

## **SOME AGRONOMIC AND QUALITY CHARACTERISTICS OF NEW RICE VARIETIES IN THE AEGEAN REGION OF TURKEY**

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### **ABSTRACT**

In this study, agronomic and quality performances of new rice genotypes were investigated in 2003 and 2004. 12 rice genotypes were used as genetic material. The experiment was conducted in a Randomized Complete Blocks Design with 3 replications under continuous flood irrigation. Based on the means of two years, the highest yield (732 kg/da) and the highest spikelet number per plant (562 spikelet /per plant) were obtained from Osmançık-97. The highest productive tiller number per plant was obtained from Demir (9,6 tiller/ plant), the highest 1.000-grain weight was obtained from Baldo (38 g) followed by Kırıl (36.5 g), Kargı (36.2 g) and Negiş (34.5 g) respectively. The shortest plant height was obtained from Toag92 (63 cm). The lowest of days to flowering time was obtained from Toag92 (63 days). The longest panicle was obtained from Troyhikary/Arborio//Nucleoryza and Toyhikary/Solnecnyi genotypes (16 cm) whereas the highest grain length was obtained from Baldo, Demir, Kargı and Gönen (6.9 mm). Also the highest grain width was obtained from Baldo, Negiş and Gönen (2.9 mm). The highest amylose content was obtained from Demir (22.2 %) and the highest crude protein content was obtained from Toag92 (12.4 %).

**Keywords:** Rice, yield, quality, variety, genotype

### **INTRODUCTION**

Rice production area has ranged from 40.000 ha to 100.000 ha, and annually total milled rice production has ranged between 150.000 and 450.000 tons depending on water availability and government policies during the last 50 years (Tuik, 2010). This production is not sufficient for domestic consumption, so the imported milled rice has reached to 337.000 tons in 2010, which was more than the domestic milled rice production in that year (Tuik, 2010).

Before 1960's, local genotypes were mostly grown in Turkey. Some Italian genotypes were introduced later and Baldo, Rocca, Ribe are still grown although their production areas are getting smaller after releasing new varieties during the last decade (Beşer, 2000).

Toag92 and Osmançık-97 were released respectively in 1992 and 1997. Growing area of Osmançık-97 has been increasing very sharply in the all rice growing regions of Turkey. It is also very popular variety in the rice industry and market. Six new varieties (Demir, Kargı, Kırıl, Negiş, Yavuz and Gönen) were registered by the Trakya Agricultural Research Institute for high yield in 2000 (Beşer, 2000, Sürek, 2011).

All varieties released in the last decade are semi dwarf, resistant to lodging and suitable for combine harvesting. Yield and quality potentials of the varieties are also determined as higher than the traditional rice varieties, so the farmers can get better quality and higher paddy yields.

Aegean region, with a typical Mediterranean climate on the west coast of Anatolia, shows distinctive climatic patterns different from any other area of the country. In this region, the lowermost and the uppermost limits of temperature are 15<sup>0</sup>C-35<sup>0</sup>C respectively from beginning of April to the first week of September. Average rainfall is 500-600 mm. Hot and dry days of summer season give us 140 days from sowing to flowering time for rice cultivation in the Aegean region.

This research was carried out to investigate some agronomic and quality characteristics of new developed varieties released by the Trakya Agricultural Research Institute and the Ege University in the Aegean Region.

### **MATERIALS AND METHODS**

This study was conducted at the experimental farm of the Department of Field Crops, Faculty of Agriculture of the Ege University, at Menemen/ Izmir during 2003-2004 growing season.

Twelve rice varieties given in Table 1 were used as genetic material. Some meteorological data of experimental area for 2003 and 2004 are given in Table 2. Some physical and chemical properties of soil samples of the research fields are also given in Table 3.

The experiment arranged in a Randomized Complete Blocks Design with 3 replications under continuous flood irrigation. In the study, 450 pregerminated seed/m<sup>2</sup> were broadcasted in standing water (Kün, 1985; Sürek, 2002). Plot size was 6 m x 3 m = 18 m<sup>2</sup>. During soil preparation

**Table 1.** The list of experimental material.

Varieties/Genotypes	Some characters
Demir (Plovdiv/Lido)	*earlier, resistant to lodging, suitable machine harvest
Yavuz (Rocca/1979-70-1)	*
Osmancık-97 (Rocca/Europa)	* resistant to lodging, suitable machine harvest, resistant to Fusarium moniliforme
Kıral (Gritna/Ballila)	* earlier, resistant to lodging, suitable machine harvest, resistant to Fusarium moniliforme
Negiş (Violenano/Seguial)	*
Gönen (Bonni/Shieni)	*
Kargı (Baldo/Ballila)	*
Baldo/Sarıkılçık//Krasnodarsky-424	**
Toyhikary/Arborio//Nucleoryza	**
Toyhikary/Solnecnyj	**
Toag92 (Nucleoryza/Labela)	***earlier, low sterility, medium height, resistant to lodging and leaf blast
Baldo (control)	commercial variety big kernel size, high quality

\*It was released at Trakya Agricultural Research Institute-Edirne, Turkey

\*\*It was developed by Ege University, Agricultural Faculty-Izmir, Turkey

\*\*\* It was released by Ege University, Agricultural Faculty-Izmir, Turkey

**Table 2.** Meteorological data of Menemen/Izmir location during the rice growing season of the years 2003 and 2004.

Menemen- 2003	May	Jun	Jul.	Ağu.	Sep.	Oct.
Mean of maximum temperature (°C)	28.9	34.0	35.6	35.9	29.5	26.3
Mean of minimum temperature (°C)	13.5	19.6	20.3	21.4	16.3	13.7
Mean temperature (°C)	21.3	27.2	28.6	28.5	22.5	19.7
Number of rainy days	5	1	0	0	0	8
Rain amount (mm)	8.5	0.8	0.0	0.0	0.0	68.5
Mean of relative humidity	52.5	37.5	37.3	38.2	46.9	51.8
Mean of sun-shine duration (hour)	9.0	11.8	12.3	11.1	9.2	6.8
Menemen-2004	May	Jun	Jul.	Ağu.	Sep.	Oct.
Mean of maximum temperature (°C)	27.0	32.9	35.6	34.6	30.8	27.4
Mean of minimum temperature (°C)	12.7	18.3	21.4	20.8	17.4	13.5
Mean temperature (°C)	20.3	26.5	29.0	27.8	23.8	19.8
Number of rainy days	5	2	1	0	0	3
Rain amount (mm)	10.7	1.6	1.8	0.0	0.0	1.6
Mean of relative humidity	48.4	45.1	37.3	45.6	49.0	54.2
Mean of sun-shine duration (hour)	8.8	10.4	12.0	10.3	9.1	7.5

**Table 3.** Selected physical and chemical properties of soil samples of the research fields at Menemen/Izmir

Soil properties	2003	2004
Ph	7.0	6.9
Total salt (%)	0.15	0.18
Lime (%)	9.20	8.00
Texture	Silty loam	Silty loam
Organic matter (%)	1.40	1.65
Total N (%)	0.06	0.04
P (ppm)	3.70	3.90
K (ppm)	290.00	310.00

N, P, and K fertilizers were applied and incorporated in the soil. Total 60 kg/ha mineral nitrogen in  $\text{NH}_4^+$  form was given as ammonium sulfate at during sowing, before tillering and one week before flowering stage (Sims et al., 1968; V. Uexkull, 1975; Kün, 1985). Eighty kg/ha ( $\text{P}_2\text{O}_5$ ) as triple super phosphate and 40 kg/ha ( $\text{K}_2\text{O}$ ) as potassium sulfate were given respectively (Sims et al., 1968; V. Uexkull, 1975; Kün, 1985).

Sowing was done on the first week of Jun after barley, in both years. Weed control was done by using herbicides containing propanil. Irrigation was stopped in the sub-plots 20 days before harvesting. Plots were harvested by hand.

Some important phenological, morphological, agronomical and quality characteristics were observed and recorded according to IRRI (1998).

Results were analyzed by using the standard ANOVA techniques of a computer program. The means were compared by using the LSD test described by Steel et al., (1979).

## RESULTS AND DISCUSSION

The results of the ANOVA for some the agronomic and morphologic characteristics studied are given in Table 4. As can be seen in Table 4. there are significant differences between traits.

Based on two years means, the highest yield was obtained from Osmancık-97 (732 kg/da) followed by

**Table 4.** The F values for some agronomic characteristics of varieties (2003 and 2004).

Variance sources	Paddy yield Kg/da	Spikelets main panicle <sup>-1</sup> (no.)	Produc. tillers plant <sup>-1</sup> (no.)	1000 grain weight (g)	Plant height (cm)	Days to flower. time (day)	Main panicle length (cm)
Rep. Variety	ns	3.450*	5.120*	ns	ns	ns	ns
Year	4.935*	66.068*	7.620*	55.666*	123.245*	32.769*	6.188*
Year x variety	ns	ns	ns	ns	ns	ns	ns

\*: Significant at 0.05 level; ns: non significant

Demir (728 kg/da) and Gönen (666 kg/da), respectively (Table 5). The highest spikelet number per plant was obtained from Osmancık-97 (562 spikelets per plant) followed by Yavuz (515 spikelet per plant). The highest value of productive tiller per plant was obtained from Demir (9.6 productive tillers per plant). The highest 1000 grain weight was obtained from Baldo (38.0 g), it was followed by the Gönen (36.6 g), Kıral (36.5 g) and Kargı (36.2 g) respectively.

The market price of Baldo is higher than that of the other varieties due to the consumer's preference. Thus, the production of the Baldo is more important than other varieties. Gönen, Kıral, and Kargı varieties will be preferred by the farmers in the near future due to their high yield and 1000 grain weights (Table 5).

**Table 5.** Comparison of some agronomic characteristics of varieties/genotypes in Menemen, Izmir/Turkey, 2003 and 2004.

Varieties/ Genotypes	Paddy yield Kg/da	Spikelets main panicle <sup>-1</sup> (no.)	Productive tillers plant <sup>-1</sup> (no.)	1.000 grain weight (g)	Plant height (cm)	Days to flowering time (day) <sup>1</sup>	Main Panicle length (cm)
Bal/Sarıklı // Kras.-424	528.0 fg	445.0 d	7.4 f	29.0 f	79.6 de	83.0 abc	12.0 cd
Yavuz	652.0 bc	515.0 b	7.4 f	30.3 ef	78.5 e	83.0 abc	11.0 d
Osmancık-97	732.0 a	562.0 a	7.2 f	33.2 bc	82.3 d	85.0 b	13.0 bcd
Kıral	560.0 def	395.0 e	9.0 b	36.5 b	78.3 e	80.0 bc	12.0 cd
Negiş	532.0 efg	372.0 ef	7.4 f	34.5 c	90.0 c	83.0 abc	13.0 bcd
Demir	728.0 a	475.0 c	9.6 a	31.4 de	70.0 f	91.0 a	15.0 ab
Kargı	588.0 de	397.0 e	8.1 de	36.2 b	101.1 a	83.0 abc	13.0 bcd
Gönen	666.0 b	472.0 cd	7.9 e	36.6 ab	96.6 b	83.0 abc	15.0 ab
Toy./Arb. //Nuc.	616.0 bcd	467.0 cd	7.4 f	32.4 cd	79.6 de	84.0 ab	16.0 a
Toy./ Sol.	576.0 def	467.0 cd	8.7 bc	30.1 ef	70.0 f	83.0 abc	16.0 a
Toag92	496.0 g	355.0 f	8.4 cd	33.2 bc	63.0 g	63.0 d	14.0 abc
Baldo	596.0 cd	387.0 e	8.4 cd	38.0 a	89.1 c	79.0 c	15.0 ab
<b>Approx.</b>	<b>605.0</b>	<b>442.4</b>	<b>8.0</b>	<b>33.4</b>	<b>81.3</b>	<b>82.0</b>	<b>14.0</b>
Lsd (0.01)	58.685	29.153	0.483	1.500	3.755	4.351	2.533

<sup>1</sup>: Days of 50% flowering

The shortest plant height was obtained from Toag92 (63 cm) followed by Baldo/Sarıklıçık//Kras.-424 and Toyhikary/Solnecnyj. Short plant height is very important for combine harvesting and for logging resistant (Table 5).

The lowest days to flowering time was obtained from Toag92 as 63 days. Toag92 matured 2 weeks earlier than Baldo. It could be said that Toag92 could be the more proper variety for the second crop conditions than the other varieties.

Toyhikary/Arborio//Nucleoryza and Baldo/Sarıklıçık//Krnodarsky-424 had the longest main panicle length (16 cm). They were followed by Baldo, Gönen and Demir varieties (Table 5).

As can be seen in Table 5, Osmancık 97 and Demir showed the highest yield performance under the Menemen ecological conditions. According to results of many years

of research conducted in the Trakya Agricultural Research Institute the yield potential of Demir was (800-900 kg/da), and it is higher than that of Osmancık 97 (700-750 kg/da).

It can be seen also in Table 5, Gönen in the statistical group ab and Kıral and Kargı in the statistical group b are closest to the variety Baldo in terms of 1000 grain weight. However these varieties could not reach the yield potential of Osmancık-97 but they might show similar yield to Osmancık-97 under appropriate ecological conditions. Mudra et al., (1970) and Plare (1971) point out that the rice had the highest interaction of "ecology x variety" among the field crops.

Results of some quality characteristics are given in Table 6. As can be seen in Table 6, the highest grain length was obtained from Baldo, Demir, Kargı and Gönen

**Table 6.** Quality characteristics of some varieties/genotypes. Menemen/Izmir. Turkey. 2004.

Varieties/genotypes	Grain length (mm) <sup>a</sup>	Grain width (mm)	grain length/width ratio <sup>b</sup>	Amylose content (%) <sup>c</sup>	Crude protein content (%)	White belly <sup>d</sup>
Bal./ Sarıkıl//Kras.-424	6.4	2.6	2.46	18.2	10.5	0
Yavuz	6.3	2.6	2.42	20.4	-	2
Osmancık-97	6.4	2.7	2.37	15.6	9.4	0
Kıral	6.7	2.8	2.39	16.5	-	2
Negış	6.8	2.9	2.34	16.8	10.7	0
Demir	6.0	2.8	2.46	22.2	-	2
Kargı	6.9	2.8	2.46	18.3	8.7	2
Gönen	6.9	2.9	2.37	18.7	10.2	1
Toy./Arb.//Nuc.	6.7	2.5	2.68	20.1	10.8	0
Toy./Sol.	6.7	2.5	2.68	21.9	10.3	3
Toag92	6.4	2.7	2.37	20.4	12.4	4
Baldo	6.9	2.9	2.37	19.6	9.4	0

<sup>a</sup>Scored using the Standard Evaluation System (SES) 0-9 scale where ,longer than 7,5 mm =too long ,6,6-7,5 mm = long 5,5-6,6mm=medium , shorter than 5,5 =short

<sup>b</sup>Scored using the Standard Evaluation System (SES) 0-9 scale where more than 3=thin 2.1-3.0 =medium , 1,1-2,0 flat ,less than 1,1= round(rounded)

<sup>c</sup>Scored using the Standard Evaluation System (SES) 0-9 scale where , 0-2 = no amylose , 8-20 = low-amylose ,21-25= medium (intermediate) amylose, more than 25 = high-amylose

<sup>d</sup>Scored using the Standard Evaluation System (SES) 0-9 scale where 0 = no belly. 9= more than 20% of kernel area

(6.9 mm). The highest grain width was obtained from Baldo, Negış and Gönen (2.9 mm).

The Negış has the lowest grain length/width ratio with 2.34. Toyhikary/Arborio//Nucleoryza had highest grain length/width ratio with 2.68.

Grain shape is determined by the ratio of grain length to grain width. There is a very close relationship between grain length and grain shape with head rice rate. Short and medium grain varieties are less broken during the processing.

Amylose content depend on environmental conditions, It can be changed 6% from season to season. High temperatures reduce amylose content during the grain filling period (Resurreccion at al., 1977). Amylose content of rice directly affects the volume of water intake and cooking in addition it has a negative relationship with stickiness of rice (Juliano, 1985).

In this study amylose content of the varieties and genotypes varied between 15.6 % and 22.2 %. Demir had the highest amylose content with 22.2 % amylose.

Crude protein content changed between 9.4 and 12.4. Toag92 had the highest % protein content with 12.4 %. It was followed by the new varieties (Toyhikary/Arborio//Nucleoryza, Baldo/Sarıklıçık//Kros-424, Toyhikary/Solnencyj, and Gönen.

White belly is a kind of characteristic depends on genetics and weather conditions during the growth period. The amount of white belly of grain reduces the efficiency of rice by increasing the rate of broken grain. Grain appearance is quite important in terms of consumer's choice and chalky grains have a less market value than the translucent grains.

### CONCLUSION

It can be concluded that new rice varieties Negış, Kıral, Gönen and Kargı can be grown in Aegean region in the future because of their height, quality and yield.

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