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# *AGRICULTURAL SCIENCE AND TECHNOLOGY*

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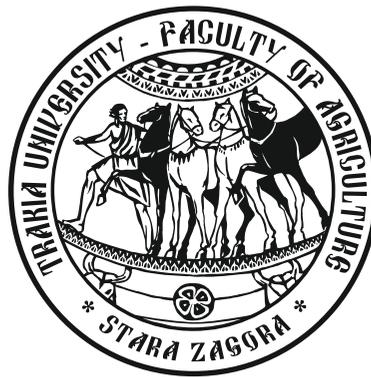
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## Productivity and economic traits of winter oilseed rape (*Brassica napus* var. *biennis*) under the conditions of Dobrudzha

G. Georgiev\*, G. Georgiev, P. Chamurliyski

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**Abstract.** During the last decade oilseed rape has become a main field crop in Bulgaria. In 2001, about 240 thousand ha were sown with this crop, mainly with foreign varieties and hybrids. The increasing demand and the large market for this oil seed crop has lead to introduction of new varieties of different production potential and economic indices. The aim of this investigation was to study the main economic indices related to yield formation and the production potential of winter oil seed rape cultivars under the conditions of Dobrudzha region. The investigation was carried out during 2009 – 2010 in the trial field of Dobrudzha Agricultural Institute (DAI). A total of 23 cultivars of winter oil seed rape were tested. The materials were obtained from international genetic stock centers and foreign companies: Gatersleben (Germany), Institute of Plant and Genetic Resources (Sadovo, Bulgaria), Limagrain (France), NPZ (Germany) and Novi Sad (Serbia). The trials were performed in three replications according to the Latin square design, the harvest plot area being 10 m<sup>2</sup>. Variety Rasmus was used as a standard. Yield and productivity elements were investigated. Two-factor dispersion analysis, and variation and correlation analyses were applied for statistical processing of the results, using software XLSTAT Pro. ver 7.0.1. Varieties Ilija and Anna demonstrated high and stable yield during the two years of investigation, reaching 5.12 t/ha and 4.93 t/ha, respectively. The highest values of the trait 1000 seed weight were measured in Kata (4.66 g) and Catalina (4.51 g). Varieties Kata and Branka significantly exceeded the standard Rasmus by number of pods per plant. Kata, Ilija and Branka can be considered suitable initial material for breeding programs aimed at developing new synthetic winter varieties of oilseed rape possessing excellent economic traits and high productivity.

**Keywords:** oilseed rape, production potential, elements of productivity

### Introduction

During the last decade oilseed rape has become a major agricultural crop in Bulgaria. About 240 thousand ha are sown annually in the country (FAO, 2011), growing mainly foreign varieties and hybrids. The areas with oilseed rape were 1 200 ha in 1997, reaching 11 000 ha by 2005 (Staneva et al., 2007). The first technical oilseed crop in Bulgaria was canola (*Brassica napus oleifera* Metzg) introduced in 1880. During the wartime years the introduction of sunflower was accelerated due to shortage of oil. Since 1965 the cultivation of canola and oilseed rape has been terminated. One of the most significant reasons for the ascent of sunflower was its considerably higher quality of oil, which is free from any low-quality ingredients such as erucic acid typical of canola and oilseed rape oil (Staneva et al., 2007). As early as 1912 Rudolf Diesel mentioned that oilseed crops can be used to obtain bio fuel that can replace petroleum (Wagener-Lohse, 2006). It was this wide range of application and the high demand for this oil seed crop that induced the introduction of new cultivars with different production potential and economic indices. The main direction in the work on development of new synthetic oilseed rape varieties is the high production potential (Sidlauskas and Bernotas, 2003).

The productivity in Bulgaria varies from 1.50 to 3 t/ha (FAO, 2011) depending on the agro-climatic and production conditions. The highest seed yield from winter oilseed rape can be obtained at high number of seeds per pod and good pod filling (Habekotte, 1997). Yield and the process of its formation depend on the genetic potential of the variety or hybrid, on the effect of the environment and on the agronomy factors (Geisler and Kullman, 1991, Hollmes, 1980; Sykes and Mailer, 1991).

The aim of this investigation was to study the main economic indices related to yield formation and the production potential of

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winter oilseed rape varieties under the conditions of Dobrudzha region.

### Material and methods

The investigation was carried out during 2009 – 2010 in the trial field of Dobrudzha Agricultural Institute (DAI), General Toshevo. Twenty-three varieties of foreign origin were tested (Table 1). Variety

**Table 1.** Origin of the investigated synthetic varieties

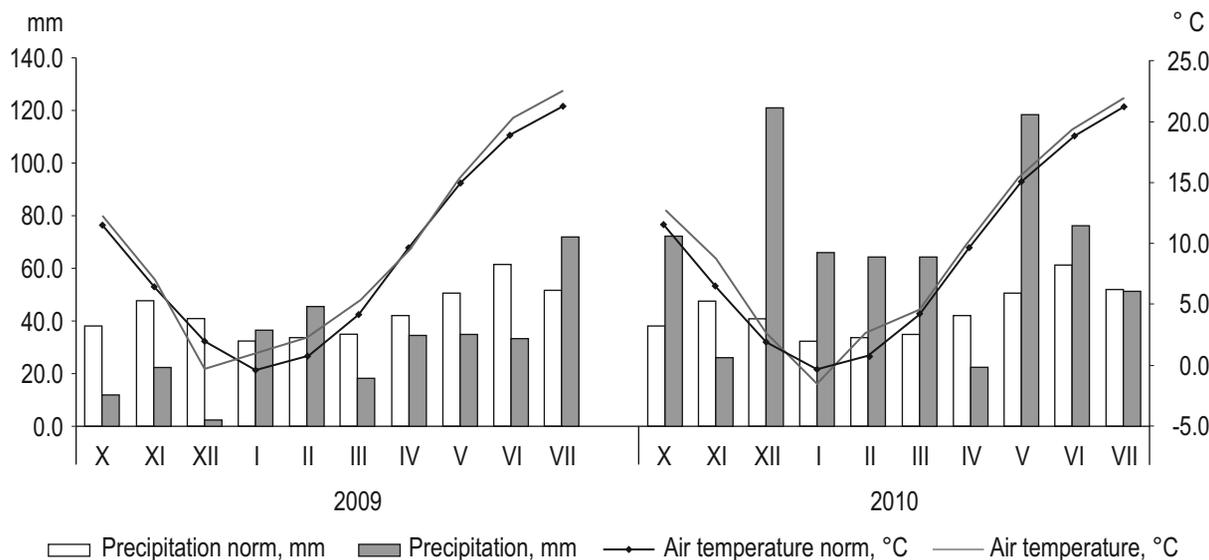
Variety	Origin	Variety	Origin
Ontario	Limagrain, France	Canti	Novi Sad, Serbia
Manitoba	Limagrain, France	Kantop	Novi Sad, Serbia
Ladoga	Limagrain, France	Anna	Novi Sad, Serbia
Catalina	Canada	Slavica	Novi Sad, Serbia
Californium	Canada	Nena	Novi Sad, Serbia
Capitol	Canada	Branka	Novi Sad, Serbia
Rasmus	NPZ, Germany	Lirajet	Novi Sad, Serbia
Chelsea	ETC	Banachanka	Novi Sad, Serbia
		Silvija	Novi Sad, Serbia
		Nevena	Novi Sad, Serbia
		Ilija	Novi Sad, Serbia
		Kata	Novi Sad, Serbia
		Aligator	Novi Sad, Serbia
		Zlatna	Novi Sad, Serbia
		Yasna	Novi Sad, Serbia

Rasmus was used as a standard. The trials were performed in three replications according to the Latin square design, the harvest plot area being 10 m<sup>2</sup>. Planting was done within the dates optimal for this region. Main fertilization was done with NPK fertilization norm 0.2 t/ha. At the beginning of February early spring nutrition was applied with saltpeter nitre at norm 1.2 t/ha. The following indices were monitored: vegetation period (number of days from germination to technical maturity); plant height (cm); number of pods per plant, number of seeds per pod; 1000 seed weight (g); yield (t/ha) – GY.

Two-factor dispersion, variation and correlation analyses were performed for statistical processing of the results using software XLSTAT Pro. ver 7.0.1.

#### Meteorological characterization

During the period 2009–2010, the combination of meteorological factors was favorable for the development of winter oilseed rape at DAI (Figure 1). The conditions during the spring and autumn of both years contributed to the successful entering into “rosette” stage and the good over wintering of the crop so that the cultivars managed to realize their genetic potential for grain yield. The temperatures during the two years were within the optimal range. The greater amounts of rainfalls in 2010 contributed to the better expression of the genetic potential of all cultivars.



**Figure 1.** Meteorological characteristics of the period of investigation (2009–2010)

## Results and discussion

The results from the two-factor dispersion analysis (Table 2) show that the obtained data can be analyzed specifically. The meteorological conditions of the year had the highest influence on yield formation – 77 %, while the genotype had only 10 % effect.

It becomes evident from the data on Table 3 that 13 varieties have longer vegetation period than the standard Rasmus, cultivar Nevena being with the shortest vegetation period. The cultivars involved in this trial were shorter than the standard, cultivar Yasna being the shortest of all (121.5 cm). Among the investigated cultivars, Californium, Ladoga and Silvija had taller stems. Cultivar Branka formed the highest number of seeds per pod (39), followed by Kata (37.5) and Silvija (35.5). These cultivars significantly exceeded the standard with more than 20 %. With regard to the trait number of pods, all investigated genotypes were rather below the level of the standard Rasmus. The highest number of pods was observed in cultivar Kanto – 218.5, which was only 82.5 % from the

standard, followed by cultivar Anna – 212.0, or 80 % from the standard. The highest variation of the values was observed by this trait. Cultivar Capitol had only 102.5 pods, which was only 38.7 % from the standard. Absolute seed weight is the trait with the highest influence on yield formation. Cultivar Anna had the highest 1000 seed weight (4.95 g) followed by Ilija and Kata with 4.92 g and 4.60 g, respectively. These were the cultivars with the highest yield per area unit, the ranking being Ilija Anna Kata with yields 5.12, 4.93 and 4.88 t/ha, respectively. The lowest yield was obtained from cultivars Lirajet – 3.32 t/ha and Chelsea – 3.52 t/ha. The highest was the variation by number of pods per plant (25.3 %), followed by the indices seeds per pod and 1000 seed weight. The lowest variation was observed by vegetation period and plant height.

The knowledge on the correlations between the traits of interest gives a possibility to make our choice of a suitable cultivar more efficient. The higher and positive their value, the greater the probability of their occurrence in the same genotype. Correlation analysis was applied to find out the strength and direction of the

**Table 2.** Results from the two-factor dispersion analysis

Source of Variation	SS	df	MS	F	P-value	F crit	%
Genotype	26.98	22	1.23	3.44	0	1.66	10.3
Year	9.20	1	9.20	25.84	0	3.94	77.1
G*Y	25.41	22	1.15	3.24	0	1.66	9.6
Error	32.75	92	0.35				2.9
Total	94.34	137					

**Table 3.** Yield and structural elements of yield

Variety	Vegetation period	Plant height, cm	Number of seeds per pod	Number of pods	1000 seed Weight, g	Yield t/ha
Ontario	281.5	124.0	31.5	193.0	4.22	4.56
Canti	285.5	122.5	30.5	184.0	4.18	4.50
Manitoba	279.0	123.0	29.5	171.0	3.85	4.75
Chelsea	281.5	129.0	31.0	178.0	3.24	3.52
Catalina	283.0	125.5	24.5	208.5	4.51	4.83
Californium	287.0	138.5	32.0	171.5	4.49	4.38
Ladoga	286.0	143.0	29.5	193.5	3.75	4.50
Kanto	284.5	128.0	31.5	218.5	4.15	4.63
Anna	282.0	120.0	28.0	212.0	3.95	4.93
Slavica	281.5	122.5	25.0	146.5	4.05	4.37
Nena	285.0	121.0	30.5	183.0	3.71	4.68
Branka	279.5	131.5	39.0	201.5	4.22	4.07
Lirajet	281.5	123.5	33.0	194.5	3.13	3.32
Banachanka	285.5	128.5	33.0	145.5	4.30	4.46
Capitol	285.0	132.0	27.0	102.5	3.24	4.06
Silvija	284.5	137.0	35.5	149.0	2.83	4.62
Nevena	278.0	132.0	32.0	121.0	3.17	3.77
Ilija	284.5	127.0	35.0	80.0	4.42	5.12
Kata	279.0	126.5	37.5	116.5	4.66	4.88
Aligator	282.5	131.5	28.5	165.0	4.01	4.32
Zlatna	286.0	131.0	27.0	137.5	3.57	3.88
Yasna	284.5	121.5	27.0	131.0	3.60	4.38
Rasmus	282.0	135.0	29.0	265.0	3.69	4.07
Average	283.0	128.4	30.7	168.2	3.9	4.4
SE	0.53	1.27	0.77	8.87	0.10	0.09
V%	0.90ns	4.74ns	12.05**	25.28***	12.97**	10.34**

\* –  $p < 0.05$ , \*\* –  $p < 0.01$ , \*\*\* –  $p < 0.001$ , ns – not significant

**Table 4.** Correlation analysis

	Vegetation period	Plant height, cm	Number of seeds per pod	Number of pods	1000 seed weight, g	Yield, t/ha
Vegetation period	1					
Plant height, cm	0.27	1				
Number of seeds per pod	-0.25	0.20	1			
Number of pods	-0.06	0.02	-0.14	1		
1000 seed weight, g	0.04	-0.19	0.11	0.07	1	
Yield, t/ha	0.17	-0.21	0.03	-0.09	0.61	1

correlations between the investigated traits. The knowledge on them would make easier the assessment of the tested genotypes. The correlations between the investigated indices are given in Table 4. The table shows that the strongest is the correlation of yield with 1000 seed weight ( $r=0.61$ ). This was the trait with the highest contribution to yield formation. The lowest was the correlation of yield with number of seeds per pod. Having in mind that this is one of the important traits related to productivity, it can be assumed that its effect on yield formation is indirect. The genotypes with higher stems have higher number of seeds per pod. Low and insignificant was the correlation of yield with the vegetation period. A negative correlation

was observed with plant height and number of pods. The shorter the vegetation period, the lower the number of pods per plant.

## Conclusion

Cultivar Anna has the optimal ratio between the traits number of pods, 1000 seed weight and yield. The cultivars with the shortest vegetation period that can be included as donors of earliness in winter oilseed rape breeding are Branka, Nevena, Kata and

Manitoba. One thousand seed weight had the highest effect on yield formation of winter oilseed rape under the conditions of Dobrudzha region.

Cultivars Kata, Ilia, Anna and Branka are suitable initial breeding material for breeding programs aimed at developing new synthetic varieties of winter oilseed rape possessing excellent economic properties.

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**Todorov N and Mitev J**, 1995. Effect of level of feeding during dry period, and body condition score on reproductive performance in dairy cows. IX<sup>th</sup> International Conference on Production Diseases in Farm Animals, Sept. 11 – 14, Berlin, Germany, p. 302 (Abstr.).

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