Preliminary results on growing oilseed rape and other brassicas for forage

Vojislav Mihailović[1a], Pero Erić[2], Ana Marjanović-Jeromela[1b], Radovan Marinković[1b], Branko Ćupina[2], Đorđe Krstić[2], Aleksandar Mikić[1a]

[1a]*Institute of Field and Vegetable Crops, Forage Crops Department, Maksima Gorkog 30, 21000 Novi Sad, Serbia*
[1b]*Institute of Field and Vegetable Crops, Oil Crops Department, Maksima Gorkog 30, 21000 Novi Sad, Serbia*
[2]*University of Novi Sad, Faculty of Agriculture, Department of Field and Vegetable Crops, Trg Dositeja Obradovića, 21000 Novi Sad, Serbia*
Email:mikic@ifvcns.ns.ac.yu

Abstract

A small-plot trial has been conducted at the Experimental Field of the Institute at Rimski Šančevi, included two winter cultivars of oilseed rape, Banaćanka and Slavica, two spring cultivars of oilseed rape, Global and Galant, two winter cultivars of fodder kale, NS-Bikovo and K-357, and two spring cultivars of white mustard, MMB 001 and MMB 002. The trial consisted of two identical blocks, where the first one was sown sown in September 2005 and the second one in March 2006. K-357 and NS-Bikovo had the significantly highest green forage yields per area unit in the autumn-sown block, with 54.9 t ha^{-1} in K-357 and 52.3 t ha^{-1} in NS-Bikovo. Although with only stems and leaves, the four winter cultivars produced significantly higher green forage yields per area unit than the spring ones in the spring-sown block as well, headed by K-357 with 38.1 t ha^{-1} in K-357 and 35.5 t ha^{-1} in Slavica.

Key words: oilseed rape, forage kale, white mustard, fresh weight yield, dry matter yield.

Introduction

Many of the species belonging to the family *Brassicaceae* Burnett, known as *brassicas*, are multi-purpose crops that can be utilised not only for various industrial purposes and human consumption, but for animal feeding as well (Erić *et al.*, 2006). Among the most important of fodder brassicas are those that are grown for forage, such as oilseed rape (*Brassica napus* L. var. *napus*), fodder kale (*Brassica oleracea* L. var. *viridis* L.), hybrid Perko PVH (*Brassica napus* L. var. *napus* x *Brassica rapa* subsp. *chinensis* (L.) Hanelt), turnip rape (*Brassica rapa* L. subsp. *oleifera* (DC.) Metzg.) and white mustard (*Sinapis alba* L. subsp. *alba*), and those that are cultivated for roots, such as rutabaga (*Brassica napus* L. var. *napobrassica* (L.) Rchb.) and fodder turnip (*Brassica rapa* L. subsp. *rapa*). All these crops have a significant place in forage crop rotations (Erić *et al.*, 1998), while those that are autumn-sown are appreciated in organic farming and sustainable agriculture (Ćupina *et al.*, 2004). Due to their ability to produce abundant biomass, forage brassicas can be grown for green manure (Erić *et al.*, 2000) and grazing (Koch *et al.*, 1989).

Apart from being one of the most valuable oil crops, oilseed rape can be cultivated for green forage and silage (Erić *et al.*, 1996). Although it is still less-known in certain parts of the country, fodder kale has become the most important forage brassica in Serbia during the last decades of the last century (Šibalić & Kunc, 1983), with a recently improved breeding programme in the Institute of Field and Vegetable Crops in Novi Sad and its cultivar NS-Bikovo as the most widespread on the country scale. Little is known about the utilisation of white mustard as a forage crop, except that it is grown mainly as a spring crop and with a period from sowing to cutting of 60 days (Vučković, 1999).

The goal of the study was to determine the potential of the brassica species and agronomic types for forage yields.

Materials and Methods

A small-plot trial has been conducted at the Experimental Field of the Institute of Field and Vegetable Crops at Rimski Šančevi. It included two winter cultivars of oilseed rape, Banaćanka and Slavica, two spring cultivars of oilseed rape, Global and Galant, two winter cultivars of fodder kale, NS-Bikovo and K-357, and two spring cultivars of white mustard, MMB 001 and MMB 002.

The trial consisted of two identical blocks, where both blocks included all eight cultivars. The cultivars of the first block were sown in September 2005, while the cultivars of the second block were sown in March 2006. The cultivars of both blocks were sown at the same seeding rate of 50 viable seeds m^{-2} (Šoštarić-Pisačić & Štafa, 1975), the same plot size of 5 m^2 and three replicates and were cut in the stage of budding and beginning of flowering.

The main forage yield components, such as plant height (cm), number of lateral branches (plant^{-1}) and number of leaves (plant^{-1}), as well as green forage yield per plant (g), were measured upon the basis of twenty plant samples per replicate shortly before the cutting. The green forage yield per area unit (t ha) was determined by recalculation of the green forage yield per plot measured *in situ*. Dry matter yield per both plant (g) and area unit (t ha^{-1}) was determined on field dry weight basis. There were also determined the portions of stems, including lateral branches and flowers, and leaves in the yields of green forage and dry matter of each cultivar in both autumn- and spring-sown blocks.

The study results were processed by analysis of variance (ANOVA) with the Least Significant Difference (LSD) test applied and using the computer software MSTAT-C.

Results and Discussion

The two spring cultivars of oilseed rape have shown a considerable tolerance to low temperatures, while the two cultivars of white mustard, despite the fast growth and development during the autumn, have not survived the winter. On the other hand, the two winter cultivars of oilseed rape and the two winter cultivars of fodder kale in the spring-sown block have remained in the vegetative stage, producing only very short stems and large leaves.

Plant height. There were differences in plant height at both levels of significance and in both blocks (Table 1). In average, the variation of plant height in the stage of budding was smaller in the autumn-sown block, ranging from 71.8 cm in Slavica and 71.9 in Galant to 98.9 cm in K-357, than in the spring-sown block, ranging from 32.0 cm in K-357 to 104.3 cm in Galant (Table 1).

Table 1. Forage yield components in oilseed rape and other brassicas in 2005/06 at Rimski Šančevi

Sowing time	Season and species	Cultivar	Plant height (cm)	Number of lateral branches (plant^{-1})	Number of leaves (plant^{-1})
Autumn	Winter oilseed rape	Banaćanka	75.2	6.1	17.4
		Slavica	71.8	6.7	18.6
	Spring oilseed rape	Global	71.9	3.9	13.3
		Galant	76.7	5.4	18.9
	Winter fodder kale	NS-Bikovo	92.2	6.2	18.7
		K-357	98.9	3.6	16.8
	Spring white mustard	MMB 001	-	-	-
		MMB 002	-	-	-
Spring	Winter oilseed rape	Banaćanka	40.3	0.0	6.0
		Slavica	53.3	0.0	9.3
	Spring oilseed rape	Global	99.7	5.7	41.3
		Galant	104.3	6.7	47.7
	Winter fodder kale	NS-Bikovo	38.3	0.0	7.7
		K-357	32.0	0.0	7.7
	Spring white mustard	MMB 001	55.6	4.6	22.1
		MMB 002	60.6	3.8	19.8
	LSD	$P < 0.05$	14.8	2.4	5.8
		$P < 0.01$	18.2	3.0	7.1

Number of lateral branches. The significantly greatest number of lateral branches per plant in both blocks (6.7) was in both Slavica in the autumn-sown block and Galant in the spring sown block. The smallest number of lateral branches per plant in the autumn-sown block (3.6) was in K-357, while the smallest number of lateral branches per plant in the spring-sown block (3.8) was in MMB 002. As previously mentioned, the four winter cultivars in the spring-sown block have not formed lateral branches.

Number of leaves. The six surviving cultivars in the autumn-sown block were characterised by average numbers of leaves per plant that varied from 13.3 in Global to 18.9 in Galant. On the other hand, the average numbers of leaves per plant in the spring-sown block varied from 6.0 in Banaćanka to 47.7 in Galant. There were no significant differences in number of leaves per plant at neither of the two levels in the autumn-sown block, but there were significant differences in number of leaves per plant at both levels in the spring-sown block.

Green forage yield per plant. With significant differences at both levels of 0.05 and 0.01, the average green forage yield per plant ranged from 28.21 g in Global to 94.15 g in NS-Bikovo in the autumn-sown block and from 26.32 g in MMB 002 and 26.50 g in MMB 001 to 199.79 g in Galant and 205.90 g in Slavica (Table 2).

Green forage yield per area unit. The two winter cultivars of fodder kale had the significantly highest green forage yields per area unit in the autumn-sown block, with 54.9 t ha^{-1} in K-357 and 52.3 t ha^{-1} in NS-Bikovo, showing that this species has a great potential for green forage yield (Dubljević, 2001). The results of the two winter cultivars of oilseed rape, with 35.7 t ha^{-1} in Slavica and 28.6 t ha^{-1} in Banaćanka, can be considered rather promising (Đukić, 2002). Although with only stems and leaves, the four winter cultivars produced significantly higher green forage yields per area unit than the spring ones in the spring-sown block as well, headed by K-357 with 38.1 t ha^{-1} in K-357 and 35.5 t ha^{-1} in Slavica. With green forage yields per area unit of 13.8 t ha^{-1} in MMB 002 and 10.2 t ha^{-1} in MMB 001, the two white mustard cultivars had a performance that was below the species average (Schuchert, 2006).

Dry matter yield per plant. The highest yields of dry matter yield per plant were in Banaćanka (8.37 g) in the autumn-sown block and Slavica (20.69 g) in the spring-sown block, while the lowest dry matter yields per plant were in Global (3.58 g) in the autumn-sown block and MMB 001 and MMB 002 (4.00 g and 4.01 g) in the spring-sown block, with significant differences at both levels.

Table 2. Forage yields in oilseed rape and other brassicas in 2005/06 at Rimski Šančevi

Sowing time	Season and species	Cultivar	Green forage yield		Dry matter yield		Dry matter portion
			(g plant^{-1})	(t ha^{-1})	(g plant^{-1})	(t ha^{-1})	
Autumn	Winter oilseed rape	Banaćanka	83.16	28.6	8.37	2.7	0.10
		Slavica	80.66	35.7	8.14	3.5	0.10
	Spring oilseed rape	Global	28.21	21.0	3.58	2.7	0.13
		Galant	41.93	20.5	5.07	2.6	0.12
	Winter fodder kale	NS-Bikovo	94.15	52.3	8.14	4.7	0.09
		K-357	82.00	54.9	6.80	4.5	0.08
	Spring white mustard	MMB 001	-	-	-	-	-
		MMB 002	-	-	-	-	-
Spring	Winter oilseed rape	Banaćanka	55.29	31.6	5.62	3.4	0.10
		Slavica	205.90	35.5	20.69	3.9	0.10
	Spring oilseed rape	Global	117.61	25.3	11.82	2.1	0.10
		Galant	199.79	23.2	19.95	2.4	0.10
	Winter fodder kale	NS-Bikovo	63.57	35.2	6.98	3.7	0.11
		K-357	51.19	38.1	5.49	4.0	0.11
	Spring white mustard	MMB 001	26.50	10.2	4.00	1.5	0.15
		MMB 002	26.32	13.8	4.01	2.0	0.15
	LSD	$P < 0.05$	11.03	4.6	1.25	0.5	0.02
		$P < 0.01$	16.28	7.2	1.82	0.8	0.03

Table 3. Portion of stems, including lateral branches and flowers, and leaves in yields of green forage and dry matter in oilseed rape and other brassicas in 2005/06 at Rimski Šančevi

Sowing time	Season and species	Cultivar	Green forage yield		Dry matter yield	
			stems	leaves	stems	leaves
Autumn	Winter oilseed rape	Banaćanka	0.60	0.40	0.57	0.43
		Slavica	0.59	0.41	0.55	0.45
	Spring oilseed rape	Global	0.71	0.29	0.71	0.29
		Galant	0.74	0.26	0.74	0.26
	Winter fodder kale	NS-Bikovo	0.54	0.46	0.57	0.43
		K-357	0.60	0.40	0.61	0.39
	Spring white mustard	MMB 001	-	-	-	-
		MMB 002	-	-	-	-
Spring	Winter oilseed rape	Banaćanka	0.00	1.00	0.00	1.00
		Slavica	0.19	0.81	0.18	0.82
	Spring oilseed rape	Global	0.76	0.24	0.76	0.24
		Galant	0.85	0.15	0.83	0.17
	Winter fodder kale	NS-Bikovo	0.00	1.00	0.00	1.00
		K-357	0.00	1.00	0.00	1.00
	Spring white mustard	MMB 001	0.64	0.36	0.43	0.57
		MMB 002	0.64	0.36	0.42	0.58

Dry matter yield per area unit. The two winter cultivars of fodder kale had the significantly highest dry matter yields per area unit in the autumn-sown block, with 4.7 t ha^{-1} in NS-Bikovo and 4.5 t ha^{-1} in K-357. The latter cultivar had the highest dry matter yield per area unit in the spring-sown block too (4.0 t ha^{-1}), while the MMB 001 had the lowest dry matter yield per area unit in the spring-sown block (1.5 t ha^{-1}).

Dry matter portion. The two spring cultivars of white mustard had the significantly largest dry matter portion (0.15) than any other cultivar in both blocks. The smallest dry matter portion values were in the two winter cultivars of fodder kale, with 0.09 in NS-Bikovo and 0.08 in K-357.

Portion of stems and leaves in yields of green forage and dry matter. In most cases, there were no differences in portions of stems, including lateral branches and flowers, and leaves between green forage yield and dry matter yield (Table 3). Notably, the portion of stems in green forage yield was larger than that of leaves, save for the four winter cultivars in the spring-sown block. The portion of stems was larger than that of leaves in dry matter yield as well, except for the two white mustard cultivars, with the portions of leaves of 0.58 in MMB 002 and 0.57 in MMB 001.

Conclusions

Although the results are preliminary, it can be concluded that forage brassicas can represent an important source of forage. Fodder kale has shown a great potential for high yields of green forage, while oilseed rape has shown its abilities to produce

high yields of forage too, especially its winter cultivars. White mustard needs more closely examination when regarded as forage plant. The trial will be carried out throughout the years that follow, providing more accurate results on the agronomic performances of these and other forage brassicas.

References

Ćupina, B., Erić, P., Krstić, Đ., Vučković, S. (2004). Forage catch crops in sustainable agriculture and organing farming. Acta Agriculturae Serbica **IX:17** 451-459.

Dubljević, R. (2001). Proizvodne osobine nekih jednogodišnjih krmnih biljaka u agroekološkim uslovima Zetsko-bjelopavlićke ravnice. PhD thesis. Faculty of Agriculture, University of Novi Sad, Novi Sad, Serbia, 101 pp.

Đukić, D. (2002). Biljke za proizvodnju stočne hrane. Faculty of Agriculture, University of Novi Sad, Novi Sad, Serbia, 421 pp.

Erić P., Đukić D., Ćupina B., Mihailović V. (1996). Krmno bilje (praktikum). Faculty of Agriculture, University of Novi Sad, Novi Sad, Serbia, 198 pp.

Erić P., Mihailović V., Ćupina B. (1998). NS-sorte krmnog bilja u krmnom konvejeru – izazov za proizvodnju jeftinije stočne hrane. Zbornik radova (a periodical of scientific research of field and vegetable crops) **30** 345-352.

Erić P., Ćupina B., Mihailović V. (2000). Zelenišno đubrenje – prošlost ili budućnost. Zbornik radova (a periodical of scientific research of field and vegetable crops) **33** 117-128.

Erić P., Ćupina B., Mihailović V., Mikić A. (2006). Brassicas in production and utilization of forage (advantages and disadvantages). Zbornik radova (a periodical of scientific research of field and vegetable crops) **42:I** 105-114.

Koch, D.W., Kercher, C., Agee, D., Jones, R. (1989). Production and utilization of high-quality cold-hardy forages. Proceedings of the XVI International Grassland Congress, Nice, France, 4-11 October 1989, 1127-1128.

Schuchert, W. (2006). Weisser Senf. Max Planck Institute for Plant Breeding Research, Cologne, Germany, http://www.mpiz-koeln.mpg.de/oeffentlichkeitsarbeit/kulturpflanzen/Nutzpflanzen/Weisser_Senf/index.html

Šibalić, I., Kunc, V. (1983). Fodder kale cultivars Grüner Angeliter and NS-555 and Perko PVH. Zbornik naučnih radova sa IV jugoslovenskog simpozijuma o krmnom bilju, Novi Sad, Serbia, 8-11 June 1982, 505-514.

Šoštarić-Pisačić, K., Štafa, Z. (1975). Stočni kelj – nova, intenzivna krmna kultura. Centar za primjenu nauke u poljoprivredi SR Hrvatske, Zagreb, Croatia, 30 pp.

Vučković S. M. (1999): Krmno bilje. Agricultural Research Institute Serbia, Belgrade, Serbia - Bonart, Nova Pazova, Serbia, 553 pp.