

Yield and some morphological properties of newly introduced Italian rice varieties grown in Macedonia

Dobre Andov, Danica Andreevska, Emilija Simeonovska

Institute of Agriculture Skopje, Department of Rice, Kočani, Republic of Macedonia

Summary

This paper presents the results of investigation of three newly introduced Italian rice varieties *Brio*, *Ellebi* and *Opale*, in comparison with two standards *Prima riska* and *R-76/6*. The field experiment (randomised block system) was conducted during 2010 and 2011 under the agro-ecological conditions of Kocani region. The paddy rice yield, stem height, panicle length and number of productive tillers per m² were analysed. In both years of investigation, the paddy rice yield of the standard variety *R-76/6* as well as the introduced *Brio*, *Ellebi* and *Opale* varieties was significantly lower compared with standard *Prima riska* variety. The stem height of the Italian rice varieties was significantly shorter in comparison with standard varieties, in both years of testing. In general, according to the results obtained in this investigation, the newly introduced varieties: *Brio*, *Ellebi* and *Opale* could be included in the rice breeding programmes, especially for breeding short stem rice varieties.

Key words: rice, varieties, paddy rice yield, stem, panicle, productive tillers

Introduction

In order to ensure higher yields and better grain quality in rice production, the use of varieties with high yielding and quality potential is an important factor, together with the technology applied. Rice production would be more successful if large assortment of rice varieties was available on the market, providing producers with the right choice regarding the productivity and quality. Lately, there has been increased interest among farmers in such varieties suited to intensive production system.

Carnahan et al. (1972) estimated 60% yield increase in USA rice production, due to introduction of new high yielding varieties. According to Russo and Callegarin (1997), the main factors limiting rice growing in Italy (low temperatures during sowing, flowering and fertilisation, diseases, weeds and red rice appearance)

might be overcome within rice breeding programmes as well as by introducing new better varieties.

The rice varieties in Macedonia are tall, with long stem, not being very suitable for intensive production systems, especially not responding to high doses of inorganic fertilisers. Medium-height rice varieties have recently contributed to higher productivity in the world rice production. This is due to a set of positive traits characterising medium-height rice genotypes, as well as increased tillering capacity, lodging resistance, positive response to nitrogen fertilisers, etc. Parallel to a breeding process, in order to enrich the assortment of rice varieties in the rice production in Macedonia, there is also need to introduce high-yielding and good quality varieties (Andov et al. 2003/2004, 2008/2009, 2010, Ilieva et al. 2005/2006). The introduced varieties require further investigations regarding their adaptability to local environmental factors (Ilieva et al. 2000, 2007, 2008). Thus, the aim of this research is to explore yield and certain morphological traits of three Italian rice varieties within the agro-ecological conditions in Kocani region (Eastern Macedonia).

Materials and methods

The research was conducted during 2010 and 2011 at the locality “Bosevica”, Department for Rice in Kočani (part of the Experimental Field of the Institute of Agriculture in Skopje).

Three newly introduced Italian rice varieties (*Brio*, *Ellebi* and *Opale*) were investigated together with standards *prima riska* (modern Macedonian variety) and *P-76/6* (domesticated Italian variety, widely spread in production in Macedonia), in order to compare their results. Field experiments were set up upon the method of randomized block system, in three repetitions. Standard technology for rice growing was applied. The statistical analysis of the results were performed by using ANOVA and tested by LSD test.

Soil and climatic conditions

Field trials were set up on alluvium soil type, carbonate-free at the examined depths (Table 1.). The soil texture was fine sandy loam. The pH of the soil solution was acid; the content of humus was low, the content of total nitrogen was strongly correlated to the content of humus. The soil was medium supplied with easy available potassium and phosphorus.

In general, climatic conditions during both years of investigation (Table 2) provided normal development of rice plants. During the rice vegetation period (from April to October), the average monthly temperature in 2010/2011 was 19.9°C, average maximum temperature was 25.4°C, while average minimum temperature was 12.8°C. The average monthly temperature during 2010 (19.7°C) was lower as compared with 2011 (20.1°C).

Tab.1. Some chemical properties of the soil from the locality “Bosevica”
Neka hemijska svojstva zemljišta sa lokaliteta “Bosevica”

Depth (cm)	CaCO ₃ (%)	Humus (%)	Total (%)	pH		Easy available (mg/100 g soil)	
				H ₂ O	nKCl	P ₂ O ₅	K ₂ O
0-20	-	2.16	0.09	5.79	4.92	17.85	14.02
20-40	-	1.50	0.06	5.88	5.07	11.57	12.04

The sum of monthly rainfalls (average value for both years of investigation) was 277.9 mm.

Tab. 2. Average monthly temperatures and monthly sums of rainfalls during the rice vegetation period in Kočani
Prosječne mjesečne temperature i mjesečne sume padavina tokom vegetacionog perioda riže u regionu Kočani

Year	Months							Average	
	IV	V	VI	VII	VIII	IX	X	per year	per vegetation
Average monthly temperature (C°)									
2010	13.7	18.5	22.1	24.9	26.9	19.3	12.2	14.3	19.7
2011	13.1	17.2	22.1	26.2	26.3	23.1	12.6	13.9	20.1
<i>Average</i>	<i>13.4</i>	<i>17.9</i>	<i>22.1</i>	<i>25.6</i>	<i>26.6</i>	<i>21.2</i>	<i>12.4</i>	<i>14.1</i>	<i>19.9</i>
Average monthly maximum temperature (C°)									
2010	19.0	23.9	26.9	29.9	32.7	25.6	16.8	19.3	25.0
2011	18.4	22.2	27.5	31.9	32.2	29.7	18.6	19.2	25.8
<i>Average</i>	<i>18.7</i>	<i>23.1</i>	<i>27.2</i>	<i>30.9</i>	<i>32.5</i>	<i>27.7</i>	<i>17.7</i>	<i>19.3</i>	<i>25.4</i>
Average monthly minimum temperature (C°)									
2010	8.3	11.8	15.2	17.0	18.7	12.4	8.2	8.9	13.1
2011	6.7	11.2	14.4	16.9	16.8	14.8	5.8	7.3	12.4
<i>Average</i>	<i>7.5</i>	<i>11.5</i>	<i>14.8</i>	<i>17.0</i>	<i>17.8</i>	<i>13.6</i>	<i>7.0</i>	<i>8.1</i>	<i>12.8</i>
Monthly sum of rainfalls (mm)									
2010	63.3	20.5	86.0	19.5	6.5	33.0	119.5	623.3	348.3
2011	15.5	42.5	44.0	23.5	16.5	30.0	35.5	296.0	207.5
<i>Average</i>	<i>39.4</i>	<i>31.5</i>	<i>65.0</i>	<i>21.5</i>	<i>11.5</i>	<i>31.5</i>	<i>77.5</i>	<i>459.7</i>	<i>277.9</i>

Results and discussion

Paddy rice yield

The obtained results for paddy rice (rough rice) yield are presented in Table 3. The highest average yield was reached by the standard variety *Prima riska* (9465 kg ha⁻¹). In both years of investigation, the yields of this standard variety were

significantly higher (for both levels of probability) compared with other varieties (the standard *R-76/6* as well as the newly introduced *Brio*, *Ellebi* and *Opale*). The *Brio* variety was the best yielding among introduced varieties and slightly, but not significantly better yielding than the standard *R-78/6*. The lowest average yield (7635 kg ha⁻¹) was found in *Ellebi*. In some former investigations (Ilieva et al. 2007), ten other introduced Italian varieties in Kocani region were examined, but none showed superiority over the standard ones regarding the yield.

Tab. 3. Paddy rice yield (kg ha⁻¹)
Prinos sirovog pirinča (kg ha⁻¹)

Varieties	Yield per year (kg ha ⁻¹)		Average yield (kg ha ⁻¹)	Index from	
	2010	2011		<i>Prima riska</i>	<i>R-76/6</i>
<i>Prima riska(st.)</i>	9960	8970	9465.00	0	+11,29
<i>R-76/6 (st.)</i>	8950	8060	8505.00	-10.14	0
<i>Brio</i>	9055	8173	8614.00	-8.99	+1.28
<i>Ellebi</i>	8070	7200	7635.00	-19.33	-10.23
<i>Opale</i>	8943	8050	8496.50	-10.23	-0.10
Average	8995.60	8090.60	8543.10	-	-
<i>LSD</i> _{0,05}	221.50	363.69			
<i>LSD</i> _{0,01}	322.62	529.73			

Tab. 4. Stem height (cm)
Visina stabla (cm)

Varieties	Year	X	S	Sx	CV (%)	min	max
<i>Prima riska(st.)</i>	2010	90.33	4.66	0.85	5.16	82.00	103.00
	2011	73.70	4.37	0.80	5.93	64.00	81.00
	average	82.02	4.52	0.83	5.55	73.00	92.00
<i>R-76/6 (st.)</i>	2010	86.20	4.21	0.77	4.89	53.00	92.00
	2011	70.30	5.06	0.92	7.20	43.00	78.00
	average	78.25	4.64	0.85	6.05	48.00	85.00
<i>Brio</i>	2010	61.07	3.86	0.70	6.32	53.00	70.00
	2011	50.77	3.51	0.64	6.91	43.00	60.00
	average	55.92	3.69	0.67	6.62	48.00	65.00
<i>Ellebi</i>	2010	62.60	3.10	0.57	4.96	57.00	69.00
	2011	53.63	2.76	0.50	5.15	47.00	59.00
	average	58.12	2.93	0.54	5.06	52.00	64.00
<i>Opale</i>	2010	65.67	4.05	0.74	6.16	55.00	74.00
	2011	53.33	4.94	0.90	9.26	46.00	65.00
	average	59.50	4.50	0.82	7.71	50.50	69.50
<i>year</i>	2010	2011					
<i>LSD</i> _{0,05}	4.06	3.16					
<i>LSD</i> _{0,01}	5.91	4.60					

Stem height

Regarding the stem height, in general, the newly introduced varieties were significantly shorter than standards in both years of investigation (Table 4.). The average stem height of *Brio* (55.92cm) had the lowest value, near the values of *Ellebi* (58.12 cm) and *Opale* (59.50 cm). The standard Prima riska variety was the tallest one (82.2 cm), but close to the other standard P-76/6 (78.25 cm).

Panicle length

The average panicle length values of the introduced *Brio* (12.75cm), *Ellebi* (16.64cm), *Opale* (13.78cm) varieties and the standard variety R-76/6 (15.30 cm) were significantly lower compared with the panicle length of *Prima riska* (18.65cm). Among the introduced varieties, *Ellebi* was characterised by the longest panicle, significantly longer than the standard R-76/6 (Table 5.).

Tab. 5. Panicle length (cm)
Dužina metlice (cm)

Varieties	Year	X	S	Sx	CV %	min	max
<i>Prima riska(st.)</i>	2010	19.23	1.99	0.36	10.37	15.00	23.00
	2011	18.07	1.39	0.25	7.68	15.00	21.00
	average	18.65	1.69	0.31	9.03	15.00	22.00
<i>R-76/6 (st.)</i>	2010	16.35	1.42	0.26	8.71	11.00	19.00
	2011	14.25	0.85	0.16	5.97	10.00	16.00
	average	15.30	1.14	0.21	7.34	10.50	17.50
<i>Brio</i>	2010	12.57	1.22	0.22	9.73	11.00	15.00
	2011	12.93	1.53	0.28	11.83	10.00	15.00
	average	12.75	1.38	0.25	10.78	10.50	15.00
<i>Ellebi</i>	2010	16.50	1.57	0.29	9.52	13.00	20.00
	2011	16.77	1.59	0.29	9.49	13.00	21.00
	average	16.64	1.58	0.29	9.51	13.00	20.50
<i>Opale</i>	2010	14.03	1.27	0.23	9.07	12.00	16.00
	2011	13.53	1.46	0.27	10.76	11.00	17.00
	average	13.78	1.37	0.25	9.92	11.50	16.50
<i>year</i>	<i>2010</i>	<i>2011</i>					
<i>LSD</i> _{0,05}	<i>0.67</i>	<i>0.73</i>					
<i>LSD</i> _{0,01}	<i>0.97</i>	<i>1.07</i>					

The number of productive tillers per m²

The highest average number of productive tillers per m² (Table 6) was found in *Ellebi* (454.34) while the lowest was in *R-76/6* (291.83). In 2010 and 2011, the tiller number per m² of *Ellebi* was significantly higher compared with other varieties.

Tab. 6. Number of productive tillers per m²
Broj produktivnih bokora po m²

Varieties	Productive tillers per m ² Year		Average productive tillers per m ²	Index from	
	2010	2011		<i>Prima riska</i>	<i>R-76/6</i>
<i>Prima riska</i> (st.)	371.33	330.00	350.67	0	+20.16
<i>R-76/6</i> (st.)	306.33	277.33	291.83	-16.78	0
<i>Brio</i>	450.00	406.00	428.00	+22.05	+46.66
<i>Ellebi</i>	478.67	430.00	454.34	+29.56	+55.69
<i>Opale</i>	341.67	302.67	322.17	-8.13	+10.40
Average	389.60	349.20	369.40	-	-
<i>LSD</i> _{0.05}	40.87	22.01			
<i>LSD</i> _{0.01}	59.53	32.05			

Conclusion

The newly introduced rice varieties were, in general, lower yielding compared with standard varieties, and significantly lower than the standard *Prima riska*.

The Italian *Ellebi* variety achieved the significantly biggest number of productive tillers per m² in comparison with other varieties.

Since the stem of the investigated Italian varieties was shorter than the standard ones, *Brio*, *Ellebi* and *Opale* will be included in the rice breeding programme for breeding medium-tall rice varieties. Also, these new varieties are going to be tested within intensive production systems under the environmental conditions of Kocani rice growing region.

References

1. *Andov D., Ilieva Verica, Andreevska Danica*, (2003/2004): Inheritance of the stem height of hybrids obtained by top-cross in rice (*Oryza sativa* L.). Yearbook of the Institute of Agriculture –Skopje, vol.XXII/XXIII:25-32, Skopje.
2. *Andov D., Andreevska Danica, Ilieva Verica* (2008/2009): Production and technological traits on some of the newly created hybrid genotypes of rice. Anniversary yearbook of the Institute of Agriculture –Skopje, vol.XXVI/XXVII:133-140, Skopje.

3. *Andov D., Andreevska Danica, Ilieva Verica, Jankuloski Lj.* (2010): Some morphological traits on some of the newly created genotypes of rice. Yearbook of the Faculty of Agricultural sciences and food- Skopje, vol.55:31-38, Skopje.
4. *Andreevska Danica, Ilieva Verica, Andov D., Zasheva Tanja* 2005/2006: Effect of foliar Split application with Kristalon™ special upon yield and dressing white rice. Yearbook of the Institute of Agriculture –Skopje, vol. XXIV/XXV:61-73, Skopje.
5. *Carnahan, H.L., Erickson, J.R., Tseng, S.T., Rutger, J.R.*, (1972): Outlook for hibrid rice in the U.S.A. In Rice breeding, pp.603-607. International Rice Research Institute, P.O. Box 933, Manila, Philipines.
6. *Ilieva Verica, Andov D., Andreevska Danica, Tomeva Elizabeta* (2000):The production potential of some introduced rice varieties in the agro-ecological conditions of Macedonia. Proceeding of papers XXV Meeting “Faculty with Farmers” 2000, vol. 8:17-26.
7. *Ilieva Verica, Andreevska Danica, Andov D., Najcevska Cvetanka:* Some more significant characteristics of the new created rice varieties Prima riska and Montesa (*Oryza sativa* L.). Yearbook of the Institute of Agriculture – Skopje, vol. XXIV/XXV:51-59, Skopje
8. *Ilieva Verica, Andreevska Danica, Andov D., Tanja Zasheva , Natalija Markova* (2007): Comparative examination of some productive-technological characteristics of introduced and standard varieties of rice (*Oryza sativa* L.). Yearbook of Faculty of Agriculture- Stip, vol. 7:35-47.
9. *Ilieva Verica, Andreevska Danica, Natalija Markova* (2008): Growth and productive-technological characteristics of introduced rice genotypes (*Oryza sativa* L.) in agro-ecological conditions of the Kočani region. Yearbook of Faculty of Agriculture- Stip, vol. 8:27-36.
10. *Russo S., Callegarin A.M.* (1997): Rice production and research potential in Italy. CIHEAM-IAMM, (réseau FAO-CIHEAM), vol.24 N°2, 139-146.

Prinos i neka morfološka svojstva novointroductoryiranih italijanskih sorti pirinča u uslovima gajenja u Makedoniji

Dobre Andov, Danica Andreevska, Emilija Simeonovska

Zemjodelski institut Skopje, Odeljenje za pirinač, Kočani, Republika Makedonija

Sažetak

U radu su prezentirani rezultati ispitivanja tri novointroductoryirane italijanske sorte pirinča: *Brio*, *Ellebi* i *Opale*, u poređenju sa dve standardne sorte *Prima riska* i *R-76/6*. Poljski eksperiment (randomizirani blok sistem) je bio sproveden tokom 2010. i 2011. u agroekološkim uslovima Kočanskog regiona. Analiziran je prinos sirovog pirinča (pirinčane arpe), zatim visina stabla, dužina metlice i broj produktivnih bokora na m². U toku dve godine ispitivanja, prinos surovog pirinča kod standardne sorte *R-76/6* i kod svih intoduciranih sorti *Brio*, *Ellebi* i *Opale* je bio signifikantno niži od prinosa standardne sorte *Prima riska*. Visina stabla italijanskih intoduciranih sorti je bila statistički značajno manja od visine standardnih sorti i to u dvegodišnjem trajanju testiranja. Generalno, u saglasnosti sa dobivenim rezultatima, novointroductoryirane sorte pirinča: *Brio*, *Ellebi* i *Opale* će biti uvedene u oplemenjivačkim programima pirinča, posebno sa ciljem dobijanja novih sorti pirinča sa kraćim stablom.

Ključne reči: pirinač, prinos sirovog pirinča, stablo, metlica, produktivni bokori