EXAMINATION ON YIELD AND SOME YIELD ASSOCIATED PARAMETERS IN DIFFERENT RICE GENOTYPES

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INTRODUCTION

Rice is one of the most important cereals cultivated worldwide, constituting the basic food for large number of human beings, sustaining 2/3 of the world population (Zhout et al., 2002). The world's farmers have to produce about 60 % more rice than at present to meet up the food demands of the expected world population by 2025 (Fageria, 2007).

In the Republic of Macedonia, rice production has an important role in economy, because it provides sufficient rice for domestic needs and a significant part of rice production is export-oriented. In recent years, the main varieties in rice production in Macedonia are the Italian varieties *San Andrea* and *R-76/6*, which account for more than 90 % of the total production. The remaining part is represented by newly introduced varieties from Italy (*Opale*, *Onice*), Turkey (*Halilbey*) and selected domestic varieties (*Prima riska* and *Biser-2*).

Among the production factors, selection of variety plays an important role in the productivity of rice in any location (Alam et al., 2009). In general, the productivity of this crop can be influenced by environmental conditions such as solar radiation, temperature and water availability during growth and development (Fageria, 2007). Grain yield depends on genotype, environment and management practices and their interaction with each other (Messina et al., 2009). Under the same management conditions, the variation of grain yield is principally explained by the effects of genotype and environment (Dingkuhn et al., 2006). Interaction between these two explanatory variables gives insight for identifying genotype suitable for specific environments (Suchit et al., 2011). The low heritability of grain yield characters made selection for high yielding varieties possible usually using various components traits associated with yield (Atlin, 2003). Rice yield depends on a number of properties: the number of plants (the number of panicle per unit area), plant height, panicle length, the number of grains per panicle, the weight of the grains in panicle and 1000 grain weight. The significance of each of these properties depends of the climatic conditions and the water regime during the vegetation, as well as from the applied agro-technical measures.

Today, rice selection is mainly aimed at increasing the grain yield potential, improving the chemical and technological properties, good adaptability and shorter vegetation.

The aim of this paper is to examine and evaluate the grain yield and some important yield associated properties, in rice varieties that dominate in rice production in Macedonia, in varieties that are recently recognized and in varieties and genotypes that according to the preliminary results represent a perspective for rice production in Republic of Macedonia.

MATERIAL AND METHODS

Plant material and experimental design

During the period 2014 – 2015, nine rice varieties were evaluated in agro-ecological conditions in the Republic of Macedonia. Five of them were new introduced varieties from Italy (*Ronaldo*, *Opale*, *Onice*, *Gloria* and *Pato*), one variety is domestic selection (*Prima riska*), two were domestic prospective lines and the variety *San Andrea*, also Italian variety is used for a long period as a main variety in commercial rice production. The experiment was performed on alluvial soil type in the region of Kocani. Each test area was 5 m^2 set in three repetitions in randomized block method.

Data collection and statistical analysis

Ten randomly selected plants from each repetition have been analyzed for the plant height and panicle length. The number of plants per m^2 was determined by counting the plants from m^2 of each repetition. 1000 grain weight, has been determined to measure 1000 grains of each repetition. Grain yield obtained from the 5 m^2 was calculated in kg/ha.

The results were calculated by analysis of variance (ANOVA) with statistical package SPSS. The data were tested by least significant difference (LSD) using Statistical analysis system software JMP.

Fig. 1. Experimental trials in Kocani region

RESULTS AND DISSCUSION

The results of mean values for grain yield and some yield associated traits are shown in Table 1. Significant differences were found between the tested varieties for all the analyzed properties.

Yield superiority was shown by *Ronaldo* variety (7 082 kg/ha) and *Prima riska* (7 057 kg/ha) but the lowest grain yield was obtained from *Gloria* variety (4 766 kg/ha). The paddy yield obtained from genotypes *78/12-3-1* and *79/22-2* statistically does not differ significantly from the yield received from *Ronaldo* and *Prima riska*.

San Andrea had the largest number of plants per m^2 (538) , followed by genotype *78/12-3-1* (502).

Significant impact on grain yield has panicle length. The variety with longer panicle has bigger number of grains. From this study *Prima riska* and *78/12-3-1* have the longest panicle (19 cm) while the shortest was recorder by *Onice* variety (12 cm). *Prima riska* variety also was the highest (92 cm) from all tested varieties.

1000 grain weight varies from 32.21 g in variety *Ronaldo* to 42.39 g in *Pato*.

Significant differences between the varieties show the presence of genetic variability among them and give a great opportunity to improve the yield. The obtained results for the tested properties show that all analyzed genotypes have great potential for yield.

Table 1. Mean values for yield and some yield related traits examined in rice varieties (2014-2015)

Variety	Plant height (cm)	Panicle length (cm)	1000 grain weight (g)	Number of plants per m^2	Grain yield (kg/ha)
Prima riska	92a	19a	38,82b	449bc	7 057a
78/12-3-1	88b	19a	35,09c	502ab	6 753a
79/22-2	86b	17b	41,21a	468bc	6 540ab
Ronaldo	54b	16cd	32,21d	446bc	7 082a
Onice	82c	12g	32,58d	464bc	5 885bc
Opale	62d	14f	32,44d	432c	5 768c
Gloria	57e	15de	41,12a	443bc	4 766d
Pato	63d	14ef	42,39a	438bc	5 234cd
San Andrea	88b	16bc	39,49b	538a	5 815c
Mean	**75**	**16,0**	**37,26**	**465**	**6 100**
Minimum	**43**	**9**	**28,34**	**202**	**1 972**
Maximum	**107**	**25**	**48,50**	**720**	**11 400**
LSD $_{0.05}$	**3,60**	**1,09**	**1,39**	**68,92**	**659,40**
CV (%)	**2,81**	**4,05**	**2,18**	**8,65**	**6,30**

The results from ANOVA obtained from the research are given in Table 2.

Grain yield was significantly affected by the year, while the influence of the variety and the interaction of variety and year have not shown significance. The impact of the year on yield formation was 87,95 % while from the variety 7,61 %. The least influence on paddy yield has the interaction between variety and year (4,44 %).

The vegetation period in both years of study differed in ration of air temperatures and amount and schedule of precipitations. Deviations in temperatures were more pronounced during the blooming and spraying the grains. Negative impact on the yield in the second year of the trials have the precipitations during grain spraying and ripening. Additionally, the worst negative impact on the research has unfavorable water regime during and after the treatment of the herbicide in the second testing year. According to this, the destruction of the weeds was not timely and fully effective.

Table 2. Influence of variety and year and their interaction on grain yield

Factor	Sum of Squares	df	Mean Square	F	η
Total	424,949	53			
Factor (A) - variety	31,600	8	3,950	14,512	7,61
Factor (B) - year	365,134	1	365,134	1341,501	**87,95***
A x B	18,417	8	2,302	8,458	4,44
Error	9,799	36	0,272		

CONCLUSION

The results from the study had proved significant differences between tested rice genotypes for all analyzed traits.

Genotypes *Ronaldo*, *Prima riska* and *78/12-3-1* have shown the highest yield potential. *Prima riska* is already recognized domestic variety, present in rice production but with better agro technology measurements can be much better ranked in rice assortment.

Pato and *79/22-2* with additional researches may also be more popular among manufactures. For a longer time in rice production, *San Andrea* variety, has the dominant role and this study shows that it is still justifies the "backbone" of rice production.

All genotypes under favorable external conditions and application of more intensive modern agro-technology, can further exploit their potential.

All genotypes can also be used as a parents in breeding programs for creation of new rice genotypes, in order to get the new high yielding varieties.

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