Morphological and Autecological Study *Verbascum suworowanum* (C. koch) O. Kuntze, var. *Suworowanum* and var. *Papillosum* (Murb.) Hub.-Mor. (Scrophulariaceae) in the Northeast Anatolia

Abstract: *Verbascum suworowanum* (C. Koch) O. Kuntze, var. *suworowanum* and *Verbascum suworowanum* var. *papillosum* (Murb.) Hub.-Mor. are included in the A group of genus of *Verbascum L.* in Flora of Turkey. A group is different from other groups by having 4 stamens. These two taxa have a local distribution in the Northwest of Anatolia and under the threatened factors. Both of them are local taxa. In this study, the detailed morphological description was not given as accurant previously in Flora of Turkey, the ecological peculiarities, pollen, seed structure and indumentum in SEM are given. The description of these two varieties are supported by palinologic and ecolologic characteristics and some suggestions and studies are started for the conservation.

Key words: Conservation, ecology, palinology, seed structure, *Verbascum*

INTRODUCTION

The genus *Verbascum* L. (Scrophulariaceae) includes about 360 species on Earth[1]. In Turkey, it has 232 species in 13 groups and 126 hybrids[2-3]. Partly artificial groups are used in the Flora of Turkey[2] account. All Turkish species of *Verbascum* and this new species belong to sect. *Bathysperma* Murb.[4-5]

*Verbascum* was previously revised by Huber-Morath for the Flora of Turkey. After that, six species and eight hybrids have been described from Turkey[1-3].


In Turkey, 188 (80%) of the 235 species are endemic[16-17]. The plants are adapted especially to steppe, open places, roadside and stony slopes.

MATERIALS AND METHODS

Soil and plants specimens which are used in this study were collected for *Verbascum suworowanum* var. *suworowanum* in Kars: Tuzluca-Kagizman, 15 km, 1000 m, 10.06.2001, stream pebble pace, N 40° 06' 62", E 43° 34' 96", FAK 3070 (GAZI), Kagizman-Erzurum, 14 km, 1300 m, 10.06.2001, pebble place, FAK 3075 (GAZI). Ibid. 16 km, 12.06.2002, FAK 3274 (GAZI); ibid. 12.07.2002, N 40° 06' 01", E 42° 58' 48", FAK 3362 (GAZI) and *Verbascum suworowanum* var. *papillosum* (Murb.) Hub.-Mor. collected in Agri: Dogubeyazit, Topcatan village (konikork), 09.06.2001, 1550 m, volcanic tuff, N 39° 35' 35", E 44° 10' 91", FAK 3088 (GAZI), ibid. 19.07.2001, FAK 3132 (GAZI); ibid. 12.07.2002, N 39° 35' 10", E 44° 10' 53", FAK 3368 (GAZI), ibid. 02.08.2002, FAK 3392 (GAZI). To determine the properties of the plant communities in the distribution area, herbarium samples were collected from the flora in the sample areas. Having been described according to Davis[5]. The abbreviations of the authors of plant names were checked from Brummitt and Powell[14].

Herbarium specimens are preserved in the in the Herbarium of Biology Department at Gazi herbarium. The morphological observations and biometric measurements were made on fresh as well as herbarium specimens. In all 20 measurements results were evaluated statistically. For palynological studies, pollen and seed samples were taken from the specimens at herbarium Gazi. Pollen preparations were made according to the Wedeholm method[29]. Pollers of each taxon were measured till a

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Gauss curve occurred for long axis (A), short axis (B), A/B, Exine, Intine, length of the colpus (clg), width of the colpus (ctl), amb (the outline of pollen grain seen in polar view), t (the distance between the apices of the two colpi of a zonocolpate pollen grain) and the mathematical average were calculated according to (M) SPSS 8.0 program. Pollen measurements were done by Prior light microscope. X 100 immersion objective were used for measurement. Lengths and widths of 10 seeds of each taxon were measured with Euromex trademark micrometer by using stereomicroscope and average values of seeds were defined. Dry seeds were coated by Polaron SC 502 trademark gold coater and investigated with Jeol JSM-840 A trademark scanning electron microscope.

Soil profiles (0-10, 10-20, 20-30 cm) were studied at each site and soil samples deep were collected. The analysis of soil samples were done according to the followings methods: Bouyoucos[25] Hydrometer method for texture, glass and calomel/combined electrode method for soil reaction, Scheibler type calsimeter for total calcium carbonate, digestion method for amount of organic substance Walkley-Black[26], semi-micro kjeldal method for nitrogen, ammonium-acetate method for potassium, Olsen[27] method for phosphorus (P2O5).

The measurements for Iron, Copper, Zinc and Mangan are done by method of Walkley-Black. The measurements are repeated three times by Perkin-Elmer 3030 B atomic spectrophotometer as 0.01 ppm. The results are evaluated according to Schröder[28].

RESULTS AND DISCUSSION

Morphological characteristics: A series of 6 foundation parameters obtained for both var. suworowianum and var. papillosum are shown in Table 1. Half of the traits are reproductive.

Pollen grains and seed structure: The pollen type in V. suworowianum var. suworowianum is tricolpate. Detailed features of pollen are as follows: polar axis (A) 20.69 µm, equatorial axis (B) 20.86 µm, A/B 0.99. Pollen shape, oblate, aperture features; colpus narrow and long with distinct margin, exine, 0.91 µm intine: 0.50 µm;

<table>
<thead>
<tr>
<th>Characters</th>
<th>var. papillosum</th>
<th>var. suworowianum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height of plants</td>
<td>25-35 cm</td>
<td>30-70 cm</td>
</tr>
<tr>
<td>Basal leaves</td>
<td>undivided, dentate</td>
<td>dentate-lobed to pinnatisect</td>
</tr>
<tr>
<td>Stem</td>
<td>glabdular below, densely covered with obtuse papillae, glabdular hairs above</td>
<td>glabdular hairs</td>
</tr>
<tr>
<td>Lower bracts</td>
<td>ovate</td>
<td>ovate- lanceolate</td>
</tr>
<tr>
<td>Corolla</td>
<td>glabdular outside sometimes sparsely glabdular</td>
<td>sparsely glabdular</td>
</tr>
<tr>
<td>Capsule</td>
<td>5.5 x 4.5-5.5 mm</td>
<td>5.5-6 x 4.5 mm</td>
</tr>
</tbody>
</table>

Table 2: Seed feature of the V. suworowianum var. suworowianum and var. papillosum

<table>
<thead>
<tr>
<th>Seed feature</th>
<th>Shape</th>
<th>Seed surface</th>
<th>Seed colour</th>
<th>Size (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>var. suworowianum</td>
<td>ovate</td>
<td>alveolate- reticulate</td>
<td>black</td>
<td>0.5 x 0.3</td>
</tr>
<tr>
<td>var. papillosum</td>
<td>ovate</td>
<td>alveolate- reticulate</td>
<td>black</td>
<td>0.5 x 0.3</td>
</tr>
</tbody>
</table>

Table 3: Conulate of pollen feature of the V. suworowianum var. suworowianum and var. papillosum

<table>
<thead>
<tr>
<th>Species</th>
<th>A (µm)</th>
<th>B (µm)</th>
<th>A/B</th>
<th>exine</th>
<th>intine</th>
<th>clg</th>
<th>cIt</th>
<th>t</th>
<th>shape</th>
<th>Amb</th>
<th>Sculpture type</th>
</tr>
</thead>
<tbody>
<tr>
<td>var. suworowianum</td>
<td>20.69</td>
<td>20.86</td>
<td>0.99</td>
<td>0.91</td>
<td>0.50</td>
<td>18.17</td>
<td>4.37</td>
<td>2.69</td>
<td>oblate</td>
<td>19.73</td>
<td>reticulate</td>
</tr>
<tr>
<td>var. papillosum</td>
<td>21.35</td>
<td>19.29</td>
<td>1.11</td>
<td>0.86</td>
<td>0.43</td>
<td>17.16</td>
<td>3.70</td>
<td>2.67</td>
<td>prolote</td>
<td>19.09</td>
<td>reticulate</td>
</tr>
</tbody>
</table>

Ecology and conservation: Verbascum suworowianum var. suworowianum is found in local area between Kağızman and Erzurum highway, near Aras valley. Var. papillosum was collected from Toppatan village, around Doğubeyazıt, Ağrı province. The population is not in majority and it is under threatened effects. According to our field observations between 2001 and 2003, the most negative factor for the threatened is the widening of roads. In addition, the distribution of populations is very close to streamside. For the var. papillosum, the most negative factor is the cattle dialing in area. Due of the interesting and sensitive morphological characteristics of these two varieties, both of were in the
Fig. 1: A: *V. sowerbyi* var. *sowerbyi* SEM microphotografy (Pollen), B: Ornamentation (FAK 3362). Magnification: A x 4300, B x 13000

Fig. 2: A: *V. sowerbyi* var. *sowerbyi* SEM microphotografy (Seed), B: Surface (FAK 3362). Magnification: A x 150, B x 500

Fig. 3: A: *V. sowerbyi* var. *papillosus* SEM microphotografy (Polen), B: Ornamentation (FAK 3392). Magnification: A x 4500, B x 13000

Fig. 4: A: *V. sowerbyi* var. *papillosus* SEM microphotografy (Seed), B: Surface (FAK 3392). Magnification: A x 120, B x 450

Fig. 5: A: The general view of glandular hairs on the leaves B: The closer view of glandular hairs (FAK 3392). Magnification: A x 100, B x 300
Table 4: Soil Chemical Analysis of *V. suworowianum* var. *suworowianum* and var. *papillosum*

<table>
<thead>
<tr>
<th>Species</th>
<th>Soil Depth (cm)</th>
<th>pH</th>
<th>Total CaCO&lt;sub&gt;3&lt;/sub&gt; (%)</th>
<th>Organic matter</th>
<th>P&lt;sub&gt;O&lt;/sub&gt;&lt;sub&gt;3&lt;/sub&gt;</th>
<th>NaCl EC 10&lt;sup&gt;-2&lt;/sup&gt;</th>
<th>Na (N)</th>
<th>Ca&lt;sup&gt;2+&lt;/sup&gt;</th>
<th>Mg&lt;sup&gt;2+&lt;/sup&gt;</th>
<th>Na&lt;sup&gt;+&lt;/sup&gt;</th>
<th>K&lt;sup&gt;+&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>var. <em>suworowianum</em></td>
<td>0-10</td>
<td>8.20</td>
<td>1.49</td>
<td>0.97</td>
<td>21</td>
<td>0.59</td>
<td>0.01</td>
<td>2535</td>
<td>127</td>
<td>21</td>
<td>103</td>
</tr>
<tr>
<td></td>
<td>10-20</td>
<td>8.20</td>
<td>1.49</td>
<td>0.97</td>
<td>21</td>
<td>0.52</td>
<td>0.02</td>
<td>2646</td>
<td>123</td>
<td>26</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>20-30</td>
<td>8.30</td>
<td>2.92</td>
<td>0.47</td>
<td>9</td>
<td>0.33</td>
<td>0.02</td>
<td>4985</td>
<td>505</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>var. <em>papillosum</em></td>
<td>0-10</td>
<td>8.10</td>
<td>5.02</td>
<td>2.21</td>
<td>26</td>
<td>0.88</td>
<td>0.01</td>
<td>2371</td>
<td>133</td>
<td>20</td>
<td>153</td>
</tr>
<tr>
<td></td>
<td>10-20</td>
<td>8.20</td>
<td>4.46</td>
<td>1.35</td>
<td>35</td>
<td>0.50</td>
<td>0.03</td>
<td>2263</td>
<td>119</td>
<td>20</td>
<td>205</td>
</tr>
<tr>
<td></td>
<td>20-30</td>
<td>8.20</td>
<td>5.18</td>
<td>0.86</td>
<td>26</td>
<td>0.50</td>
<td>0.02</td>
<td>1504</td>
<td>253</td>
<td>20</td>
<td>153</td>
</tr>
</tbody>
</table>

category of VU (vulnerable) according to Turkish Red Data Book[23].


Var. *suworowianum* and var. *papillosum*; by taking the soil samples, (0-10, 10-20, 20-30 cm), var. *suworowianum* is found as a poor by organic matters, is normal by % of N, is medium by values pH (basic), the lime is very poor by % of total CaCO<sub>3</sub> (Table 4) and is very poor with P<sub>O</sub><sub>3</sub>, %, Ca<sup>2+</sup>, Mg<sup>2+</sup>, K<sup>+</sup> and Na<sup>+</sup>. On the other hand, var. *papillosum*, organic matters is found as middle, % of N is normal, soil reaction is middle of PH (basic), total % of CaCO<sub>3</sub> is poor and P<sub>O</sub><sub>3</sub>, %, Ca<sup>2+</sup>, Mg<sup>2+</sup>, K<sup>+</sup> and Na<sup>+</sup> is poor[24,31].

In this study, it is found that there are some differences between these two varieties:

- Height of plant for var. *papillosum* is 25-35 cm, for var. *suworowianum* is 30-70 cm; basal leaves of var. *papillosum* undivided, dentate, var. *suworowianum* dentate-lobed to pinnatisect; stem for var. *papillosum* glandular below, densely covered with obtuse papille, glandular hairs above; lower bracts of var. *papillosum* is ovate, for var. *suworowianum* is ovate-lanceolate; corolla for var. *papillosum* is glabrous outside, sometimes sparsely glandular, for var. *suworowianum* is sparsely glandular; capsule for var. *papillosum* 5-5.5 x 4.5-5.5 mm, for var. *suworowianum* 5.5-6 x 4.5-5 mm. For these two varieties, any differences are not found for seed characteristics. In both variety, the surface of seed is hollow-reticulate, ovate and black. As a result of analysing the pollen morphology of two varieties, it was determined that they can be divided two group regarding the ratio (A/B) of polar axis to equatorial axis. The pollen type is prolate for var. *papillosum* whereas it is oblata for var. *suworowianum*.

- The size of population of plants is mainly depend of morphological variations, the differences of seeds, genetical variations, the presence of predator in habitat and ecological factors[20-23].

As a result of analysing of soil structure by taking the samples of soil particles, it was determined that var. *suworowianum* has more content of Ca<sup>2+</sup> than that of var. *papillosum*. However, var. *suworowianum* is much poor regarding organic materials and CaCO<sub>3</sub> % than that of var. *papillosum*. Other characters of soil content and habitat are mainly similar.

One of the other important factor that can effect the vigour of species is the flow of gene among these three population. In some of previous studies that carried out in different plant species, it was found among the plant species which are pollinated by insects, the isolation can be seen from 1 m to several km. In future, by detailed studies, the effect of ant, insects and wind on the dispersion of seeds will be examined with the long period of observation within the long part of time.

This species can be the indicator of limestone and tufa when the habitat is take into consideration.

In order to complete the *in situ* activities regarding the conservation of these two rare varieties, the seeds of both var. *suworowianum* and var. *papillosum* are collected carefully and in less amount and kept in seed bank of Çanakkale 18 Mart University, Biology Department and seed bank of İzmir Menemen. The collection of seeds will be continued in long period without damage. On the other hand, we are studying on the germination of seeds, the gaining of plant to cultivation and production of plant.

By improving the new technics on the production of plant, the wild population under threatened will be preserved and excess demand of plant will be provided.

Var. *suworowianum* and var. *papillosum* taxa have narrow distribution and that’s why the population of both of them are under the extinction.
The threatened category of species was previously given as VU (vulnerable) but as it is mentioned above, due to of the ecological reasons and long field observations, the CR (Critically endangered) category can be suggested.

In this region, the endemic plants are in majority and the farmers can be trained or guided to other meadows that has richness of grass, especially to the areas that have productivity on the south and east directions. Of course, it is not possible to preserve all the plant species in this way but at least it can be done for the Centaurea odyssae that is known only from one locality.

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REFERENCES


