Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia in the trial year of 2010 on four locations in different regions of the country with contrasting environments, namely Kruševac, Novi Sad, Pančevo and Sombor. It included only the applied line of spring-sown forage white mustard, since there were no forage white mustard cultivars in the national list.

In 2010, the forage white mustard line 320-04-00835/2010-11 was sown in early to mid-March, at a row spacing of 50 cm, with a plot size of 10 m^2 and with five replicates. It was cut in the stages of full budding and the very beginning of flowering, on average, in mid-April.

There was monitored plant height (cm), standing ability (with a scale from 1, denoting a 100% lodging, to 9, denoting no lodging at all), fresh forage yield (kg ha^{-1}), forage dry matter yield (kg ha^{-1}) and the contents (%) of crude protein, crude fibre, neutral detergent fibre (NDF) and acid detergent fibre (ADF).

The study results were processed by analysis of variance (ANOVA) with the Least Significant Difference (LSD) test applied.

Results and Discussion

Overall, the tested line of forage white mustard 320-04-00835/2010-11 had significantly lower fresh forage (13520 kg ha^{-1}) and forage dry matter (1927 kg ha^{-1}) yields in comparison to the results achieved by the fodder kale cultivar Perast, with 48653 kg ha^{-1} of fresh forage yield and 6657 kg ha^{-1} of forage dry matter yield (Mihailović et al. 2008). This is not surprising and was expected and, in a way, may be considered not appropriately comparable, since the great difference in plant architecture between fodder kale and white mustard and, most of all, the fact that Perast is an autumn-sown cultivar, with a much longer growing season and more available conditions to form an abundant aboveground biomass.

On the other hand, the greatest advantage of cultivating spring-sown white mustard cultivars is its rare ability to fit into almost every farming design and crop rotation, since its early spring sowing and extremely short growing season. In that way, it may easily provide a timely sowing of the succeeding crops of an utmost importance for the national agricultures of the European southeast, such as soybean (*Glycine max* (L.) Merr.), sunflower (*Helianthus annuus* L.) or maize (*Zea mays* L.).

Conclusions

Based upon its agronomic performance in the official state trials, the spring-sown forage white mustard line 320-04-00835/2010-11 was registered in Serbia under a name of NS Gorica on October 8, 2011. It is anticipated that the new spring-sown forage white mustard cultivar NS Gorica will find its place in forage production for feeding ruminants throughout Serbia, especially in its mountainous areas with developed industry of milk and meat.

Acknowledgements

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Table 1. Monitored characteristics of the forage white mustard line 320-04-00835/2010-11 in 2010 on four locations in Serbia

Characteristic	Value
Plant height (cm)	82.6
Standing ability (1-9)	9.0
Fresh forage yield (kg ha^{-1})	13520
Forage dry matter yield (kg ha^{-1})	1927
Crude protein content (%)	17.06
Crude fibre content (%)	22.93
Neutral detergent fibre (%)	45.75
Acid detergent fibre (%)	32.45

Possible origin of the words denoting mustard crops (*Brassica* spp. and *Sinapis* spp.) in the Afroasiatic languages

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Introduction

Many cultivated *Brassica* and *Sinapis* species originated in the Mediterranean centre of diversity, with a distribution from the Iberian Peninsula to Asia Minor and beyond to the easternmost regions of Indian sub-continent (Zeven & Zhukovsky 1975). Archaeobotanical analyses indicate the presence of either collected wild seeds, belonging to *Sinapis* and other *Brassicaceae* species, or their cultivated forms, as early as the 10th millennium BP (Willcox 2002). The archaeobotanical evidence of the mustard seeds in the Mediterranean neighbouring regions is less numerous than the one of cereals, most likely due to a higher degradability because of their high oil proportion of about 40% (Marjanović-Jeromela et al. 2011).

Regarding the extreme rarity of material findings, numerous crop historians think that the assistance of historical linguistics is most welcome in revealing the exact place and time of domesticating the mustard crops (Zohary & Hopf 2014). Diverse researches by population geneticists strongly suggest that the first Near East farmers belonged to the large Afroasiatic ethnolinguistic family (Cavalli-Sforza & Seielstad 2001), also known as Afrasian or, more traditionally, Hamito-Semitic. The majority of contemporary views classify it into six main sub-families or branches, namely Berber, Chadic, Cushitic, Egyptian, Omotic and Semitic, with about 300 living languages and dialects and more than 350 million native speakers today (Huehnergard 2004) (Fig. 1). The largest branch is Semitic, with its languages spoken by more than 320 million people, out of which around 300 million belong to the Arabic language and dialects (Fig. 2).

Material and methods

This research was aimed at testing the possibility to reconstruct the most ancient words denoting or relating to the mustard crop in the Afroasiatic languages.

The first step in this brief linguistic analysis was to identify the words related to the mustard crop in the modern Afroasiatic languages, with an emphasis on the Semitic branch, since their speakers today inhabit the hypothetical geographic area identified as it most probable centre of origin.

Further, all the available printed and electronic etymological databases were searched for the attested proto-words, also known as roots or root words, of the Proto-Afroasiatic language and its direct derivatives that could be morphologically and semantically linked with the present lexicology denoting the mustard crop in their

Results and Discussion

A rather thorough analysis of the lexicology relating the mustard crop in the present Afroasiatic languages did not produce almost any result, except the words in three Semitic languages, namely Arabic, Hebrew and Maltese, with *xrdl/khardal*, *hardal* and *mustarda*, respectively.

By all means this remarkable scarcity of the results was quite expected, since it is the speakers of the Semitic languages who only deal with agriculture in its narrowest sense among the Afroasiatic peoples and who still live in the regions where the mustard crop was domesticated and have been grown for millennia. On the other hand, the speakers of the other Afroasiatic languages migrated from their supposed common Afroasiatic homeland in Levant (Diamond & Bellwood 2003), about 8,000 BC, rather far from the Mediterranean basin and still live a mostly nomadic way of life, with mustard and many other ancient Near East crops forgotten and absent from their diets literally for eons.

The Proto-Afroasiatic language is considered as being spoken from 16,000 BC to 11,000 BC (Ehret 2002). So far, the root denoting the mustard crop that brought forth the words for this crop in its modern derivatives, such as those in Arabic or Hebrew, has not been definitely attested. This may be explained by the fact the etymologies of the Proto-Afroasiatic family are still less-explored in comparison to much better studied ones, such as Indo-European.

However, there is one potential candidate, **hud-*, with a primeval meaning *cut*. This Proto-Afroasiatic root produced two direct descendants. One is the Proto-Semitic **hud-*, meaning both *cut* and *dig/till*, giving the extinct Akkadian *hadādu*, meaning *cut*, and the Arabic *hdd [-u-]*, meaning *dig/till*. Another is Proto-Central-Chadic **ɣud-*, meaning *cut*, *chop* and *harvest*, producing the Cineni *wiɣde-nanà*, meanining *cut*, the Gava *xužə-gànà*, meaning *chop*, and Glavda *ɣud*, meaning both *cut* and *harvest* (Militarev 2006).

The Proto-Semitic language is one of the descendants, either direct or indirect, with an unknown mediating one, of Proto-Afroasiatic. Currently, it is estimated that it originated around 3,750 BC (Kitchen et al. 2009). With a certain dose of caution, it may be proposed that the attested Proto-Semitic root **hVrut_-*, with a still unidentified Proto-Afroasiatic ancestor and meaning *till*, *plow* and *plowland*, is either fully responsible for the morphology or the words in both extinct and living Semitic languages denoting the mustard crop (Fig. 3) or is rather close to a still unattested Proto-Semitic root that, apart from the adequate morphology, also denoted the mustard crop more specifically.

In any way, the phenomenon of shifting the meaning of the proto-word to something similar in and among its descendants is very common worldwide (Lockwood 1977). There are many examples related to the field crops, such as faba bean (*Vicia faba* L.) or pea (*Pisum sativum* L.) in the Indo-European languages (Mikić 2012). This may lead to a hypothesis that the Proto-Semitic **hVrut_-* or its close morphological relative is an ultimate origin of the contemporary Arabic and Hebrew words denoting the mustard crop. In other words, the root word once denoting the actions of tilling and ploughing gradually, over millennia, retained its form in most parts but began to denote mustard, as, according to the archaeobotanical findings, one of the economically most important oil crops in the region at the time.

The origin of the Maltese *mustarda* has, since this language is basically Arabic but with many borrowings from English and Italian, the same primeval origin as the modern English *mustard* and the modern French *moutarde*: the Old French word *mostarde*, dating back to 12th century AD and being derived from the Latin *mustum*, denoting *new wine*, because it was initially prepared by adding must to the ground mustard grains to make a paste (Harper 2014).

Conclusions

The authors sincerely hope that the results of this very preliminary research may contribute to casting more light onto the earliest days of the most ancient cultivated plants in the world, with an emphasis on mustard as one of the oldest oil crops. They also anticipate it will contribute to the recent advances in integrating efforts by archaebotany, palaeogenetics and historical linguistics.

Acknowledgements
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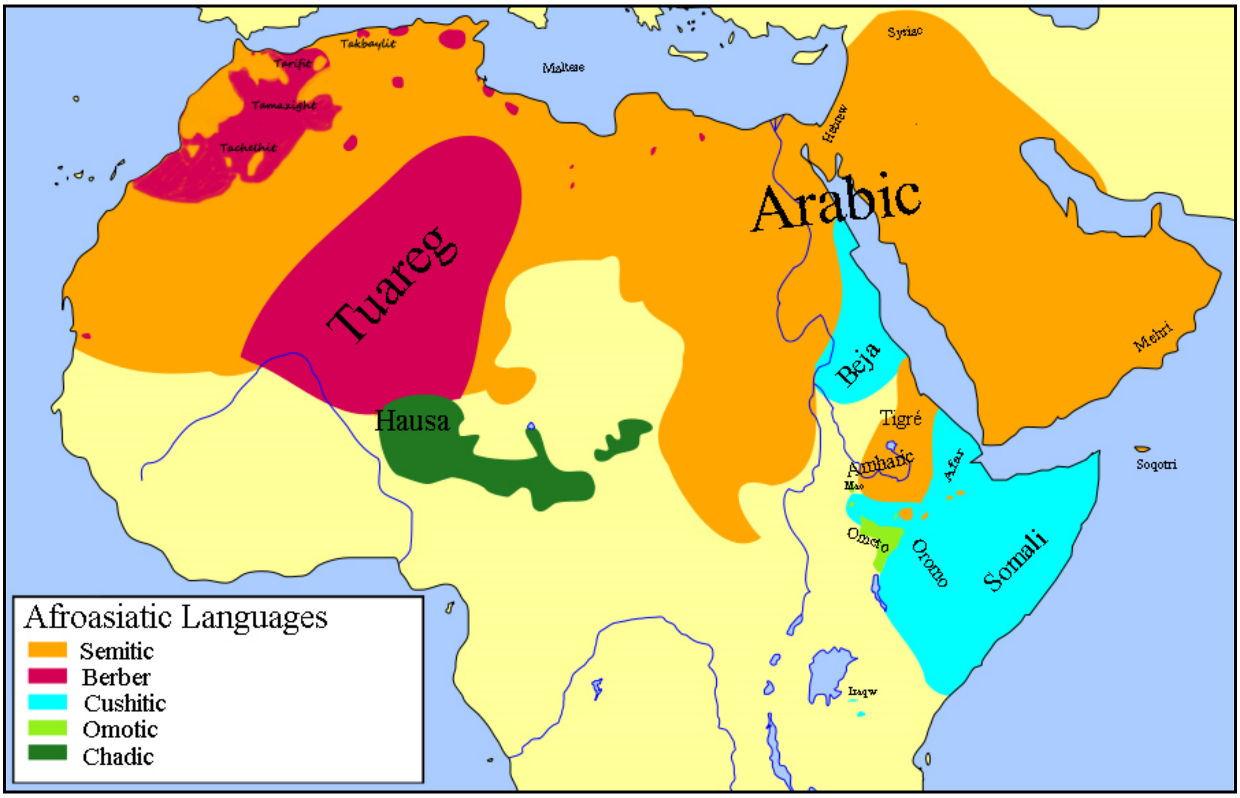

Figure 1. The map of the currently-spoken languages of the different branches of the Afroasiatic language family

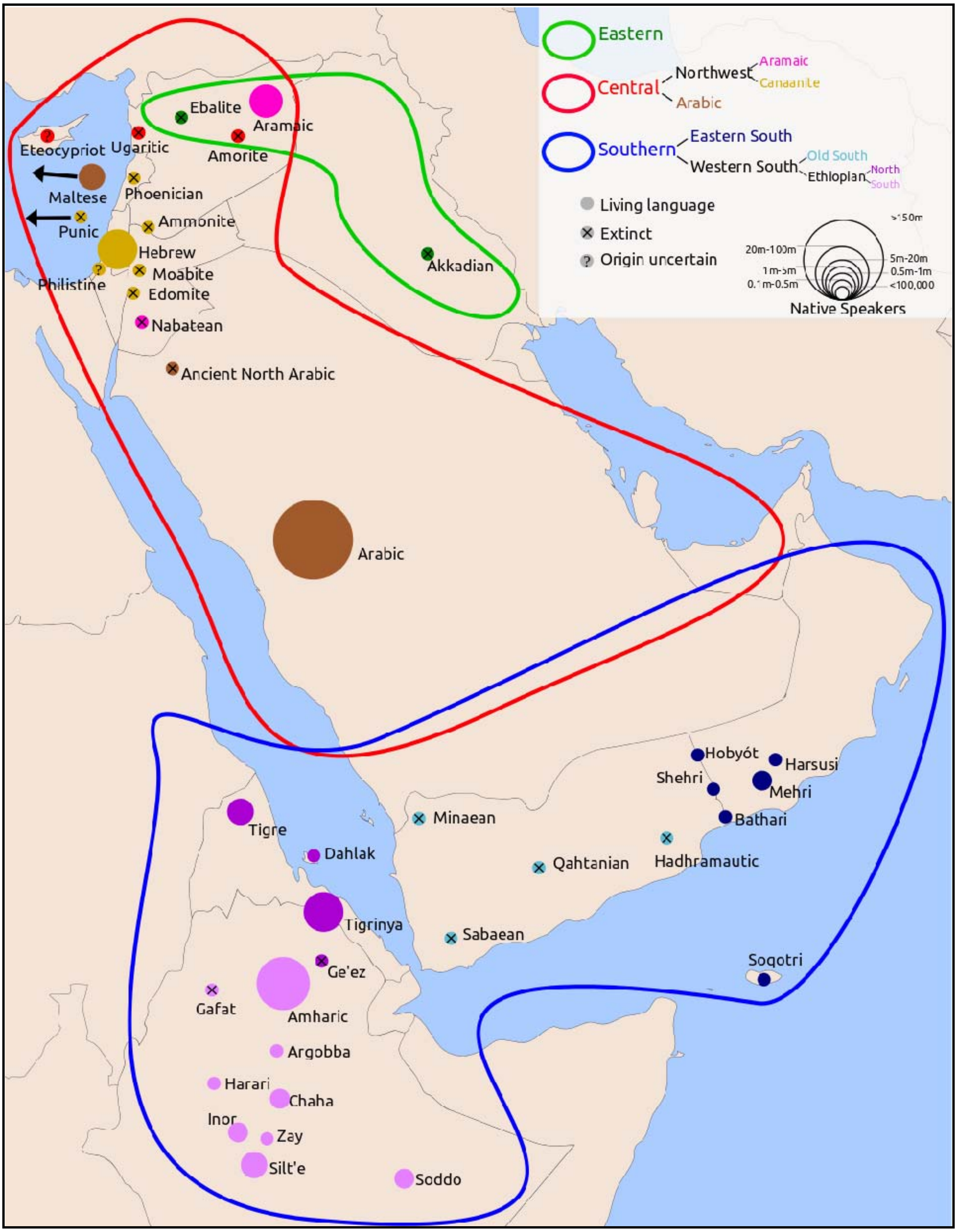

Figure 2. The geographic distribution of the Semitic languages: the extinct ones are labelled with the checked circles

Figure 3. The evolution of the Proto-Semitic root *hVrut_- into some of its extinct (surrounding leaves) and living (surrounding inflorescences) descending languages

CRUCIFERAE NEWSLETTER Nr. 35

Instructions to the authors – 2015

Deadline for contribution submission: **December 1st 2015**

The current issue of the Cruciferae Newsletter (vol. 35) will be published online at the beginning of year 2016 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.

1- All contributions should be written in **English**.

2- Authors should submit manuscripts only by email to **cruciferaenewsletter@rennes.inra.fr**. A manuscript file in Microsoft Word (or some other word processing format) is required. The manuscript file must be named as following: Full name of the first author_Year of submission.doc or .rtf.

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**).

4- The heading of the paper must be written in boldface letters and must include the title (1st line), followed by the author names (lines below) and their address (3rd lines) with the email address of the corresponding author.

5- Tables, figures and photographs must be included in, or at the end of the text.

6- While submitting their contributions, authors should mention **one of the listed topics** that is the most relevant to their work (see the list below), in order to facilitate the editing process.

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Table 1. Title

Figure 1. Title