Pollen Morphology of Some Sunflower (*Helianthus annuus* L. Heliantheae) Cultivars

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**Abstract:** Pollen morphological studies have been carried on seven selected sunflower cultivars (P-4223, SANBRO, MERIC-2002, 04TR-063, 04TR-068, ISERA, 04TR-066) by using light microscopy (LM) and scanning electron microscopy (SEM). Pollen grains are tricolporate, spheroidal-oblate, spheroidal, echinate and tectum perforate. Isera has showed differences in pollen dimensions, length of the spine, length of the colpus, exine thickness and perforations in spine base from other cultivars.

**Key words:** *Helianthus annuus* · LM, Pollen morphology · SEM · Sunflower hybrids

**INTRODUCTION**

The sunflower (*Helianthus annuus* L.) belongs to the tribe Heliantheae of the Asteraceae family and is cultivated in many countries for industrial purposes. The sunflower has great economic importance because of its use in the food industry, both as a raw material for cooking oil production and for processing of its dried seeds [1, 2]. In Turkey a number of sunflower cultivars are grown and maintained by farmers. The most important region for sunflower cultivation is the Thrace region of Turkey, especially Edirne, Tekirdaş and Kirkkareli cities. Throughout the Turkey, more than 70% of these sunflower plantations are found in Thrace region [3].

Because the pollen of sunflower is rather heavy and spiny, transferring of pollen is carried out generally by insect pollinators principally bees [4]. Another aspect of the sunflower pollen is its high allergenic potential. The risk of occupational allergy is common especially when there is a close contact or exposure to sunflower pollen [1, 5].

Micromorphological characters are frequently used to complement macromorphological data for discriminating taxa. For this purpose pollen characters are widely accepted as reliable taxonomic characters. There are a lot of studies on pollen morphology of certain members of the plant families via LM and SEM but, relatively few studies have been conducted on cultivars regarding their pollen morphology [6-8].

Although there were intensive studies regarding the pollen morphology of Asteraceae family [5, 9-13], there have not been any studies dealing with pollen morphology of the sunflower cultivars. The investigated cultivars (P-4223, SANBRO, MERIC-2002, 04TR-063, 04TR-068, ISERA, 04TR-066) are of great importance because of their common usage in the sunflower plantations in Turkey.

In this paper an attempt to provide information about the pollen morphology of the seven selected sunflower cultivars, certain quantitative pollen characters are measured and some investigations.

**MATERIALS AND METHODS**

Fresh polliniferous material of seven cultivars of sunflower were obtained randomly from several plants growing and maintained in the experimental field of Trakya Agricultural Research Institute. The names of the cultivars investigated are: 1) P-4223 2) SANBRO 3) MERIC-2002 4) 04TR-063 5) 04TR-068 6) ISERA 7) 04TR-066

The pollen grains were prepared for light microscopy by the standard methods described by Wodehouse [14]. For LM, the pollen grains were mounted in stained glycerine jelly, and observations were made with a Leica DM 1000 microscope, under oil immersion (1000, 1.25) using a 10x eye piece. Pollen morphological observations under LM, including measurements of the Polar axis (P)
Table 1: Pollen morphological parameter of the investigated sunflowers cultivars (μm) (Mean±Standard deviation)

<table>
<thead>
<tr>
<th>Cultivars</th>
<th>P/E ratio</th>
<th>CLg</th>
<th>CLt</th>
<th>Plg</th>
<th>PLt</th>
<th>L</th>
<th>db</th>
<th>dt</th>
<th>Ex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunbro</td>
<td>31.28±1.39</td>
<td>30.8±1.28</td>
<td>1.01</td>
<td>19.67±1.66</td>
<td>9.64±0.78</td>
<td>8.58±0.67</td>
<td>8.75±0.84</td>
<td>32.23±2.02</td>
<td>5.30±0.41</td>
</tr>
<tr>
<td>Isera</td>
<td>31.85±3.14</td>
<td>32.7±2.07</td>
<td>0.97</td>
<td>23.72±3.92</td>
<td>7.76±0.44</td>
<td>6.79±0.46</td>
<td>6.51±0.66</td>
<td>28.60±4.03</td>
<td>6.42±0.49</td>
</tr>
<tr>
<td>04-TR-66</td>
<td>30.32±2.36</td>
<td>29.63±3.17</td>
<td>1.02</td>
<td>19.70±2.15</td>
<td>9.96±0.79</td>
<td>7.72±0.83</td>
<td>7.24±0.59</td>
<td>31.66±1.13</td>
<td>6.31±0.52</td>
</tr>
<tr>
<td>04-TR-68</td>
<td>30.48±1.41</td>
<td>30.23±0.71</td>
<td>1.00</td>
<td>16.36±1.09</td>
<td>6.69±0.20</td>
<td>7.82±0.51</td>
<td>7.48±0.45</td>
<td>29.67±0.51</td>
<td>6.14±0.53</td>
</tr>
<tr>
<td>P4223</td>
<td>27.54±1.42</td>
<td>28.63±3.31</td>
<td>0.96</td>
<td>16.90±0.48</td>
<td>8.00±0.90</td>
<td>6.81±0.73</td>
<td>6.82±0.59</td>
<td>29.78±0.96</td>
<td>5.87±0.65</td>
</tr>
<tr>
<td>Meriç 2002</td>
<td>30.14±1.02</td>
<td>30.22±1.45</td>
<td>0.99</td>
<td>19.75±1.65</td>
<td>9.38±1.13</td>
<td>8.88±0.64</td>
<td>8.80±0.70</td>
<td>29.85±1.78</td>
<td>5.89±0.61</td>
</tr>
<tr>
<td>04-TR-66</td>
<td>29.80±1.51</td>
<td>30.01±1.49</td>
<td>0.99</td>
<td>18.04±0.90</td>
<td>8.30±0.98</td>
<td>6.99±0.83</td>
<td>7.02±0.78</td>
<td>30.59±1.31</td>
<td>6.09±0.61</td>
</tr>
</tbody>
</table>

P: Polar axis E: Equatorial axis CLg: Length of the colpus CLt: Width of the colpus PLg: Width of the porus PLt: Length of the spine dt: Width of the spine

and equatorial axis (E), length of the colpus (CLg), width of the colpus (CLt), length of the porus (PLg), width of the porus (PLt), spine length (dt), width of the spine (dt) and exine thickness were based on 30 fully expanded grains of each cultivar. These measurements are shown in Table 1. For SEM studies, pollen grains were put on stubs, sputter coated with gold plate and examined under Jeol JSM-6060LV SEM in Gazlı University. The terminologies for pollen morphology were used in accordance with Skvarla and Larson [9] and Faegri & Iversen [15].

RESULTS

Light microscope investigations show that the pollen grains are tricolporate, the shape varies from spheroidal (Sunbro, 04-TR-063, 04-TR-066, 04-TR-068, Meriç-2002) to oblata-spheroidal (Isera, P4223), isopolar, echinate and the tectum perforate. The measurements of the pollen dimensions are P(27.5-32.7μm), E(28.6-32.7μm), CLg(16.3-23.7μm), CLt(7.7-9.9μm), PLg(6.7-8.8μm), PLt(6.8-8.7μm), L(28.6-32.2μm), dt(5.3-6.4μm), db(2.8-3.1μm) and Ex (1.0-1.3μm). The spines are conical. The longest polar axis was measured in Isera and the shortest in P4223. The greatest colpus size was determined in Isera and the longest pore size was observed in Meriç 2002. The highest length of the spine was found in Isera and the lowest in Sunbro. The thickest exine (Table 1). Operculum diameters of Sunbro (6.61 0.39), Isera (5.62 0.40), Meriç (5.46 0.69) are bigger relatively than 04-TR-63(4.97 0.55)04-TR-068(4.840.48), P4223(4.640.58) and 04-TR-66(4.61 0.58). SEM investigations showed that the number of the spines in 10μm² was ranged from 3 to 6. There were 6 spines in Isera and 4 in Sunbro, 04-TR-66, 04-TR-063 and 04-TR-068, 3 in P4223 and Meriç 2002. The most perforations in spine base were found in Isera and Meriç 2002, the lowest in 04-TR-063 and P4223. Isera has small perforations in spine base according to others cultivars. The most interspine distance was determined in 04-TR-068 (Figure 1-3).

DISCUSSION

The pollen grains belonging to sunflower cultivars which were investigated for the first time in Turkey are tricolporate, spheroidal, oblata-spheroidal, echinate and the tectum perforate. Skvarla and Larson (1965) described the tectum as perforate in an early TEM study of Compositae [9]. Horner and Pearson (1978) observed that tricolporate pollen of sunflower wall was spumalate, two layered exine (ektexine and endexine) separated by a spacer layer [5]. Perveen (1999) studied on the pollen grains of Tridax L., Eclipta L., Blainvillea Cass, Enhydra Lour. genera found in Helianthae tribe and he stated that pollen grains were isopolar, oblata-spheroidal to prolate-spheroidal, prolate-subprolate rarely suboblate, tricolporate occasionally tetralcolporate, tectum echinate for Helianthae tribe [13]. Skvarla et al. (1977) divided Asteraceae pollen grains into four types according to their exine structures: Heliannothid, Senecioide, Arctotoide and Antemoid [10]. Bolick (1978) said that two basic patterns of exine ultrastructure were found in Compositaeae, the caveate Helianthoid pattern and the non caveate Anthemoid pattern [11]. It was determined differences among the pollen dimensions in examined cultivars. The longest pollen size (P(X)) (31.8±32.7μm) was found in Isera and the shortest in P-4223 (27.5X28.6 μm). While the longest colpus size was measured in Isera (23.72±3.92) the shortest was measured in 04-TR-68 (16.36±1.09). The greatest length of the porus was observed in Meriç 2002 and the shortest in Isera. The spines are conical all cultivars and twisted in Isera (Fig. 1.E). The width of the spine value is almost similar in Isera, 04-TR-68, 04-TR-66 and Sanbro and Meriç 2002 but it is small value in P4223. While Isera had longest spine length, Sanbro had the shortest spine length. The thickest exine was observed in Isera while the thinnest one was measured in P4223. Exine thickness showed similar mean values in taxa examined (Table 1). Perveen (1999) measured Polar axis (13.21-) 19.15±1.05 (-25.1) μm,
Fig. 1: Pollen grains in SEM. A-B Sanbro. A. Equatorial view X1500 B. Exine sculpture with perforations of spine base X8000. C-D P4223. C. Equatorial view X1500 D. Exine sculpture with perforations of spine base X8000. E-F Isera E. Equatorial view X1500 F. Exine sculpture with perforations of spine base X8000
equatorial diameter (16.81-) 24.23±1.23 (-28.71) μm, colpi
(9.81-) 15.76 ± 0.09 (-21.71) μm, apocolpium (1.20-)
5.96±0.59 (-10.72) μm, exine (0.5-) 3.94±0.10 (-4.21) μm in
Heliantheae [13].

According to SEM investigations, the numbers of the spine in 10 μm² area were 6 for Isera, 3 for P-4223 and
Meriç 2002, 4 for Sambro, 04-TR-66, 04-TR-63 and 04-TR-
68. There were more perforations in spine base of Isera
and Meriç 2002 than the other cultivars but Isera has
small perforations in spine base (Fig. 1-3).

04-TR-68 (3.94μm) had the most interspine distance
according to P-4223 (2.86μm). Sambro, Isera, 04-TR-66
and Meriç 2002 (2.5μm) showed similar values. 04-TR-63
(1.75μm) was the least interspine distance. Peveren (1999)
found that interspinal distance was 4.03-4.6 μm in
Heliantheae [13].

Wagenitz (1955) stated that the ekktexine fragments
(ooperculum) on endexine which are progressive
evolutionary characteristics are of important
discriminating features in the Asteraceae family. In
our study it was seen in all cultivars studied. Sambro and Isera
cultivars have the biggest ooperculum diameters among the
examined cultivars [16].

As a result, among the investigated cultivars, Isera
has showed differences in pollen dimensions, length of
the spine, perforations in spine base, length of the colpus
and exine thickness from other cultivars (Fig 1 E,F).

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