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FRUIT QUALITY PARAMETERS OF MUTANT KINNOW MANDARIN GENOTYPES

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Abstract
Citrus fruits are the most produced fruit group in the world and have a production amount of nearly 170 million tons. Turkey is one of the important producer countries in the world and produces 7.9 million tons annually. Mandarin is one of the most important species in table consumption with its ability to be peeled in a branch. In addition, attractive and seedless mandarin varieties that ripen in different periods are demanded by the producer. In this study, mutant individuals were obtained by applying gamma irradiation to cuttings in the late season Kinnow mandarin cultivars. Fruit characteristics were examined in these plants taken to the field and quality parameters and seedlessness characteristics were evaluated. In the obtained results, variations in fruit characteristics were determined among the mutant genotypes. Fruit weight varied between 179.9 (Genotype 54) -65 (Genotype 19) g among the genotypes. Genotype 9 was found to have the highest rind thickness (5.32 mm), whereas Genotype 5 had the lowest (2.1 mm) rind thickness. The seed number varied between 16.8 (Genotype 21) and 3.0 (Genotype 1). The TSS/acidity ratio of the genotypes was between 14.7% (Genotype 12) and 6.2% (Genotype 18). The study results show that gamma irradiation caused significant variation in Kinnow mandarin.

Keywords: Citrus, mandarin, mutation breeding

1. INTRODUCTION

Citrus fruits are a fruit group originating from Southeast Asia. Today, they are widely grown in tropical and subtropical regions of the world. Citrus fruits are the most cultivated fruit group in the world, with annual production exceeding 169 million tons. Turkey ranks first in Europe in terms of production, with a production of 7.9 million tons. Approximately 3 million tons of this production consists of mandarins (FAO, 2023).

In citrus fruits, the main desired factors are that the variety produces regular products in sufficient quality and quantity, is resistant to diseases and pests, and the tree is long-lasting and strong. In table varieties, the desired characters are the size, attractiveness and shape of the fruit, easy peeling of the peel, thinness of the slice membrane, aroma, seedlessness, fruit peel color and attractiveness (Göral, 1987). Varieties containing more than these characteristics are the varieties targeted in breeding. In addition to these, early, very early late or very late varieties are especially sought after

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varieties due to being out of season in the market and obtaining and improving their characteristics is important in terms of breeding.

Mandarin and mandarin hybrids group are the most preferred citrus fruits in the world, especially for table consumption. Easy peeling feature, ease of consumption, color range, harvesting at different periods and availability of seedless varieties are important reasons for preference for mandarins.

There are problems related to fruit harvest time, fruit size and quality in existing mandarin varieties in Turkey. It is a known fact that especially large and seedless varieties can be exported easily and at good prices in world markets. For this reason, there is a need for new variety development programs to be carried out and early and mid-late mandarin varieties and especially seedless varieties to be introduced to the citrus sector.

In citrus breeding, selection and mutation breeding methods are used, primarily hybridization. In this context, mutation breeding is preferred due to its advantages such as obtaining results in a shorter time compared to other methods and being able to regulate only one or two characteristics of the variety used without changing the characteristics too much. The use of rays to create artificial mutation in citrus fruits was first described in 1935 (Haskins and Moore, 1935). In later studies, the Star Ruby garpefruit variety (Hensz, 1971) and more compact crowned mutants were obtained in Jaffa orange using gamma rays (Vardi and Spiegel-Roy, 1978). In recent studies in Türkiye, three seeded lemon varieties were developed with the same method (Uzun et al. 2008). In addition, Tango, Daisy SL, Fairchild SL and Kinnow SL seedless mandarin cultivars were obtained with mutation breeding and are being cultivated commercially (Williams and Roose, 2008a,b)

In the mutant varieties obtained by mutation, different positive characteristics such as high productivity, early ripening, reddish rind color, reduced number of seeds, high quality fruit, smooth rind surface, reduced tree volume etc. were determined (Spiegel-Roy and Kochba 1973, Donini, 1992).

In this study, it was aimed to create a mutation in Kinnow mandarin, with gamma rays to increase seedlessness, later ripening and fruit quality.

2. MATERIALS AND METHODS

Mutations were created by applying gamma radiation from Co60 source at 50 gray dose to kinnow mandarin budwoods. Mutation applications and obtaining M1 V3 plants were done according to the method described by Gulsen et al. 2007. Then, 56 mutant M1V3 genotypes obtained were planted in the field 8 years ago on orange rootstock.

The study area is located in the field of Alata Horticultural Research Institute in Mersin-Erdemli.

The pomological characteristics specified below were carried for 25 fruits per genotypes.

Fruit and (g): Measurements were made with a precision scale sensitive to 0.01 grams.

Fruit length, width and rind thickness (mm): Measured for each fruit using a digital caliper.

Seed and carpel number: Counted

Total soluble solids (%): Measured with hand refractometer

Acidity (%): Determined by NaOH titration.

Data were analyzed using JMP 5.0 (SAS Institute Inc., Cary, NC, USA) and means separated and grouped using Tukey's test ($p<0.05$).

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3. RESULTS AND DISCUSSIONS

High levels of variation were determined among the genotypes in terms of the examined parameters. Fruit weight varied between 179.9 (Genotype 54) and 65 (Genotype 19) g among the genotypes (Figure 1). Fruit weight was sufficient for mandarin in most of the genotypes. In previous studies fruit weight of Kinnow mandarin in different locations as follow; Altaf et al. (2008), 101-287 g; Hayat et al. (2022), 109-180 g; Pandey et al. (2022), 179-214 g. Differences between studies are related to the genetic structure of the genotypes used, ecology and cultural practices.

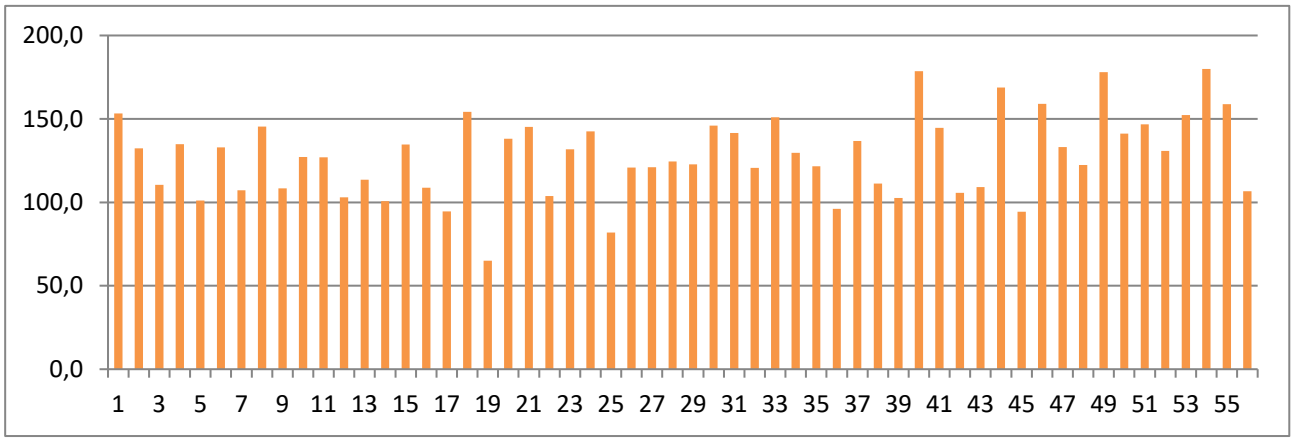


Figure 1. Fruit weight values (g) of mutant Kinnow mandarin genotypes

Fruit length was found to be between 28 mm and 72 mm (a), whereas fruit width was found to be between 27 mm and 76 mm (Figure 2 and 3). A lesser variation was detected between genotypes for these two values. Altaf and Khan (2009) determined the fruit height as 31-63.5 mm and width as 30.7-78.5 mm in Kinnow mandarin in their studies in Pakistan. These results are generally consistent with our study.

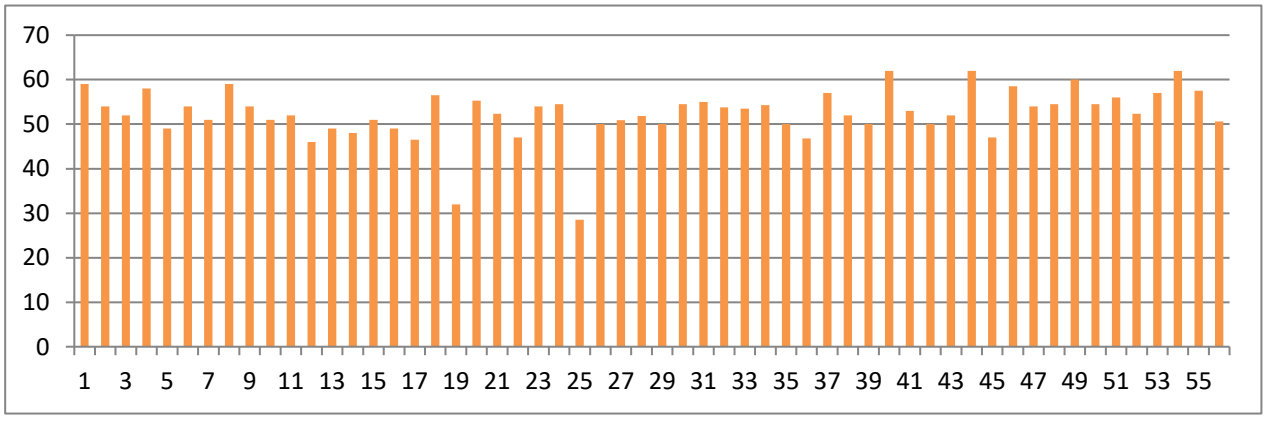


Figure 2. Fruit lenght of Kinnow genotypes

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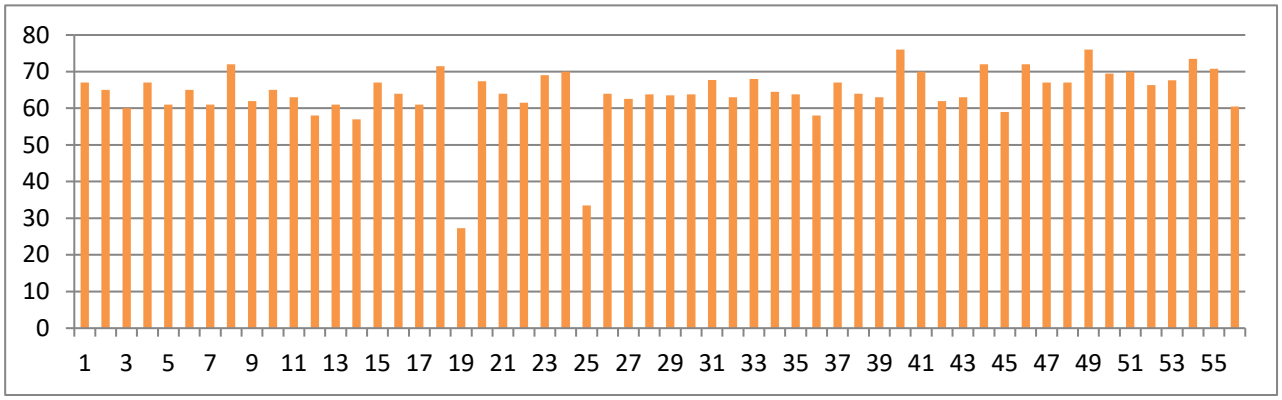


Figure 3. Fruit width distribution of Kinnow genotypes

Genotype 9 was found to have the highest rind thickness (5.32 mm), whereas Genotype 5 had the lowest (2.1 mm) rind thickness. In the study conducted in Pakistan, rind thickness was found to be between 2.46-3.2 mm in Kinnow mandarins on different rootstocks (Hayat et al. 2022) . Khan et al. (2020) determined the peel thickness as 2.48-3.01 mm in Kinnow mandarin. The higher peel thickness values obtained in our study can be explained by the large number of genotypes we used and the different genetic structures of the genotypes.

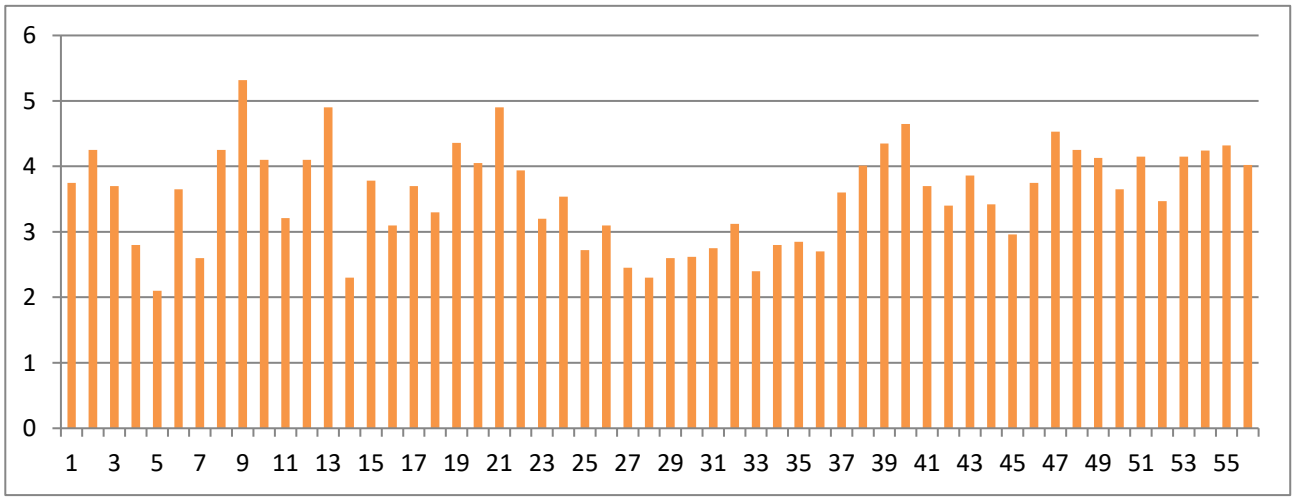


Figure 4. Rind thickness values of Kinnow genotypes

Seed number varied between 16.8 (Genotype 21) and 3.0 (Genotype 1). In citrus, seed number is a trait that can be reduced by mutation applications. In our study, seed number was found to be quite low in some genotypes. With further studies, these have the potential to become candidate new cultivar. Altaf et al. (2008) determined the number of seeds between 3-35 in Kinnow mandarins from different regions.

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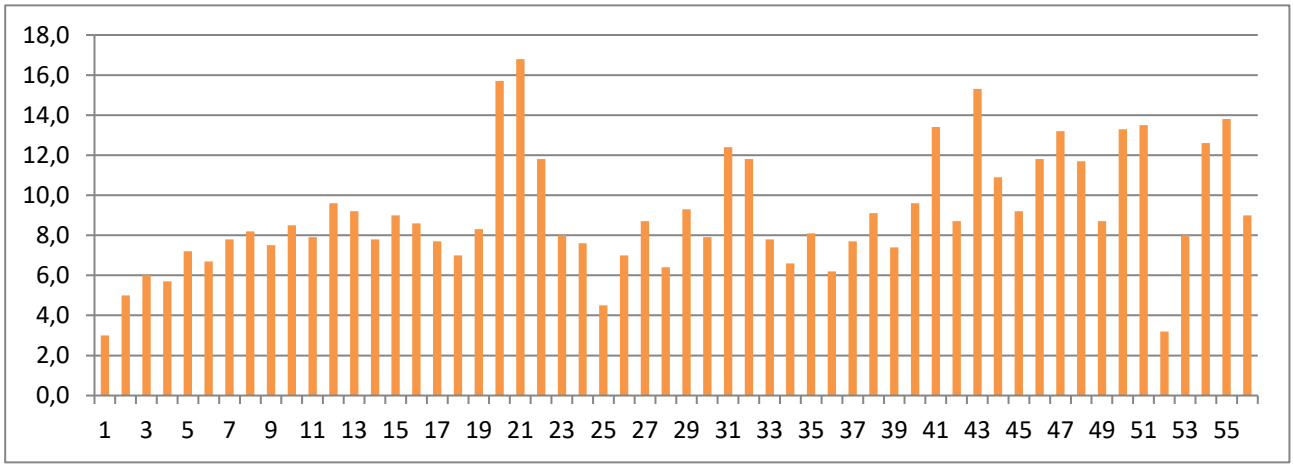


Figure 5. Seed number of Kinnow genotypes studied

TSS/Acidity ratio is an important parameter for determining the harvest period. For mandarins, this value must be at least 8 for harvest. TSS/acidity ratio of the genotypes was between 14.7% (Genotype 12) and 6.2% (Genotype 18). In this case, some of the genotypes seem to be able to be harvested in the early period and some in the late period. Pandey et al. (2022) found this value as 10.80-15.19% in Kinnow mandarins on different rootstocks. Hayat et al. (2022) determined the TSS/acidity ratio between 11.49-18.75% on different rootstocks. The differences between the studies may be due to the genotypes used, ecology and harvest periods.

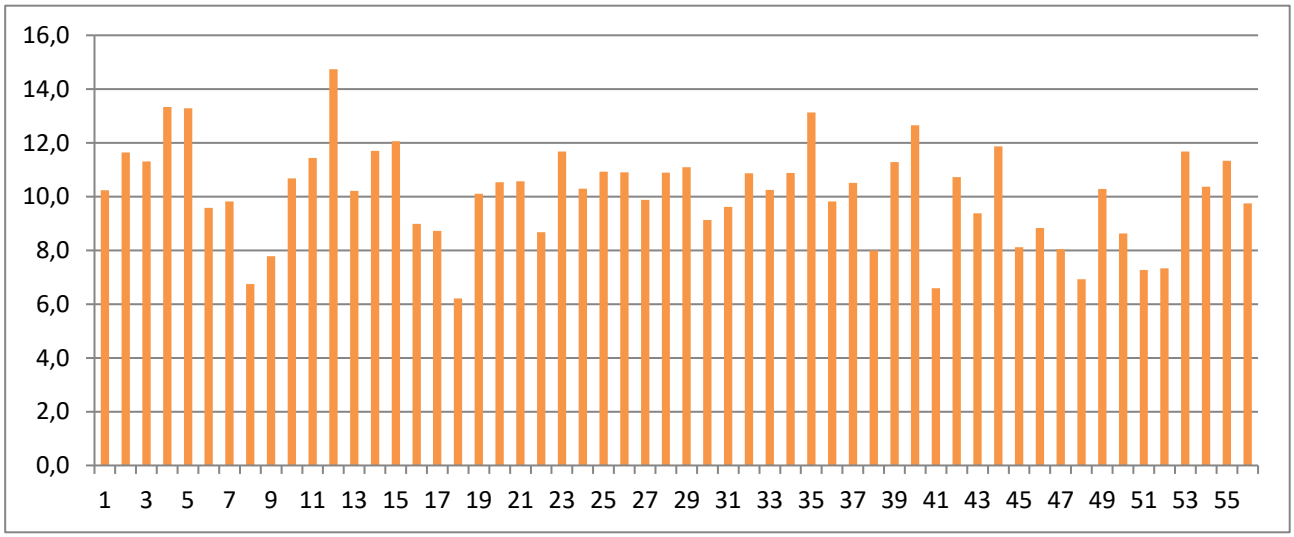


Figure 6. TSS/acidity ratio of Kinnow genotypes

4. CONCLUSIONS

Mutation breeding is used to obtain different fruit characteristics in citrus fruits. The obtained results show that mutation applications in Kinnow mandarin create significant variations in fruit characteristics. This method is useful for obtaining new promising cultivars of mandarins. The genotypes in our study should be evaluated over longer periods and promising cultivar names should be determined.

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