Assessment of pollen quality and quantity in white and black Turkish *Myrtus communis* L. accessions, through in vitro pollen germination under varied boric acid concentrations

Senay Karabiyik*, Mehmet Ali Saridas
Çukurova University, Faculty of Agriculture, Department of Horticulture, 01330, Adana, Turkey
*Email: senaybehlul@gmail.com

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ABSTRACT

This study aimed to evaluate the pollen properties, pollen viability and germination with suitable germination medium and amount of pollen production in 6 Turkish myrtle genotypes. The genotypes were evaluated as their origin and fruit colours in terms of 3 different origins (Erdemli, Karaisali and Tarsus) and 2 fruit colours (black and white). Results showed that, pollen properties were affected from fruit colours and black genotypes generally showed higher pollen properties. The amount of pollen production of one flower was very high ranging from 2.5 to 4.5 million. Pollen viability and germination rates showed sufficient results for successful pollination in Turkish myrtle genotypes. Among pollen germination media, the best pollen germination rate was obtained from 50 ppm boric acid. Consequently, this study identified the pollen performance of white and black Turkish myrtle genotypes and suggested an optimal pollen germination medium for *Myrtus communis* which can be used in the future breeding programmes.

Keywords: Anther, flower, Myrtaceae, pollen biology, pollination

INTRODUCTION

Myrtle (*Myrtus communis* L.) belongs to the family Myrtaceae and is one of the most significant species widely spread in the Mediterranean region, the Middle East and warmer regions of North America and Australia. In Turkey, it has been intensively grown naturally in the Mediterranean region especially near natural pine forests, particularly in the Taurus Mountains and riversides. The species are growing wild in warm and temperate regions of the Mediterranean basin, where it is well known for its medicinal and aromatic properties (Mulas et al., 1999; Yildirim et al., 2013). Essential oil from the leaves is used in the perfume and food industries (Lawrence, 1994; Boelens and Jimenez, 1992), while both leaves and berries are used to produce typical liqueurs (Mulas et al., 1999). Due to the success of myrtle liqueur and the number of processing industries, the demand for raw material has increased (Mulas and Fadda, 2004).

Myrtle flowers need pollination to set fruits and a successful pollination depends on quality of flowers especially in terms of pollen quality. Myrtle fruits has lots of seeds (Mulas and Fadda, 2004). Whether this seed existence disturbs customers, the studies for decreasing seed number caused excessive fruit drops (Gonzalez-Varo et al., 2009, Alim, 2020). This shows that, seed formation after...
Pollen quality and quantity in Myrtle

Successful pollination and fertilization is essential for adequate fruit set in myrtle.

Myrtle buds develop from the leaf axillae on young shoots as single flowers (Mulas and Fadda, 2004). It has a 1-2.5 cm green or red peduncle generally linked with fruit colour. Myrtle flowers are hermaphrodite with both stamens and pistil are at the same flower (Fig. 1a). Flowers comprise of 5 green sepals, 5 white or pinky petals, about 100-150 stamens with long filaments and a little anther. Pollens are triangular in shape and has tricolporate apertures with a diameter about 8-15 mm (Fig. 1b). The flower has a single pistil at the middle of the flower. It is embedded into the receptacle showing an inferior ovary type with 3 syncarpous carpels with axile placentation of about 25-50 ovules (Mulas and Fadda, 2004). Flowers secrete lots of nectar at the bottom of the anthers and originally near from the apex of the anther in order to attract pollinator insects for a better pollination (Ciccarelli et al., 2008).

Recent studies have been showed that, myrtle pollen viability is very high immediately after anthesis. Along with the end of the first day, pollen viability declines and 36 hours after anthesis almost all grains become unviable. At the same time, while pollen viability remains high for several hours at high temperature and dry conditions, it rapidly decreases at high humidity (Aronne, 1999). So, myrtle pollen should be transferred to the stigma as soon as possible by pollinator insects which indicates the importance of pollen limitation and pollen viability one more time. Although myrtle is a self-compatible species and needs pollinators to increase fruit set, fruit size and quality increases with cross pollination showing that the pollen quality has a great importance for myrtle fruit formation (Aizen and Harder, 2007; Gonzalez-Varo et al., 2009).

Considering the effects of pollen importance in myrtle flowers, this study aims to evaluate the pollen quality in terms of pollen viability and pollen germination rates, suitable in vitro pollen germination medium and in vitro pollen tube growth rate parameters were evaluated. For this purpose, at least 100 unopened flowers were collected one day before anthesis from 5 trees of each genotype and immediately taken to the Cytology Laboratory in Cukurova University.

**Amount of pollen production and pollen homogeneity**

For determining amount of pollen production and homogeneity tests, 30 flowers were separated to 3 groups and anthers of each group (10 flowers for each) were taken to plastic containers. Prepared samples were left to dry for at least 15 days. Pollen production tests were made by hemacytometric method and counting slides were prepared according to Eti (1990) with 4 ml of sterile water (Fig. 2a). Then, the samples were analysed with Olympus BX 51 light microscope and micrographs were taken with DP72 camera with a specified area on the micrograph (Fig. 2b). Following preparation, the quantity of pollen within the specified area was tallied, and subsequent calculations were performed, incorporating a modification based on Eti (1990). While calculation, the counting place volume was found with multiplication of the created area and depth of hemacytometric slide. The amount of pollen at calculated volume was then rated to whole container volume to find “amount of pollen for 10 flowers”. Then the “pollen number per flower” was found by dividing each data to 10. At least 12 areas were counted for each replication and the average data were used for calculation.

**MATERIALS AND METHODS**

This study was conducted in 2023 flowering season of 6 Turkish myrtle genotypes. The genotypes were selected for their superior qualities from Mediterranean region of Türkiye (Simsek et al., 2020). The selected genotypes were from 3 different regions of Türkiye (Erdemli, Karaisali and Tarsus) due to their fruit colours (white and black) (Table 1). The selected genotypes were planted in research field of Cukurova University in 2020 at 3x2 m spacing. Plants were 3 years old, drip irrigated and all necessary cultural practices were followed uniformly in the research field.

In this study the amount of pollen production and pollen homogeneity, in vitro pollen viability and germination rates, suitable in vitro pollen germination medium and in vitro pollen tube growth rate parameters were evaluated. For this purpose, at least 100 unopened flowers were collected one day before anthesis from 5 trees of each genotype and immediately taken to the Cytology Laboratory in Cukurova University.
The “normally developed pollen ratio” was also determined in each micrograph by counting and rating normally developed pollen to total pollen in created volumes according to Anvari (1977).

**In vitro pollen viability rate**

In order to obtain pollen for viability tests, anthers from 6 genotypes of myrtus were collected randomly before anthesis. Anthers of the collected flowers were separated and placed in room temperature until dehiscence for about one night (Mulas and Fadda, 2004). After pollen dehiscence, pollen viability rates were determined using 1% TTC test (2,3,5 Triphenyl tetrazolium chlorid). TTC was prepared and evaluated according to Norton (1966). For each genotype 3 slide replication were prepared and at least 100 pollen grains were counted from each replication. Pollen counting were made by Olympus BX51 microscope. While counting, red pollens were considered as “viable”, light pinkies as “semi viable” and uncoloured pollens as “non-viable” (Fig. 3a). Then the pollen viability rate was calculated according to Norton (1966) as the ratio of “sum of total viable and half of semi viable pollens” to “total pollen number”.

**Suitable in vitro pollen germination medium and in vitro pollen germination rate**

In order to determine pollen germination data, same pollens were used that was prepared for pollen viability tests. The suitable in vitro pollen germination tests were all performed in a basic media, which consisted of 1% agar, 100 ml distilled water and 15% sucrose (Mulas and Fadda, 2004) with single factor experiment of boric acid (H₃BO₃) in concentration of 0, 50 and 100 ppm.

Media and germination petri dishes were prepared according to Karabiyik and Eti (2016). Pollen germination ratio for each medium was determined after 24 hours. The pollen grains were considered to be germinated when the pollen tube length was greater than the diameter of the pollen grain (Fig. 3b). At least 100 pollen grains were counted for each replication.

The in vitro pollen tube growth rate was also determined after 2, 4 and 10 hours of preparation in order to set out the difference at emergence and elongation of pollen tubes for each media and genotype. In order to measure pollen tube length in specified hours, little segments were taken from prepared media between slide and cover glass and immediately taken to -20°C to stop growth and fix the media samples filled with pollen. Experiments were prepared as 3 replications for pollen tube measuring tests. The in vitro pollen tube growth was determined by measuring pollen tube length with Olympus BX 51 microscope equipped with a DP 72 digital camera (Fig. 3c). At least 30 pollen tubes were measured for each media, each hour and each replication. By this way, the fastest pollen germinating media could be determined for myrtle genotypes.

**Statistical analysis**

All data analysis was performed using JMP 13 statistical software. The effects of the treatments were analysed using one way anova analysis of variance. A P value of < 0.05 was considered to be significant. The statistical analysis was conducted in terms of the origins and fruit colour of genotypes. By this way, 2 factorial randomised design has been used for analysing pollen production, normally developed pollen and pollen viability data. In the other part of our experiment, the pollen germination rate was analysed by 3 factorial randomised design as genotype origin, colour and boron concentrations. Percentages were analysed after arc-sin transformation.

**RESULTS AND DISCUSSION**

**Amount of pollen production and normally developed pollen rate**

Amount of pollen production for 6 Turkish myrtle genotypes were given in Table 2 in terms of origins and fruit colours of the genotypes. The table shows that amount of pollen production in one flower significantly influenced by fruit colour and origin x colour interaction while differences between genotypes did not find to be important. The pollen production in each flower was very high ranging between 2 657 493 (Karaisali-White_KB) and 4 885 013 (Karaisali-Black_KS) pollens per flower and the average pollen production was definitely higher in black genotypes (3 843 840) than white genotypes (3 056 213). In terms of genotype origin averages, the highest pollen production was detected in Karaisali genotypes (3
Table 1: Origins and fruit colours of used genotypes

<table>
<thead>
<tr>
<th>Genotype name</th>
<th>Genotype code</th>
<th>Origin</th>
<th>Fruit Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erdemli beyazi</td>
<td>EB</td>
<td>Erdemli/Mersin</td>
<td>White fruited</td>
</tr>
<tr>
<td>Erdemli siyahi</td>
<td>ES</td>
<td>Erdemli/Mersin</td>
<td>Black fruited</td>
</tr>
<tr>
<td>Karaisali beyazi</td>
<td>KB</td>
<td>Karaisali/Adana</td>
<td>White fruited</td>
</tr>
<tr>
<td>Karaisali siyahi</td>
<td>KS</td>
<td>Karaisali/Adana</td>
<td>Black fruited</td>
</tr>
<tr>
<td>Tarsus beyazi</td>
<td>TB</td>
<td>Tarsus/Mersin</td>
<td>White fruited</td>
</tr>
<tr>
<td>Tarsus siyahi</td>
<td>TS</td>
<td>Tarsus/Mersin</td>
<td>Black fruited</td>
</tr>
</tbody>
</table>

Table 2: Amount of pollen production per flower in 6 Turkish myrtle genotypes in terms of their origins and fruit colours (pollen/anther)

<table>
<thead>
<tr>
<th>Origins</th>
<th>Fruit Colours</th>
<th>Origins Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>White</td>
<td>Black</td>
</tr>
<tr>
<td>Erdemli</td>
<td>3 295 146 b</td>
<td>3 412 266 b</td>
</tr>
<tr>
<td>Karaisali</td>
<td>2 657 493 b</td>
<td>4 885 013 a</td>
</tr>
<tr>
<td>Tarsus</td>
<td>3 216 000 b</td>
<td>3 234 240 b</td>
</tr>
</tbody>
</table>

Colours Average 3 056 213 B 3 843 840 A

LSD_{origin}***: 3,605 LSD_{colour}**: 2,943 LSD_{ori x col}***: 5,098

1 Differences between averages showed by different letters are statistically significant
2 N.S. means not-significant; ** means p<0.01; *** means p<0.001.

Table 3: Normally developed pollen ratios in 6 Turkish myrtle genotypes in terms of their origins and fruit colours (%)

<table>
<thead>
<tr>
<th>Origins</th>
<th>Fruit Colours</th>
<th>Origins Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>White</td>
<td>Black</td>
</tr>
<tr>
<td>Erdemli</td>
<td>93.17</td>
<td>93.97</td>
</tr>
<tr>
<td>Karaisali</td>
<td>89.35</td>
<td>88.02</td>
</tr>
<tr>
<td>Tarsus</td>
<td>93.95</td>
<td>93.75</td>
</tr>
</tbody>
</table>

Colours Average 92.16 91.91

LSD_{origin}***: 1,985 LSD_{colour}: N.S. LSD_{ori x col}: N.S.

1 Statistical analysis were made after arc-sin transformation.
2 Differences between averages showed by different letters are statistically significant
N.S. means not-significant; *** means p<0.001.

Table 4: Pollen viability levels in 6 Turkish myrtle genotypes in terms of their origins and fruit colours (%)

<table>
<thead>
<tr>
<th>Origins</th>
<th>Fruit Colours</th>
<th>Origins Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>White</td>
<td>Black</td>
</tr>
<tr>
<td>Erdemli</td>
<td>42.84 cd</td>
<td>85.46 a</td>
</tr>
<tr>
<td>Karaisali</td>
<td>51.99 b</td>
<td>35.11 d</td>
</tr>
<tr>
<td>Tarsus</td>
<td>50.30 bc</td>
<td>44.63 bc</td>
</tr>
</tbody>
</table>

Colours Average 48.38 B 55.07 A

LSD_{origin}***: 3,605 LSD_{colour}**: 2,943 LSD_{ori x col}***: 5,098

1 Differences between averages showed by different letters are statistically significant
N.S. means not-significant; ** means p<0.01; *** means p<0.001.
Table 5: Pollen germination levels in 6 Turkish myrtle genotypes in terms of their origins, fruit colours and Boron concentrations (%)\(^1\)

<table>
<thead>
<tr>
<th>Origins</th>
<th>Boron Concent.</th>
<th>Fruit Colours</th>
<th>Origin x Boron</th>
<th>Origins Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>White</td>
<td>Black</td>
<td></td>
</tr>
<tr>
<td>Erdemli</td>
<td>0 ppm</td>
<td>26,20</td>
<td>46,34</td>
<td>36,27</td>
</tr>
<tr>
<td></td>
<td>50 ppm</td>
<td>27,99</td>
<td>63,49</td>
<td>41,58</td>
</tr>
<tr>
<td></td>
<td>100 ppm</td>
<td>19,68</td>
<td>65,79</td>
<td>46,89</td>
</tr>
<tr>
<td>Origin x Colour</td>
<td>24,62 b(^2)</td>
<td>58,54 a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Karaisali</td>
<td>0 ppm</td>
<td>31,00</td>
<td>68,07</td>
<td>49,53</td>
</tr>
<tr>
<td></td>
<td>50 ppm</td>
<td>37,45</td>
<td>37,27</td>
<td>37,36</td>
</tr>
<tr>
<td></td>
<td>100 ppm</td>
<td>26,04</td>
<td>55,37</td>
<td>40,71</td>
</tr>
<tr>
<td>Origin x Colour</td>
<td>31,50 b</td>
<td>53,57 a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tarsus</td>
<td>0 ppm</td>
<td>47,17</td>
<td>43,57</td>
<td>45,37</td>
</tr>
<tr>
<td></td>
<td>50 ppm</td>
<td>51,15</td>
<td>67,14</td>
<td>59,15</td>
</tr>
<tr>
<td></td>
<td>100 ppm</td>
<td>50,54</td>
<td>48,49</td>
<td>49,52</td>
</tr>
<tr>
<td>Origin x Colour</td>
<td>49,62 a</td>
<td>53,07 a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colours Average</td>
<td>35,25 B</td>
<td>55,06 A</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

LSD\(_{origin}\): N.S.  \quad LSD\(_{colour}\): ***; 4,919 \quad LSD\(_{ori x bor}\): N.S. \quad LSD\(_{ori x col}\): ***; 8,521

1 Statistical analysis were made after arc-sin transformation.

2 Differences between averages showed by different letters are statistically significant

N.S. means not-significant; *** means \(p<0.001\).

771 253), followed by Erdemli (3 535 706) and Tarsus (3 225 120) genotypes.

Pollen production is an important data for seeded cultivars as it guarantees the pollen meeting probability with the stigma. In this study, amount of pollen production in one myrtle flower was very high at about 2.5 millions and 4.5 millions. However, myrtle flowers have a lot of anthers between 120-150 (Mulas and Fadda, 2004) and this means each anther has at about 15 000 – 30 000 pollens. To the best of our knowledge, there is not any data for amount of pollen production in myrtle flowers and this report is the first for pollen production for \textit{Myrtus communis}. However, the data was coherent with other species like citrus (Karabiyik and Eti, 2019), carob (Eti, 1990), strawberry (Karabiyik \textit{et al.}, 2016), pecan (Karabyyyk and Eti, 2018), watermelon (Adiguzel \textit{et al.}, 2022), loquat (Karabiyik and Eti, 2015) etc. in terms of amount of pollen produced in one anther.

Nevertheless, pollen production for myrtle genotypes should be higher than most of the species. Because, Beardsell \textit{et al.} (1989) have been stated that members of Myrtaceae has secretes under anthers of the stamens called anther glands that helps flowers to attract pollinator insects, especially the bees. The authors have been reported that this secrete mixes with pollen which acts as a food source for insects (Ciccarelli \textit{et al.}, 2008). This structure of flowers causes lots of pollen loses, so the high pollen production roles out these handicap.

Normally developed pollen ratios were given in Table 3. The data showed that normally developed pollen shows pollen homogeneity level is generally high and only origin of the genotype affects normally developed pollen ratio. The highest ratio was obtained from Erdemli (93.57%) and Tarsus (93.85%) genotypes while Karaisali genotypes (88.68%) had the lowest homogeneity level. Fruit colour did not differ significantly and white genotypes had an average of 92.16% while black genotypes has an average of 91.91% pollen homogeneity level.

Besides the high pollen production of a genotype, it is important to have a genotype high normally developed pollen ratio. Anvari (1977) have been stated that the undeveloped or abnormal pollens, which shows diversions from normal shape and size, are unlikely to germinate. So, if the normal rate of pollen ratio approach to 100%, the
Pollen quality and quantity in Myrtle

Fig. 1: Flower (a) and pollen (b) of myrtle

Fig. 2: The hemacytometric slide (a) and the pollen counting area (b)

Fig. 3: a. pollen viability test, b. germinated pollens, c. Pollen tube elongation

Fig. 4: Pollen tube growth rate of Turkish myrtle accessions in different in vitro pollen germination media.
pollination potential of genotype will increase in the same rate. The results showed that myrtle pollens have adequate pollen homogeneity and pollen production level for successful pollination.

**In vitro pollen viability rate**

In vitro pollen viability have been detected by TTC method and the results were shown in Table 4. The statistical analysis showed that origin, colour and origin x colour interaction significantly affected pollen viability rate of used myrtle genotypes. Pollen viability rate was highest in Erdemli originated genotypes with 64.15% while it was 47.47% in Tarsus and 43.55% in Karaisali. In terms of fruit colours, average of black cultivars showed better results (55.07%) than white genotypes (48.38%). The origin x colour interaction data had a wide range as much as 35.11% (Karaisali-Black_KS) and 85.46% (Erdemli-Black_ES).

As Mulas and Fadda (2004) have been reported, pollen viability rate was not differed between freshly opened flowers and dried flowers and the pollen viability rates of 10 myrtus genotypes were higher than our results that differed between 85% and 95%. It is thought that this difference is originated from differences in genotype and ecological conditions (Eti, 1991).

**In vitro pollen germination rates and suitable pollen germination media**

Table 4 shows in vitro pollen germination levels of 6 Turkish myrtle genotypes in terms of their origin and fruit colours as well as different germination media. In the study, different concentrations of boric acid (H\textsubscript{3}BO\textsubscript{3}) were tested for optimization of in vitro pollen germination medium. The results showed that boric acid concentration has no importance on pollen germination ratio while fruit colour and origin x colour interaction (genotype effect) showed statistically important values.

In terms of fruit colours, pollen germination levels were higher in black genotypes (55.06%) than white genotypes (35.25%), like pollen production and pollen viability levels. Origin x colour interaction that shows the germination levels of each genotype were highest in Erdemli-Black (ES) which was followed by Karaisali-black (KS) and Tarsus-black (TS) and the lowest from Erdemli-white (EB).

In general, pollen germination level gives the best results for the pollen quality of a genotype. Although genotypes should have a good pollen production and pollen viability percentage; pollen germination, pollen tube emergence and pollen tube growth has such a degree importance for pollination and especially for fertilization level. In a recent study, Mulas and Fadda (2004) tested 10 myrtle genotypes in terms of pollen germination levels with 10, 15 and 20% sucrose concentrations and found the rates of 6 genotypes as 70 to 85%; other 3 genotypes differing from 25 to 40% and one genotype with 0.7%. Authors reported the best media as 10 and 15% sucrose concentrations for most of the genotypes. The 15% sucrose concentration that was used in this study was suitable for myrtle pollen germination. Despite the statistical analysis has no significant importance, a 50 ppm Boric acid addition to germination media could increase pollen germination rate for most of the genotypes.

Pollen germination assays frequently require optimisation as well as being time consuming and difficult to reproduce (Rathod et al., 2018). The germination media should imitate stigma surface for the truest data. It has been reported that, boric acid content in the pollen is insufficient (O’Kelley, 1957) and Boron in the stigma and style is required to compensate for this; thus a certain amount of boric acid needs to be added to in vitro cultures (Johri and Vasil, 1961; Luo et al., 2020). There was not any test for additional substances for *Myrtus communis*. In general, 10 ppm (0.001%) or higher concentrations of Boric acid is toxic to plant growth while pollen grains can tolerate concentrations up to 1 200 ppm (0.12%) and optimum results were obtained between 10 and 150 ppm concentrations for pollen germination for most of the species (Johri and Vassil, 1961).

In this study, the results of viability and germination rates were in parallel except from Karaisali-black (KS). The chemical TTC (Tetrazolium) forms a red coloured compound formazan by H transfer reactions catalysed by the enzyme dehydrogenases (Norton, 1966). This results shows that, only TTC test might not give the real performance for some myrtle genotypes due to its possible insufficient reaction capacity with H’ ions. So, different viability tests...
accomplished with in vitro pollen germination could be used for better results in future studies.

Pollen tube growth rate was also evaluated in this study and results were given in Fig. 4. The pollen tube growth rate was faster in 50 ppm boric acid concentrations which means pollen tubes will emerge and grow faster in a boron fertilized genotype. In 0 ppm Boron (Control) especially KB and EB did not emerge any pollen tubes in first 2 hours while KS and ES could not show their real performance of pollen tube acceleration. At the same time, 100 ppm Boric acid also increases the first emergence and formed faster pollen tubes.

It is known that boron accelerates pollen tube by its promoting absorption of sugars and their metabolism by forming sugar-borate complexes, increased oxygen uptake and is involved in the synthesis of pectic materials required for the wall of the actively elongating pollen tube (Johri and Vasil, 1961). As pollen did not have sufficient boron content and stigma and style will compensate boron requirement, addition of boric acid to the germination medium simulates this situation and shows the real potential of performance of pollen tube elongation. When Table 5 and Figure 4 were evaluated together boric acid was thought to be accelerated the first pollen tube emergence and pollen tube elongation ratio but not have any effect on pollen germination ratio.

CONCLUSION

Pollen quality and quantity is vital for understanding fertility and incompatibility, pollen-pistil interaction, breeding, crop improvement and seed industry. For successful pollination, the insight knowledge of pollen biology including pollen viability, germination and amount of pollen production is required for reasonable approaches to increase productivity. This study evaluates amount of pollen production, normally developed pollen ratio, pollen viability and germination levels with suitable pollen germination medium as well as pollen germination rates of 6 Turkish myrtle genotypes in terms of their origins and fruit colours. In Myrtus communis, amount of pollen production per flower was found to be very high as much as 2.5-4.5 million. The high pollen production is thought to be related with anther secretes that will cause pollen losses. Normally developed pollen ratio was also so high and sufficient for successful pollination. The pollen viability and germination rates were sufficient for most of the genotypes and pollen tube elongation was faster in the media containing 50 ppm boric acid with 15% sucrose and 1% agar solution which is thought to be the best media for Myrtus communis pollen germination tests. In general, all pollen properties were higher in black genotypes than the white genotypes.

In future studies, pollination capacity of white cultivars should be experienced for it’s possible stimulatory effect because of their lower pollen characteristics. So, a pollination study should be planned for potential seed number decreasing effect of white genotypes.

REFERENCES:


