Possibilities for utilization of oilseed rape meal as protein feed

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Abstract

A small-plot trial has been carried out at the Experimental Field of the Institute of Field and Vegetable Crops at Rimski Šančevi from August 1997 to June 2000. It included ten winter cultivars of oilseed rape, namely Sremica, Banaćanka, Octavia, Jana, Casino, Valesca, Duna, Orkan, Pronto and Artus. There were significant differences at levels of both 0.05 and 0.01 in all monitored characteristics. The greatest plant height was in Valesca (130 cm), while the smallest plant height was in Pronto (116 cm). Number of lateral branches varied from 5.4 plant^{-1} in both Valesca and Orkan to 7.1 plant^{-1} in Octavia. Duna had the greatest number of husks (157.8 plant^{-1}), while Valesca had the smallest number of husks (112.3 plant^{-1}). Thousand seed mass ranged between 3.42 g in Jana and 4.14 g in Octavia. Thanks to the highest seed yield (11.48 g plant^{-1}) and the largest crude protein content (219 g kg^{-1}), Sremica had the highest crude protein yield (1355 kg ha^{-1}).The lowest seed yield was in Jana (8.38 g plant^{-1}), while the smallest crude protein content was in Banaćanka (185 g kg^{-1}). Orkan had the lowest crude protein yield (837 kg ha^{-1}). Crude protein yield was in high positive correlation with nearly all other monitored characteristics, namely with seed yield (r=0.988), number of lateral branches (r=0.806), number of husks (r=0.805), plant height (r=0.719) and thousand seed mass (r=0.462), while it was in no correlation with crude protein content (r=0.085).

Key words: oilseed rape, protein feed, seed yield, crude protein content, crude protein yield.

Introduction

Contemporary animal husbandry in both Serbia and the world on the whole has been faced with constant demand for plant proteins (Mihailović *et al.*, 2004a). Although annual legumes, such as pea, faba bean and vetches, are generally considered one of the least expensive and most quality answers to this challenge, as well as an excellent substitutes for soya bean meal in dry years (Mikić *et al.*, 2006), the potential of other non-legume crops for high, quality and stable protein yields has also been examined.

Oilseed rape (*Brassica napus* L. var. *napus*) is highly appreciated as both edible and industrial oil crop, especially beacuse of a high oil content in its seed of between 40 % and 48 % (Marjanović-Jeromela *et al.*, 2002). On the other hand, oil extraction leaves behind oilseed rape meal, an excellent source of protein supplement for livestock, with a crude protein content of about 40 % and a lysine content rather close to that in soya bean (Gilliland & Hang, 2003).

Breeding oilseed rape for increased protein content is based upon knowledge of the relationship between main agronomic characteristics. Among the goals of all such programmes are decreased contents of both erucic acid and glucosinolate (Eőri, 2001), due to their unsuitability in animal feeding. Although it is widely accepted that oil content and crude protein content are in a negative correlation (Marjanović-Jeromela *et al.*, 2003), there are promising results of the possibility for obtaining progenies with high correlations between these two important characteristics (Engqvist & Becker, 1993).

The study was aimed at determining the agronomic characteristics of winter oilseed rape cultivars related to crude protein yield, assessing thus the possibility for utilisation of oilseed rape meal as protein feed.

Materials and Methods

A small-plot trial has been carried out at the Experimental Field of the Institute of Field and Vegetable Crops at Rimski Šančevi from August 1997 to June 2000. It included ten winter cultivars of oilseed rape of diverse geographical origin, namely Sremica, Banaćanka, Octavia, Jana, Casino, Valesca, Duna, Orkan, Pronto and Artus. All ten cultivars were sown at an average seeding rate of between 2.5 kg ha^{-1} and 3.5 kg ha^{-1}, providing thus between 60 plants m^{-2} and 70 plants m^{-2} after emergence and 50 plants m^{-2} and 55 plants m^{-2} before harvest (Marinković *et al.*, 2006, at a plot size of 5 m^2 and three replicates and were harvested in the full maturity of husks.

There were monitored main agronomic characteristics related to crude protein yield, such as plant height (cm), number of lateral branches (plant^{-1}), number of husks (plant^{-1}), thousand seed mass (g), seed yield (g plant^{-1}), crude protein content (g kg^{-1}) and crude protein yield (kg ha^{-1}).

The study results were processed by analysis of variance (ANOVA) with the Least Significant Difference (LSD) test applied, using the computer software MSTAT-C. There were also calculated the simple correlation coefficients (r) between all monitored characteristics.

Results and Discussion

Plant height. There were significant differences in plant height at levels of both 0.05 and 0.01 among the ten examined cultivars (Table 1). As an important forage and seed yield component (Aly *et al.*, 1999), the average values of plant height varied from 116 cm in Pronto to 130 cm in Valesca.

Number of lateral branches. The greatest average number of lateral branches was in Oktavija (7.1 plant^{-1}), while the smallest average number of lateral branches was in Valesca and Orkan (5.4 plant^{-1}), with significant differences at both levels for this characteristics.

Number of husks. Being one of the main seed yield components (Marjanović-Jeromela *et al.*, 2004), the average number of husks ranged between 112.3 plant^{-1} in Valesca and 157.8 plant^{-1} in Duna. There were significant differences in number of husks at levels of both 0.05 and 0.01 among the examined winter cultivars of oilseed rape.

Thousand seed mass. With significant differences at both levels, the largest average thousand seed mass was in Oktavija (4.14 g), while the smallest average thousand seed mass was in Jana (3.42 g).

Table 1. The average values for seed yield components in ten winter cultivars of oilseed rape from 1997 to 2000 at Rimski Šančevi

Cultivar		Plant height (cm)	Number of lateral branches (plant^{-1})	Number of husks (plant^{-1})	Thousand seed mass (g)
Sremica		127	6.8	147.9	3.83
Banaćanka		125	6.7	120.0	3.88
Oktavija		122	7.1	140.8	4.14
Jana		123	6.6	114.4	3.42
Casino		129	6.1	124.9	4.05
Valesca		130	5.4	112.3	3.83
Duna		125	6.0	157.8	3.77
Orkan		124	5.4	122.6	4.05
Pronto		116	6.1	120.1	3.55
Artus		127	7.0	117.3	3.86
LSD	$P < 0.05$	5	0.7	13.1	0.14
	$P < 0.05$	7	0.9	17.3	0.18

Seed yield. The cultivar Sremica produced the highest seed yield (11.48 g plant^{-1}), while the cultivars Orkan and Jana produced the lowest seed yields (8.35 g plant^{-1} and 8.38 g plant^{-1}). There were significant differences in seed yield at levels of both 0.05 and 0.01 among the ten examined cultivars (Table 2).

Crude protein content. As a characteristics that is under a great influence of environmental factors (Champolivier & Merrien, 1996; Pritchard et al., 2000), the average crude protein content was significantly higher in the cultivar Sremica (219 g kg^{-1}) in comparison with all other nine examined cultivars. The lowest average crude protein content was in Banaćanka (185 g kg^{-1}). Generally, the crude protein content in oilseed cultivars was lower than in protein pea (Mihailović *et al.*, 2005) and at the similar level with those in the forage dry matter of pea and vetches (Mihailović *et al.*, 2004b).

Crude protein yield. Thanks to a rather preserved stand until harvest in terms of crop density, the cultivars Sremica and Oktavija had significantly higher crude protein yields as compared with other eight examined cultivars of oilseed rape, with 1355 kg ha^{-1} in Sremica and 1085 kg ha^{-1} in Oktavija and with Sremica having significantly higher crude protein yield at both levels in comparison with Oktavija.

Table 2. The average values for seed yield, crude protein content and crude protein yield in ten winter cultivars of oilseed rape from 1997 to 2000 at Rimski Šančevi

Cultivar		Seed yield (g plant^{-1})	Crude protein content (g kg^{-1})	Crude protein yield (kg ha^{-1})
Sremica		11.48	219	1355
Banaćanka		8.88	185	885
Oktavija		10.00	201	1085
Jana		8.38	195	881
Casino		8.76	192	909
Valesca		9.52	187	960
Duna		9.52	189	973
Orkan		8.35	186	837
Pronto		9.85	188	1002
Artus		9.51	186	956
LSD	$P < 0.05$	1.09	9	47
	$P < 0.01$	1.41	11	66

The Table 3 shows the simple correlation coefficients (r) between the monitored agronomic characteristics, namely plant

height (1), number of lateral branches (2), number of husks (3), thousand seed mass (4), seed yield (5), crude protein content (6) and crude protein yield (7). The significantly high positive correlations at a level of 0.01 were between seed yield and plant height (r=0.774), number of lateral branches (r=0.810) and number of husks (r=0.821), as well as between crude protein yield and number of lateral branches (r=0.806), number of husks (r=0.805) and seed yield (r=0.988).

Table 3. The simple correlation coefficients (r) between agronomic characteristics of oilseed rape related to crude protein yield

	1	2	3	4	5	6	7	LSD	
1	1.000	0.521	0.734	0.354	0.774	-0.397	0.719	$P<0.05$	$P<0.01$
2		1.000	0.701	0.396	0.810	0.069	0.806		
3			1.000	0.440	0.821	-0.036	0.805		
4				1.000	0.470	-0.005	0.462	0.602	0.735
5					1.000	-0.057	0.988		
6						1.000	0.085		
7							1.000		

Conclusions

Apart from being one of the most important oil crops, oilseed rape has a considerable potential for crude protein yield, mainly thanks to high seed yields and large crude protein content, and can represent an important source of plant protein for animal husbandry. There is a solid base to consider breeding oilseed rape for crude protein yield reliable and possible to perform simultaneously with breeding for oil yield and chemical composition.

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