Cruciferae Newsletter

May 2016 – vol. n°35

Acknowledgements

The current issue of the Cruciferae Newsletter (vol. 35) is published online from the Brassica website (http://www.brassica.info/info/publications/cruciferae-newsletter.php). 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

Intercropping spring-sown brassicas with cereals for green manure

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Introduction

Brassica and cereal crops have been cultivated in Southeast Europe since Neolithic, as one of the major segments of the so-called "agricultural revolution", having commenced in the Near East (Zohary et al. 2012). The Balkan Peninsula was one of its main routes leading to the continent's centre and has remained oriented towards growing these crops until today. In many regions, spring-sown cultivars of both brassicas, such as rapeseed (*Brassica napus* L.) and white mustard (*Sinapis alba* L.), and cereals, like oat (*Avena sativa* L.), barley (*Hordeum vulgare* L.) and common wheat (*Triticum aestivum* L. subsp. *aestivum*) are used for forage production, either as sole crops or in mixtures mostly with annual legumes, such as pea (*Pisum sativum* L.) or common vetch (*Vicia sativa* L.) (Ćupina et al. 2011, Ćupina et al. 2014).

Intercropping, most often referring to sowing and cultivating two or more domesticated species at the same place and at the same time together, is one of the most ancient attested farming designs (Hauggaard-Nielsen et al. 2011). Mixtures of brassicas and legumes proved to be beneficial to both components, especially for the first one, due to an enhanced supply with nitrogen (Cortés-Mora et al. 2010). The agronomic performance of the intercrops of various spring-sown brassicas and cereals has remained rather scarcely examined, although it could provide diverse agricultural practices in contrasting temperate environments with a number of advantages (Mihailović et al. 2014).

The goal of this study was to assess the possibility of intercropping spring-sown brassicas with cereals for green manure, thus examining its suitability for ecological services.

Materials and Methods

A small-plot trial was established during the growing seasons of 2013 and 2014 at the Experimental Field of the Institute of Field and Vegetable Crops at Rimski Šančevi, near the city of Novi Sad. It encompassed six intercrops of two spring-sown brassicas, rapeseed and white mustard, with three spring-sown cereals, oat, barley and common wheat, as well as sole crops of all five examined species.

In both trial seasons, all six intercrops and five sole crops were sown in the first decade of March, with a double-reduced sowing rate in the intercrops, providing no more expensive sowing costs in a potential wide-scale production. In both sole crops and intercrops, two brassicas were cut in the stages of full budding and the very commencement of flowering, while three cereals were cut at the onset of appearing of spikes and racemes.

In all the sole crops and intercrops, the aboveground biomass nitrogen yield (kg ha^{-1}) calculation was based upon the values of forage dry matter yield (kg ha^{-1}) and forage dry matter nitrogen content (g kg^{-1}), as determined by the Kjeldahl method.

The land equivalent ratio (LER) values for aboveground biomass nitrogen yield were calculated after the following formula (Mikić et al. 2015):

$$LER = SB_{IC} / SB_{SC} + SC_{IC} / SC_{SC},$$

where SB_{IC} is the aboveground biomass nitrogen yield of a brassica in an intercrop with a cereal, SB_{SC} is the aboveground biomass nitrogen yield of a brassica in its sole crop, SC_{IC} is the aboveground biomass nitrogen yield of a cereal in an intercrop and SC_{SC} is the aboveground biomass nitrogen yield of a cereal in its sole crop. The results were processed by analysis of variance (ANOVA) with the Least Significant Difference (LSD) test.

Results and Discussion

Among the two-year average values of aboveground biomass nitrogen yield and their LER in sole crops and intercrops of spring-sown forage brassicas and cereals, significant differences at a level 0f 0.05 were determined (Table 1).

In the sole crops of the spring-sown brassicas, the two-year average aboveground biomass nitrogen yield was 196 kg ha^{-1}, while in the sole crops of the spring-sown cereals it was 210 kg ha^{-1}. Among the five individual examined species, the two-year average aboveground biomass nitrogen yield ranged from 186 kg ha^{-1} in rapeseed to 222 kg ha^{-1} in oat. The sole crops of both rapeseed and white mustard had much higher aboveground biomass nitrogen yield in comparison to the results of two preliminary trials in the same environment, with the maximum values of 132 kg ha^{-1} in rapeseed (Krstić et al. 2012) and 138 kg ha^{-1} in white mustard (Krstić et al. 2010).

Regarding the average two-year values of total aboveground biomass nitrogen yield in the intercrops of spring-sown forage brassicas and cereals, it varied between 194 kg ha^{-1} in the intercrop of white mustard and barley to 266 kg ha^{-1} in the intercrop of white mustard and oat. Among brassicas, rapeseed had the highest two-year average individual contribution to the total aboveground biomass nitrogen yield when intercropped with common wheat (113 kg ha^{-1}), while white mustard had the lowest two-year average individual contribution to the total aboveground biomass nitrogen yield when intercropped with oat (76 kg ha^{-1}). The aboveground biomass nitrogen yield in the intercrops of spring-sown brassicas and cereals had a significantly smaller variation in comparison to a trial with the intercrops of spring-sown brassicas and annual legumes, with amplitude of 174 kg ha^{-1} (Marjanović Jeromela et al. 2015). All the intercrops of autumn-sown brassicas and cereals had the average two-year values of LER higher than 1, with rapeseed and common wheat being significantly the most economically reliable (1.24).

Conclusions

Producing mixtures of various spring-sown forage brassicas with cereals may be an additional source of environment-friendly increasing of soil fertility in temperate and other regions, providing high and stable aboveground biomass nitrogen yield for different contemporary cropping systems and contributing to their species diversity, and with future analyses of degrading incorporated aboveground biomass in the soil and its effect on the nutrients behaviour as highly desirable.

Table 1. Average values of aboveground biomass nitrogen yield (kg ha^{-1}) in the sole crops of spring-sown brassicas and cereals in the trial at Rimski Šančevi for 2013 and 2014

Sole crop / Intercrop	Brasica aboveground biomass nitrogen yield	Cereal aboveground biomass nitrogen yield	Total aboveground biomass nitrogen yield	LER
Rapeseed	186	-	-	-
White mustard	206	-	-	-
Brassicas average	196	-	-	-
Barley	-	200	-	-
Common wheat	-	209	-	-
Oat	-	222	-	-
Cereals average	-	210	-	-
Rapeseed + barley	107	135	242	1.16
Rapeseed + common wheat	113	120	233	1.24
Rapeseed + oat	101	130	230	1.13
Rapeseed + cereal average	107	128	235	1.18
White mustard + barley	99	122	194	1.03
White mustard + common wheat	82	133	235	1.10
White mustard + oat	76	180	266	1.15
White mustard + cereal average	86	145	232	1.09
$LSD_{0.05}$	22	18	21	0.06

Acknowledgements

The Ministry of Education, Science and Technological Development of the Republic of Serbia.

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