Pollen morphology of *Cornus mas* L. and *Cornus sanguinea* L.

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*Cornus mas* L. ve *Cornus sanguinea* L. Türlerinin Polen Morfolojisı


Anahtar Kelimeler: Polen morfolojisı, *Cornus mas*, *Cornus sanguinea*

1. INTRODUCTION

Cornaceae family has 7 genera and 110 species, most of which can be found in East and Southeast Asia, and growing in temperate and humid regions of the north hemisphere (Kubitzki, 2004; Heywood et al., 2007). Many *Cornus* (dogwood) species are cultivated for their edible fruits or as ornamental plant for their spectacular flower, fruit and leaves. Some species are also utilized to create a decorative effect in the winter season because of their carmine or yellow trunk and branches (Karlıoğlu, 2014). In our country, there are 2 *Cornus* species which can grow up naturally. These are *C. mas* and *C. sanguinea* (Chamberlain, 1972; Güner et al., 2012).

Although several researches have been conducted about the genus *Cornus* in the field of systematic botany (Chamberlain, 1972; Krüssmann, 1976; Kayacik, 1982; Karlıoğlu, 2014), there have been mostly studies on the pollen morphology of Cornaceae in the field of palynology (Erdtmann, 1952; Chao, 1954; Moore and Webb, 1978; Ferguson, 1966; Perven and Quaiser, 2002). The pollen shape of Cornaceae changes between spheroidal and prolate (Erdtmann, 1952; Stafford and Heath, 1991; Perven and Quaiser, 2002), and its

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aperture type is tricolporate (Chao, 1954; Wodehouse, 1959). Nevertheless, the number of the measurements proving the difference of the morphology of the pollen in these researches is quite insufficient. Aytug et al. (1971) and Aytug and Merev (2002) have ascertained that *Cornus mas*’s pollen is tricolporate and they have carried out some palynological measurements on modern and fossil pollen grains. Sorkun (2008) has pointed out that only the diameter of tricolporate and colpus of *Cornus mas*’s pollen is bigger than the diameter of its pore. Also, Mert (2009) investigated the pollen length, pollen width, intine and exine thickness of six cornelian cherry (*Cornus mas* L.) cultivars. However many palynological studies have been made about especially Cornaceae, there has been no detailed and comparative study about the pollen morphology of 2 species of *Cornus* which grows naturally in Turkey.

Nowadays, the methods to categorize the plants used by the systematic botanists are mostly based on the morphological characters. The data from pollen morphology can be utilized to detect and categorize the plants generally on family and genera basis while sometimes there can be significant differences pointed out on species basis (Bradley, 1999). A similar study was performed by Akkemik (1995) and has demonstrated the possibility of the discrimination of *Carpinus orientalis* and *Carpinus betulus* in terms of pollen morphology. Hereby, it is possible to discriminate the species in the pollen analysis of the same plant species. In this context, this study aims to present differences of the pollen grains and showing the possibility of the discrimination of the species in the same genus by analyzing the pollen morphology of 2 *Cornus* species differing in their inflorescences color, size and blooming time with the help of light and scanning electron microscope in detail.

2. MATERIAL AND METHOD

The research materials are the pollen grains of *C. mas* picked from Çankırı-Korubaşı Hill neighborhood and the pollen grains of *C. sanguinea* picked from Belgrad Forest. The flower color, inflorescences features (Figure 1) and flowering time are quite different for 2 species of dogwood in this study.

The pollen grains have been brought to Istanbul University Faculty of Forestry Forest Botany Department Palynology Laboratory and prepared with pollen preparation according to the Wodehouse method (Wodehouse, 1959). The measurement and diagnosis of the number of the pollen grains in the pollen preparations are performed by using x40, x100 immersion objective and 10x ocular in the computer assisted Lecia DM750 light microscope. With the light microscope, at least 50 measurements are performed for each pollen feature (P: Polar axis, E: Equatorial axis, Clg: Length of colpus, Clt: Width of colpus, Plg: Length of porus, Plt: Width of porus, t: Apocolpium and Ex: Exine thickness). A part of this pollen is kept in the fridge in +4˚C for the measurement with Scanning Electron Microscope (SEM). The size of the pollen, aperture type and the features of ornamentation are studied in detail by taking photos with both SEM and light microscope.
3. RESULTS AND DISCUSSION

The pollen grains of *Cornus* species have tricolporate aperture. While the shape of *Cornus mas*’s pollen is spheroidal, *Cornus sanguinea*’s is subprolate (Figure 2; Table 1). The polar axis of *Cornus mas*’s pollen grains ranges from 21.54 to 27.36 μm and their equatorial axis ranges from 21.31 to 26.72 μm. The polar axis of *Cornus sanguinea*’s pollen grains ranges from 54.41 to 71.69 μm and their equatorial axis ranges from 46.03 to 63.42 μm (Table 1).

Table 1. The polar and equatorial axis, length and width of colpus and porus, apocolpium and exine thickness of *C. mas* and *C. sanguinea*

<table>
<thead>
<tr>
<th>Plant species</th>
<th><em>Cornus mas</em></th>
<th><em>Cornus sanguinea</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Polar axis (P) (μm)</td>
<td>(21.54-27.36)</td>
<td>(54.41-71.69)</td>
</tr>
<tr>
<td>Equatorial axis (E) (μm)</td>
<td>(21.31-26.72)</td>
<td>(46.03-63.42)</td>
</tr>
<tr>
<td>P/E rate and pollen shape</td>
<td>0.99 (sferoidal)</td>
<td>1.15 (subprolate)</td>
</tr>
<tr>
<td>Aperture</td>
<td>Tricolporate</td>
<td>Tricolporate</td>
</tr>
<tr>
<td>Ornamentation</td>
<td>Granulate</td>
<td>Granulate</td>
</tr>
<tr>
<td>Colpus (C) (μm)</td>
<td>Clg (12.34-18.82)</td>
<td>(41.53-61.86)</td>
</tr>
<tr>
<td></td>
<td>CIt (3.72-6.19)</td>
<td>(7.32-14.23)</td>
</tr>
<tr>
<td>Porus (P) (μm)</td>
<td>Plg (4.29-8.83)</td>
<td>(7.96-12.80)</td>
</tr>
<tr>
<td></td>
<td>Plt (3.72-6.19)</td>
<td>(7.32-14.23)</td>
</tr>
<tr>
<td>Apocolpium (t) (μm)</td>
<td>(3.97-5.85)</td>
<td>(8.83-15.70)</td>
</tr>
<tr>
<td>Exine thickness (Ex) (μm)</td>
<td>(0.99-1.77)</td>
<td>(1.30-3.49)</td>
</tr>
</tbody>
</table>
The colpus length (Clg), colpus width (Clt), porus length (Plg), porus width (Plt), apocolpium (t) and exine thickness (Ex) of both the pollen of two species have been measured and found that they are different (Table 1; Figure 3). The colpus length of *C. mas*’s pollen grains ranges from 12.34 to 18.82 μm and their colpus width ranges from 3.72 to 6.19 μm. On the contrary, the colpus length of *C. sanguinea*’s pollen grains ranges from 41.53 to 61.86 μm and their colpus width ranges from 7.32 to 14.23 μm. The porus length of *C. mas*’s pollen grains ranges from 4.29 to 8.83 μm and their porus width ranges from 3.72 to 6.19 μm. However, the porus length of *Cornus sanguinea*’s pollen grains ranges from 7.96 to 12.80 μm and their colpus width ranges from 7.32 to 14.23 μm (Table 1; Figure 3).

Moreover, when both of the plant species’ pollen ornamentation is analyzed with SEM, it has been detected that it is granulate and the aperture type is tricolporate (Figure 4).

Figure 3. The equatorial and polar view of *C. mas* (a, b) and *C. sanguinea* (c, d) in Scanning Electron Microscope

Moreover, when both of the plant species’ pollen ornamentation is analyzed with SEM, it has been detected that it is granulate and the aperture type is tricolporate (Figure 4).
The apocolpium (t) of *Cornus mas*’s pollen grains ranges from 3.97 to 5.85 μm and their exine thickness (Ex) ranges from 0.99 to 1.77 μm. On the contrary, the apocolpium of *C. sanguinea*’s pollen grains ranges between 8.83 and 15.70 μm, and their exine thickness ranges from 1.30 to 3.49 μm (Table 1). There is a clear difference between these features.

Whether there is a considerable difference between two species or not in terms of the variables P, E, Clg, Clt, Plg, Plt, t, and exine thickness has been examined by using t-test which compares independent samples. The results of t-test reveals the considerable differences between two species on the level of significance \( p=0.001 \) in terms of all those variables (Table 2).

Table 2. The results of t-test for independent samples (P: Polar axis, E: Equatorial axis, Clg: The length of colpus, Clt: The width of colpus, Plg: The length of porus, Plt: The width of porus, t: Apocolpium and Ex: Exine thickness)

<table>
<thead>
<tr>
<th></th>
<th>P</th>
<th>E</th>
<th>Clg</th>
<th>Clt</th>
<th>Plg</th>
<th>Plt</th>
<th>t</th>
<th>Ex</th>
</tr>
</thead>
<tbody>
<tr>
<td>t- value</td>
<td>63.042***</td>
<td>56.524***</td>
<td>52.495***</td>
<td>17.088***</td>
<td>22.859***</td>
<td>30.369***</td>
<td>17.141***</td>
<td></td>
</tr>
</tbody>
</table>

*** \( p=0.001 \) it shows significance level
Many plants can be distinguished by pollen morphology with the pollen diagnosis keys (Erdtman, 1952; Erdtman, 1957; Faegri and Iversen, 1964; Iwanami et al., 1988; Moore et al., 1991; Hesse et al., 2009) formed on genera level. This study has shown that the identification of 2 dogwoods which grows naturally in our country would be in the species level by using palynological parameters.

According to Aytug et al. (1971), the length of the polar axis is \( P \): 62.42 µm and equatorial axis length \( E \) is 56.22 µm for the pollen grains of \( C. \) mas. The colpus length \( \text{Clg} \) for fresh pollen grains of \( C. \) mas has not been measured. The colpus width \( \text{Ctl} \) is 11.18 µm, the porus length \( \text{Plg} \) is 9.30 µm and porus width is \( \text{Plt} \) 11.18 µm. The apocolpium \( \text{t} \) is 11.74 µm and exine thickness \( \text{Ex} \) is detected as 1.17 µm. The pollen type is sphaeroidae and the sculpture is detected as granula. When all these measurement results are considered, there is a sampling error for \( C. \) mas' pollen grains. According to the data of pollen morphology obtained from Aytug et al. (1971), their results should belong to the \( C. \) sanguinea because polar and equatorial axis lengths of its pollen grains are significantly bigger than those of \( C. \) mas.

Mert (2009) also described the pollen length, pollen width, intine and exine thickness of pollen grains of six cornelian cherry (\( C. \) mas) cultivars. The pollen grain length and width for the studied cultivars ranged from 23.63 to 25.13 µm and 24.25 to 27.13 µm respectively. In this study, pollen shapes determined as oblate spheroidal and prolate spheroidal. When (Mert, 2009) pollen grain results compared with our study, only pollen length values found similar.

Moreover, some pollen characters of Cornaceae was investigated by Erdtman (1952), Chao (1954), Moore et al. (1991), and it is found similar to the pollen morphology data of \( C. \) mas in our research.

4. CONCLUSIONS

A considerable difference between \( C. \) mas and \( C. \) sanguinea was found in terms of the variables \( (P, E, \text{Clg}, \text{Ctl}, \text{Plg}, \text{Plt}, \text{t}, \text{Ex}) \) on the level of significance \( p=0.001 \) by using t-test which compares independent samples. The polar and equatorial axis, the length of colpus and porus, apocolpium and exine thickness of \( C. \) mas and \( C. \) sanguinea' pollen grains are quite different from each other. \( C. \) sanguinea pollen size is considerably bigger than \( C. \) mas. Aperture type is tricolporate is the same for both of them while pollen shape is spheroidal for \( C. \) mas unlike the subprolate shape of \( C. \) sanguinea. Both of them have same pollen ornamentation as granulate.

Thus, it is possible to distinguish the pollen of \( C. \) mas and \( C. \) sanguinea on the species level by using with this detailed pollen morphology study.

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