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RUBIN - NEW BULGARIAN RED PEPPER VARIETY FOR GRINDING

TODOROVA VELICHKA and PEVICHAROVA GALINA[1]

ABSTRACT: The new variety for grinding was bred at the Maritsa Vegetable Crops Research Institute, Plovdiv, Bulgaria. The plants form mid-high about 60 cm indeterminate bush with 20 - 21 cm long stem, 2 - 3 comparatively well-leafed branches and on average 16 red fruits.

Rubin differed by the pendant fruits and easier picking from the other two Bulgarian varieties Gorogled 6 and Buketen 50. The fruit length was on average 9 - 11 cm, the diameter - approximately 2 cm and the fruit weight is on average 14 g.

Rubin exceeds in dry matter yield Gorogled 6 and Buketen 50 by 54 % and 111 %, respectively. The dry matter content at the optimal harvesting term was about 25 % and the pigments were 170 - 220 ASTA. The new variety did not differ in total pigment content from Gorogled 6 and Buketen 50.

Key words: *paprika, Capsicum annuum L., morphological characters, yield, dry matter, pigments, variation*

INTRODUCTION: Red pepper for grinding is a raw material intended mainly for production of red pepper for powder and oleoresine containing harmless nature pigments. They are widely used in the culinary, canning industry and pharmacy.

In the Republic of Bulgaria this production started at the end of XIX century as a result of acquaintance with the Hungarian experience. Bulgaria is one of the European countries with long tradition in growing of varieties and has specialised in production of red pepper for grinding. Red pepper for powder produced from these varieties possesses high pigment content. Nowadays the main varieties in Bulgaria are Gorogled 6 and Buketen 50. They are bred at the "Maritsa" Vegetable Crops Research Institute, Plovdiv. High dry matter and pigment content are typical for these varieties. They are described with erect fruits and sun burns are frequently observed on them. As a result the produce quality is getting worse. A new variety Rubin was bred at the "Maritsa" Vegetable Crops Research Institute, Plovdiv in order to overcome this problem and for cultivar enrichment. It was bred by intervarietal hybridization, followed by a continuous individual selection with authors team: professor Yordan Todorov, scientific researcher Velichka Todorova, associate professor Galina Pevicharova and junior expert Lozina Georgieva. For two years this variety has been tested successfully for Distinction, Uniformity and Stability in the Executive Agency for Variety Testing, Field inspection and Seed quality control.

The purpose of the present study was to make comparison between the productive possibilities, morphological and quality characteristics of the new variety with those of the main varieties Gorogled 6 and Buketen 50.

Material and methods

Experimental work was performed during period 2003 - 2005 on alluvial meadow soils in the experimental field of the "Maritsa" Vegetable Crops Research Institute, Plovdiv. The new variety Rubin was tested in parallel with two main Bulgarian varieties - Gorogled 6 and Buketen 50.

Originalni naučni rad (Original scientific paper)

[1] Dr TODOROVA VELICHKA and dr PEVICHAROVA GALINA, Maritsa Vegetable Crops Research Institute, Plovdiv, Bulgaria

The trail was conducted by block method in four replications (4,2 m^2/replication). The plant were sown on furrowed surface by 70/15 cm scheme on the 21st of May 2003 and 15th of May 2004 and 2005. They were cultivated by technology for red pepper grinding (Todorov and Kostov, 1996). On the basis of the biometric measurings of randomized 20 plants and fruits from each genotype the following morphological characters were analysed: plant height (cm), stem height (cm), red fruit per plant (number), length (cm), fruit diameter (cm) and average weight (g). Fresh yield and dry matter yield (kg/dka), dry mater content (%) and total pigment content in ASTA units were also evaluated. Fruit harvests were on 22.10.2003, 11.10.2004 and 23.10.2005. The dry matter content was determined by weight method after drying at 50 - 70°C until constant weight (Manuelyan, 1966). The pigment content was determined by ASTA method 19, improved by Manuelyan (1979).

The data were processed by variation analysis, two-way analysis of variance (Lidanski, 1988) and Duncan sMultiple Range Test (1955).

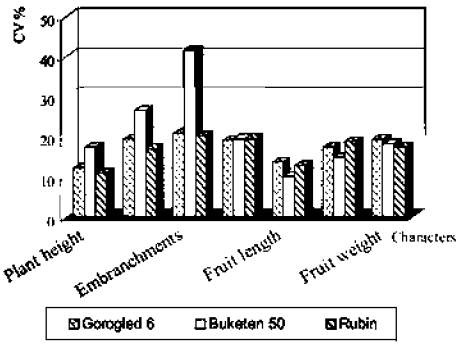
Results and discussion

The three studied varieties demonstrated significant differences by many characters of the plant and fruit morphology (Table 1). Variety Rubin differed with the highest plants 60.37 cm and the longest stem 20.67 cm. The yield depends on a great number of quantitative characters as the most significant of them are the fruit number per plant and fruit weight. The red fruit number per plant in Rubin was 16 while in Gorogled 6 and Buketen 50 the number was 12 and 9, respectively. The fruits of new variety are pendant, easier picking, with sharp apex, narrowed at the base and with covering calyx. The average weight of the fruits in the three studied varieties was 14 - 15 g. Rubin has longer fruits on average 10 cm, while in Gorogled 6 and Buketen 50 they were approximately 7 - 8 cm. The fruit diameter in red pepper for grinding varieties is better not to be very big because fruit decay during storage and drying overcomes. In this connection the fruits of variety Rubin possess smaller diameter - 1,64 cm.

Tab. 1. Comparative evaluation by morphological characters

Characters	Rubin		Gorogled 6		Buketen 50	
	$\bar{x}$	$S_{\bar{x}}$	$\bar{x}$	$S_{\bar{x}}$	$\bar{x}$	$S_{\bar{x}}$
Plant height (cm)	60.37	0.91	53.50	1.24	37.42	0.94
Stem height (cm)	20.67	0.47	15.63	0.47	17.55	0.71
Embranchments (number)	2.47	0.06	2.48	0.06	1.70	0.10
Red fruits per plant (number)	15.77	0.65	12.42	0.63	8.90	0.43
Fruit weight (g)	14.12	0.38	14.02	0.60	15.42	0.80
Fruit length (cm)	9.76	0.22	7.27	0.19	7.90	0.17
Fruit diameter (cm)	1.64	0.04	2.56	0.10	2.26	0.09

Fig. 1. Variation by morphological characters



On the basis of summarised data it was established that in most analysed characters, variety Rubin is described with variation that is close to that of Gorogled 6 (Fig. 1). The coefficient of variation is from 11.08 % for plant height to 20.08 % for number of embranchments.

The combination of genotypes morphological characters and the interaction with environment determined the phenotypic expression of the productive and quality characters. The effects of genotypes, environment and interaction between them have an important role in new variety creation and breeding programmes success. The investigations related to a study of the extend of pepper genotypes response to the continuously varying environmental conditions i.e. the interaction

between them, is scanty (Stoffella et al., 1995, Lohithaswa et al., 1999, Todorova, 2003).

The results of two-way analysis of variance showed that the genotypes determined predominantly the expression of fresh yield and dry matter yield (Table 2). The strength of their effect was 83.70% for the first character and 61.76 % for the second one.

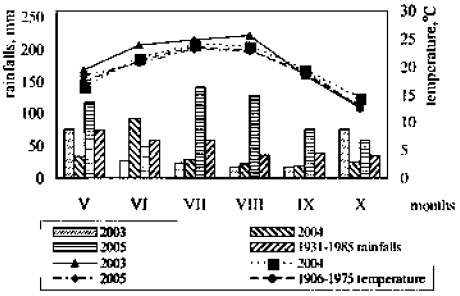
Tab. 2. Two-way analysis of variance of the productive and quality characters

Sources of variation	df	Means squares	F value	Influence, %
Yield				
Genotype (G)	2	2303578***	191.37	83.70
Environment (E)	2	271873.1***	22.58	9.88
Interaction (G x E)	4	7105.66	0.59	
Error	27	12037.51		
Dry matter yield				
Genotype (G)	2	155424.4***	89.36	61.76
Environment (E)	2	60801.37***	34.96	24.16
Interaction (G x E)	4	5964.82*	3.43	4.74
Error	27	1739.31		
Dry matter content				
Genotype (G)	2	34.91***	9.26	8.97
Environment (E)	2	216.36***	57.37	55.59
Interaction (G x E)	4	43.51***	11.54	22.36
Error	27	3.77		
Total pigment content				
Genotype (G)	2	2225.53*	3.92	6.74
Environment (E)	2	20200.44***	35.62	61.20
Interaction (G x E)	4	1463.86	2.58	
Error	27	567.13	3.92	

* p<5% ** p<1% *** p<0.1%

The experimental years, as a component of the environment, also demonstrated the proven differences. They are significant source of variation in the expression of analysed characters and their effect on dry matter content and total pigment content was predominant. Climatic conditions are the most probable reason for the differences in the years of study. During the investigation all other components of the environment are comparatively stable - plants were grown on soils with similar structure and composition and the applied technology was the same. The period July - September in 2003 and 2004 had smaller rainfall amount compared to the climatic norm (Figure 2). The effect of genotype x year interaction on of dry matter yield and dry matter content was significant as in the second character it reached up to 22.36 %. These results confirm the ones, established by Todorova (2003) that the three sources of variation have proven effect on dry matter yield.

Fig. 2. Climatic conditions of the experimental period



For whole investigated period Rubin had high and stable yields (Table 3). In dry matter yield new variety exceeded Gorogled 6 and Buketen 50 by 54 % and 111 %, respectively. There were not significant differences between studied cultivars in dry matter content (24 27%). In the first experimental year the total values of pigments were higher for the three varieties (Table 4). It was probably due

to the meteorological conditions - 2003 year was hotter then the others. New variety did not differ from Gorogled 6 and Buketen 50 in respect of the total pigments. The produced powder possesses intensive red colour, saturated aroma and typical pepper taste.

Tab. 3. Productivity and dry matter content of the varieties

Years	Varieties	Yield		Dry matter yield		Dry matter content	
		kg/dka	%	kg/dka	%	%	%
2003	Gorogled 6	1108.57 b	100	358.93 b	100	31.00 a	100
	Buketen 50	1020.24 b	92.03	228.57 c	63.68	21.50 b	69.35
	Rubin	1826.19 a	164.74	538.69 a	150.08	28.25 a	91.13
2004	Gorogled 6	872.62 b	100	255.36 b	100	29.23 a	100
	Buketen 50	713.10 c	81.72	220.24 b	86.25	30.94 a	105.84
	Rubin	1476.19 a	169.17	389.28 a	152.45	26.35 b	90.15
2005	Gorogled 6	953.57 b	100	208.33 b	100	21.89 n.s.	100
	Buketen 50	773.81 c	81.15	151.78 c	72.86	19.71 n.s.	90.04
	Rubin	1664.88 a	174.59	342.86 a	164.57	20.54 n.s.	93.85
Average	Gorogled 6	978.25 b	100	274.21 b	100	27.37 n.s.	100
	Buketen 50	835.71 c	85.43	200.20 c	73.01	24.05 n.s.	89.00
	Rubin	1655.75 a	169.26	423.61 a	154.49	25.05 n.s.	92.70

a, b, c, n.s. Duncan Multiple Range Test ($p<0.05$)

Tab. 4. Total pigment content (ASTA)

Variety	2003	2004	2005	Average
Gorogled 6	233 n.s.	187 n.s.	152 b	191 n.s.
Buketen 50	260 n.s.	172 n.s.	197 a	210 n.s.
Rubin	230 n.s.	183 n.s.	138 b	184 n.s.

a, b, c, n.s. Duncan Multiple Range Test ($p<0.05$)

Conclusion

The agrobiological evaluation of variety Rubin demonstrated that original gene plasma with valuable morphological characters was created.

In dry matter yield new variety exceeded Gorogled 6 and Buketen 50 by 54 % and 111 %, respectively.

The higher and stable productive potential in combination with high pigment content of Rubin are reliable warrant for its competitive power.

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SUMMARY

The new red pepper variety for grinding was bred at the Maritsa Vegetable Crops Research Institute, Plovdiv, Bulgaria. The agrobiological evaluation of variety Rubin demonstrates that original gene plasma with valuable morphological characters was created.

The plants form mid-high about 60 cm indeterminate bush with 20 - 21 cm long stem, 2-3 comparatively well-leafed embranchments and on average 16 red fruits per plant (Table 1). The fruits of new variety were with sharp apex, narrowed on the base and with covering calyx.

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