INTER-GENERIC VARIATIONS IN POLLEN GRAINS OF THE FAMILY VITACEAE AND THEIR TAXONOMIC SIGNIFICANCE

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Inter-generic variations in the pollen grain characters viz. diameter, wall thickness, protoplasmic area and viability in 50 species belonging to six genera of Vitaceae were studied. Based on such characters, the genera Vitis and Ampelocissus appeared to be close relationship. While Cissus and Cayratia exhibited maximum inter-specific variations for these pollen characters. The species belongs to the genus Leea with sub-oblate to sub-prolate pollen grains, thicker wall and relatively more protoplasmic area than the species of other genera leads to isolation of genus from the family Vitaceae. The correlations among the pollen length and breadth, pollen length and protoplasmic area and pollen breadth and protoplasmic area observed to be significant. Classification and graphic presentation, based on pollen characters shows marked differences in the genera of family Vitaceae and supports the taxonomic treatment of genus Leea in separate family Leeaceae.

Key Words: Pollen characters, Fam. Vitaceae, Variation and correlation studies.

The family Vitaceae comprises about 600 species, belonging to eleven genera distributed in tropical and sub-tropical countries. Taxonomically, these species are classified on the basis of macroscopic characters like plant habit, floral structure, seed, etc. Earlier workers have attempted to classify the Vitis genus, (an economically importan taxon) including cultivated grapes on the basis of fruit, bark, seeds and pollen characters.

The observations on pollen morphology have been reported on Vitis species and varieties by Nair et al. (1964), Bamzai & Randhawa (1965), Chelam & Satyanarayan (1967), Amajad et al. (1969), Prasad (1972), Randhawa & Iyer, (1977), Nema & Sharma (1981) and Liu & Zue (1985). Similarly, pollen morphology on SEM have also been reported by Lombardo et al. (1978), Ahmedullah (1983), Castelli et al. (1986) and Uzum and Iltar (1987).

Reille Mauric (1967) studied pollen morphology of 52 species belonging to nine genera and suggested classification of this family which corroborates with that of Planchon (1887). It will be seen from the above that the information on pollen grains studies of Vitaceae family appears to be meagre. Hence, an attempt has been made to study the inter-generic variations/relationships within the family based on pollen characters of 50 species belonging to six genera.

MATERIALS AND METHODS

Fresh pollen grains from dehiscing anthers of 50 species belonging to six genera, viz., Vitis Linn. (14), Ampelocissus Planch. (3), Ampelopsis Michx (3), Cayratia Juss. (5), Cissus Linn. (12) and Leea Linn. (13) were collected from the grape germplasm main­tained at this Institute. For observations of pollen grains characters, the anthers from matured flowers were fixed in Carnoy’s fluid for six hours and transferred to 70% alcohol for preservation.

Quantitative data on pollen characters like-diameter, pollen wall thickness and protoplasmic area (μm²) were recorded from random 50 unacetolysed pollen grains with ocular micrometer. Pollen grains collected from dehiscing anthers of fully matured flowers were stained in 0.01 aceto-carmine solution. Pollen viability was recorded on stained and unstained randomly selected 500 pollen grains.

RESULTS

Observations recorded on pollen grain size, wall thickness, protoplasmic area and viability of pollen in the six genera are summarized in Table 1.

Pollen shape :

The pollen grains were spheroidal in Ampelocissus and oblate spheroidal in Vitis, Ampelopsis, Cayratia
Table 1: Variation in Pollen grain characters of Family Vitaceae.

<table>
<thead>
<tr>
<th>Genera</th>
<th>No. of species studied</th>
<th>Mean Grain Size (μm)</th>
<th>Mean Diameter (μm)</th>
<th>B/L ratio</th>
<th>Wall Thickness (μm)</th>
<th>Protoplasmic area (μm²)</th>
<th>Pollen Viability (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Length</td>
<td>Mean</td>
<td>Range</td>
<td>Mean</td>
<td>Breadth</td>
<td>Mean</td>
</tr>
<tr>
<td>Vitis</td>
<td>14</td>
<td>18-43</td>
<td>23.1*</td>
<td>16-43</td>
<td>22.3*</td>
<td>22.7*</td>
<td>0.96</td>
</tr>
<tr>
<td>Ampelocissus</td>
<td>3</td>
<td>21-39</td>
<td>30.7</td>
<td>21-39</td>
<td>30.5</td>
<td>30.6</td>
<td>1.00</td>
</tr>
<tr>
<td>Ampelopsis</td>
<td>28-60</td>
<td>38.9</td>
<td>35.5</td>
<td>25-53</td>
<td>37.5</td>
<td>38.2</td>
<td>0.96</td>
</tr>
<tr>
<td>Cayratia</td>
<td>5</td>
<td>28-53</td>
<td>41.6</td>
<td>27-48</td>
<td>39.1</td>
<td>40.4</td>
<td>0.94</td>
</tr>
<tr>
<td>Cissus</td>
<td>12</td>
<td>27-53</td>
<td>40.0</td>
<td>21-50</td>
<td>36.1</td>
<td>38.1</td>
<td>0.90</td>
</tr>
<tr>
<td>Leea</td>
<td>13</td>
<td>28-64</td>
<td>44.8*</td>
<td>25-60</td>
<td>41.4</td>
<td>43.1*</td>
<td>0.92</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>18-64</td>
<td>36.52</td>
<td>16-60</td>
<td>34.48</td>
<td>35.53</td>
<td>0.95</td>
</tr>
<tr>
<td></td>
<td>±8.07</td>
<td>±7.00</td>
<td>±7.55</td>
<td>±0.54</td>
<td>±287</td>
<td>±10</td>
<td>±10</td>
</tr>
</tbody>
</table>

*Significant at 0.05 level.

and Cissus species. Likewise, sub-oblate to sub-prolate shape was noted in Leea species.

Pollen size:

(a) Length- It ranges from 18 to 64 μm with a mean for the family being 36.52 μm. Within the genus, maximum difference has been noted in Leea followed by Ampelopsis and minimum in Ampelocissus. Other genera occupy intermediate position. Mean values are highest in Leea and lowest in Vitis.

(b) Breadth- Range difference is again maximum in Leea followed by Cissus. Mean values suggest more or less similar situations indicated by length means.

(c) Diameter- This gives the average values of length and breadth and was maximum in Leea (43.1 μm), Cayratia (40.4 μm) and minimum in Vitis (22.7 μm).

(d) Breadth/Length ratio (B/L)- Only in Ampelocissus species the pollen grains appeared to be round with B/L ratio being one. In other genera, this ratio indicates oblong nature except in Leea.

Pollen wall thickness:

This character appears to suggest maximum variations in the genus Cissus and minimum in Ampelocissus and Vitis genera. Mean values are highest in Leea and lowest in Vitis. More or less similar trends are noted for protoplasmic area.

Protoplasmic area:

It is an internal area of stained cytoplasm designated as protoplasm of pollen grain. Protoplasmic area was minimum in Vitis species (276 μm²) and maximum in Leea species (1042 μm²). Protoplasmic area of Ampelopsis, Cayratia and Cissus was closely associated with each other.

Pollen viability:

Higher viability is recorded in Ampelopsis species and relatively lower in Leea and Vitis. Higher values in Ampelopsis species might be due to availability of only three species for the study. Interspecific variations in the genus Leea are rather conspicuous.

DISCUSSION

The pollen morphology of family Vitaceae studied by Erdtman (1952), suggest the pollen grains as 3-colporate, oblate, spheroidal prolate. Detailed measurements of pollen morphology of 22 types of Vitaceae have been reported later by Straka & Simon (1967). According to Bamzai & Randhawa (1965), the unacetolysed pollen grains in Vitis species were spheroidal, oblate spheroidal, prolate spheroidal or sub-prolate. Randhawa & Iyer (1977) noted the spheroidal or oblate spheroidal shape of the unacetolysed pollen grains in almost all species and varieties of grapes. In present studies, pollen characters of fresh unacetolysed pollen have been studied with quantitative measurements with procedure as suggested by Erdtman (1952) and Nair et al. (1964). Morphological characters of pollen grains recorded on the basis externally, suggest either oblate spheroidal pollen grains in Ampelocissus or sub-oblate to sub-prolate in Leea species. Most of the species have 3-colporate pollen grains, though in some species (Vitis parviflora, Vitis champini) monomegaporate pollen grains have been noted, thus confirming the earlier report by Nema & Sharma (1981).
Pollen grains of family Vitaceae and their taxonomic significance

Table 2. Classification of genera based on Pollen Characters.

<table>
<thead>
<tr>
<th>Key proposed to the genera of family Vitaceae:</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Pollen grains spheroidal to oblate in shape.</td>
</tr>
<tr>
<td>Pollen size, wall thickness and protoplasmic area below the mean of the character</td>
</tr>
<tr>
<td>Pollen viability below the mean ................. Vitis</td>
</tr>
<tr>
<td>Pollen viability above the mean ............. Ampelocissus.</td>
</tr>
<tr>
<td>Pollen size, wall thickness and protoplasmic area above the mean of the character</td>
</tr>
<tr>
<td>Pollen viability below the mean ............. Ampelopsis.</td>
</tr>
<tr>
<td>Pollen viability above the mean ............. Cayratia.</td>
</tr>
<tr>
<td>B. Pollen grains sub-oblate to sub-prolate in shape.</td>
</tr>
<tr>
<td>Pollen size, wall thickness and protoplasmic area above the mean of the character</td>
</tr>
<tr>
<td>Pollen viability equal to the mean .......... Leea.</td>
</tr>
</tbody>
</table>

Reille Maurice (1967), suggested the classification of the family Vitaceae, based on pollen morphology. Likewise, Tarhavschi & Petria (1968) were reported pollen morphology of 31 species of family Leeaceae, as pollen grains of medium to large in size, sub-oblate to sub-prolate and 3-colporate types of pollen grains.

Average values for pollen size or pollen diameter (expressed as mean of length and breadth) have been observed to be maximum in Leea species (43.1 μm) and minimum in Vitis species (22.7 μm). Both these values differ significantly from the family mean. Thus, based on diameter these two genera can be identified. Similar trends noted for pollen-wall thickness support these observations.

Relationship among the genera of family Vitaceae based on pollen characters revealed that pollen are comparatively smaller in size in Vitis species, while bigger in Leea species (Fig. 1). This also supports the classification of the genus Leea on the basis of its specialized characteristics like shrub habit and stipules. Based on these characters earlier taxonomists have suggested to treat Leeaceae as a separate family comprising of a single genus Leea (Cronquist, 1968).

Pollen-wall thickness also revealed Vitis and Ampelocissus to be close to each other than rest of the genera as both have relatively thin pollen grain wall. It supports the earlier report by Reille Maurice (1967). He proposed a classification, based on exine and pore characters, approaching that of Planchon (1887). Data on protoplasmic area also suggest the above trends.

On further processing these observations by plotting the graph of protoplasmic area (μm²) v/s genus, three groups could be marked on the graph. First group comprises of most of the Vitis and Ampelocissus species, second group of Ampelopsis, Cayratia and Cissus species and third group of Leea species in isolated position (Fig. 2). It is remarkable that the species belonging to the second group genera are closely associated to the some extent suggesting thereby the relationships among these species. This is also confirmed for pollen wall thickness.

Flowers of the Vitis and Ampelocissus have pentameral symmetry, while the Ampelopsis, Cayratia and Cissus have tetramera flowers. Hence, they may have close affinities with each other. Though, Leea has pentameral flowers but it differs in habit and morphological characters (Gamble, 1935, Kanjilal et al., 1936).

Extreme ranges of pollen viability observed in Leea species (7-96 %) might be due to the wide ranges of variations in the localities from which these species have been collected—from Assam to Andaman Islands. Low viability in Vitis species might be due to heterozygous nature of these species ultimately resulting in relatively poor viability.

Correlations worked out for pollen characters suggest the significance in pollen length and breadth, pollen length and protoplasmic area and pollen breadth and protoplasmic area. Pollen size and pollen viability have negative correlation with each other. Coefficient of correlation between pollen characters of family Vitaceae shows as follows.

The classification based on pollen characters shows marked variations on generic level. Key to genera as proposed is shown in Table 2. Ridsdale (1974) has treated Leeaceae as a separate family from Vitaceae. Present data on pollen grain characters also supports the isolated position of the genus Leea. The data also confirm close relationship among Vitis and Ampelocissus species. These observations, in a way, provide additional evidence supporting the taxonomic treatment of the family Vitaceae and isolating the position of genus Leea in separate family Leeaceae.
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