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Research Article

Pollen Morphology of Some Species in the Family Solanaceae

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Abstract: The study investigates the significance of pollen morphology in the systematics of some species in the family Solanaceae. Pollen grains from anthers of *Solanum gilo* Linn., *Solanum macrocarpon* Linn., *Capsicum frutescens* Linn., *Capsicum chinense* Jacq., *Physalis angulata* Linn., *Solanum pimpinellifolium* (L.) Mill., *Datura metel* Linn., *Solanum indicum* Linn., *Solanum torvum* Sw., *Nicotiana tabacum* Linn. were collected and acetolysed and studied according to standard methods. The pollen grains of the species of the family Solanaceae studied looked similar with some differences. Acolpate pollen grains were observed in *Capsicum frutescens*, *Datura metel*, *Nicotiana tabacum*, and *Solanum gilo* while monocolpate was observed in *Capsicum chinense, Datura metel*, *Solanum gilo,* and *Solanum indicum*. Bicolpate pollen grains were observed in *Capsicum chinense*, *Solanum pimpinellifolium, Physalis angulata, Solanum gilo, Solanum indicum* and *Solanum torvum*. Tricolpate pollens were observed in all the species except in *Datura metel* which has only acolpate and monocolpate pollen types indicating that it is a primitive dicotyledon. *Datura metel* pollen grains also have a characteristic thick wall and the highest mean diameter, which delimits it from the other species. *Nicotiana tabacum* is the only species with tetracolpate pollens which is a mark of recent evolutionary descent in comparison to the other species studied. The pollen grains sizes fall into the classification groups minuta (pollen grain diameter 10–25µm) and media (pollen grain diameter 25–50µm).

Key Words: Pollen, Solanaceae, primitive, advanced, colpate.

1. Introduction

The family Solanaceae consists of around 90 genera and 2,600 species (D'Arcy, 1979 and 1991). They are mainly divided between two sub-families, the Solanoideae and the Cestroideae. Only eight genera namely, *Datura, Nicotiana, Schwenckia, Capsicum, Discopodium, Physalis, Withania* and *Solanum* of the family Solanaceae are reported in West Africa and in Nigeria (Hutchinson and Dalziel, 1963). Generally, the family is herbaceous or woody. Many plants in the family are economically important. Products include potato (*Solanum* sp.) and tomato (*Solanum lycopersicum* Linn.). Edible fruits can be found in the genus *Physalis* (Cape gooseberry, Jamberry, Sugar, Cherry, Chinese lantern etc., according to the species and variety), *Capsicum* (sweet and chilli peppers), etc. Most produce poisonous alkaloids and some are commercially important in this connection (*Nicotiana*, *Datura*).

The significance of pollen morphology in Plant Systematics has been stressed by various researchers. According to Stuessy (2009), data from pollen grains are known to be useful at all levels of the taxonomic hierarchy (generic, subgeneric, inter-specific and intra-specific levels), and can often be helpful in suggesting a relationship. The study of pollinic morphology generates information on genetic identity and parentage of genotypes, which is important for the exploration of germplasms aimed at maximizing the use of genetic diversity (He *et al*., 1995). The works of Akinwusi and Illoh (1996) on the pollen morphology of *Hibiscus* and Adedeji (2010) on the Palynology of the genus *Stachytarpheta* show that the study of pollen grains (Palynology) provides useful data for the taxonomy of genera of plants. Adedeji (2005) traced the evolutionary relationships among the three species of *Emilia* based on their pollen morphology. There is a paucity of information on the pollen morphology of the family Solanaceae, most especially in Nigeria. This study

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reports the pollen morphology of some species in the family Solanaceae in Nigeria.

2. Materials and Methods

Pollen grains from anthers of *Solanum gilo* Linn., *Solanum macrocarpon* Linn., *Capsicum frutescens* Linn., *Capsicum chinense* Jacq., *Physalis angulata* Linn., *Solanum pimpinellifolium* (L.) Mill., *Datura metel* Linn., *Solanum indicum* Linn., *Solanum torvum* Sw., *Nicotiana tabacum* Linn. were collected from different locations in Obafemi Awolowo University, Ile-Ife, Osun State Nigeria. Acetolysis was carried out according to the methods of Erdtman (1960). Acetolysed pollen grains were mounted in glycerol and examined under the light microscope. Measurements of wall thickness and pollen diameter were taken for each taxon with the aid of the ocular micrometer inserted in the eyepiece of the microscope. Numbers of furrows on each pollen grain were also counted. Photomicrographs of the acetolysed pollen grains were taken with the aid of Amscope Digital Camera mounted on a light research microscope at ≥ X400 magnification.

3. Results

The pollen grains in the species studied showed several variations. Colpi generally present and pores are not found in any of the ten species studied.

3.1 *Capsicum chinense* Jacq.

The pollen types present are monocolpate (Plate 1E), bicolpate (Plate 1B, D, & F) and tricolpate (Plate 1A & C). Shape is prolate-spheroidal. The mean diameter of the pollen grains is 24.27 ± 0.80µm. Pollen wall thickness is 4.43 ± 0.41µm.

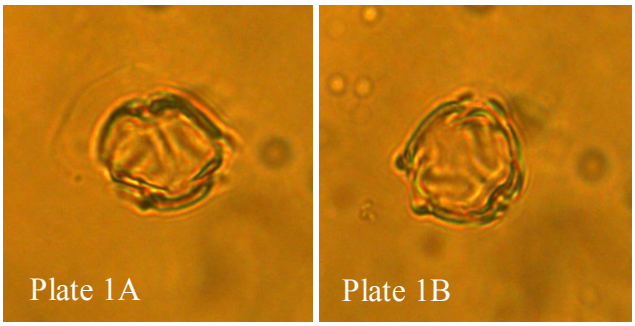


Plate 1A

Plate 1B


Plate 1C


Plate 1D


Plate 1E


Plate 1F

3.2 *Capsicum frutescens* Linn.

Pollen types present are acolpate (Plate 2A), bicolpate (Plate 2B) and tricolpate (2C & D). Shape is prolate-spheroidal. The mean diameter of the pollen is 24.73 ± 0.34µm. Pollen wall thickness is 3.50 ± 0.10µm.

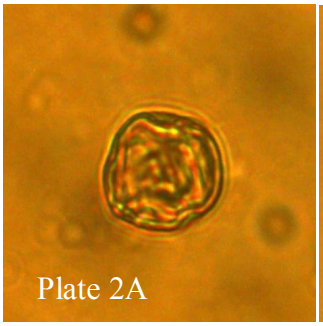


Plate 2A

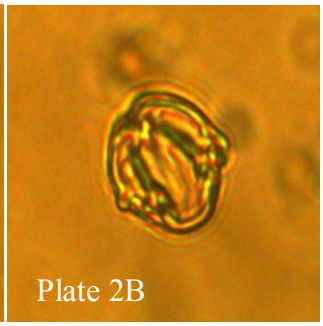


Plate 2B

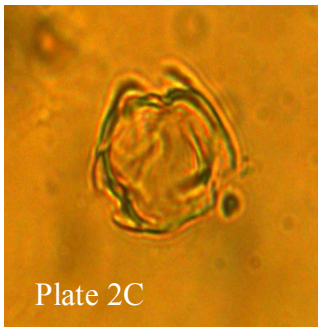


Plate 2C

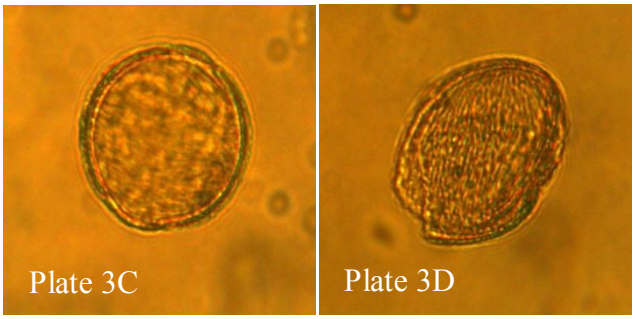

Plate 2D

3.3 *Datura metel* Linn.

The pollen types present are acolpate (Plate 3A, B, C, & E) and monocolpate (Plate 3D). Shape is prolate-spheroidal. The mean diameter of the pollen grains is 48.18 ± 0.96µm. Pollen wall thickness is 6.68 ± 0.58µm.

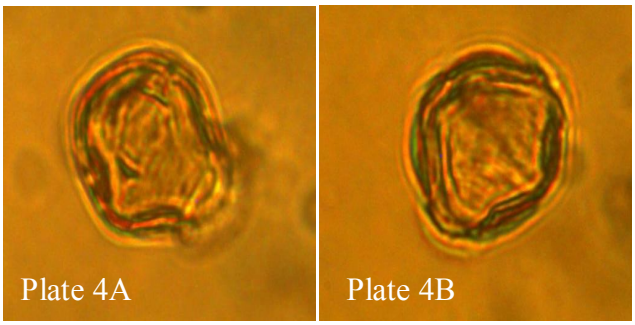

Plate 3A

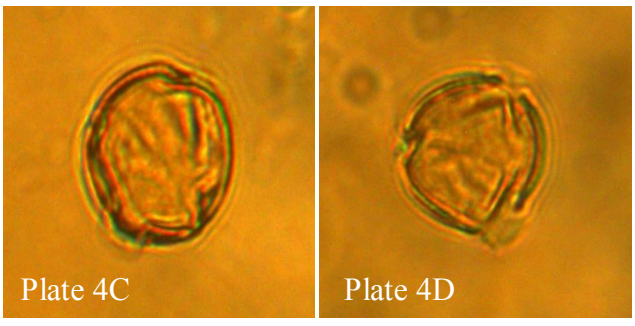

Plate 3B

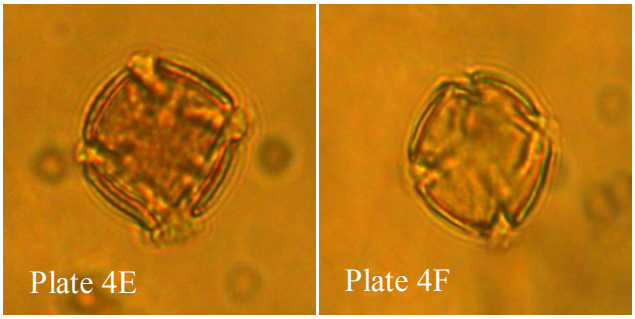


3.4 *Nicotiana tabacum* Linn.

Acolpate pollen grain types present (4A, B & C), tricolpate (Plate 4D) and tetracolpate (Plate 4E & F) also present. Pollen grain shape is prolate-spheroidal. Mean diameter of pollen grains is 27.88 ± 0.32µm. Pollen wall thickness is 3.97 ± 0.32µm.

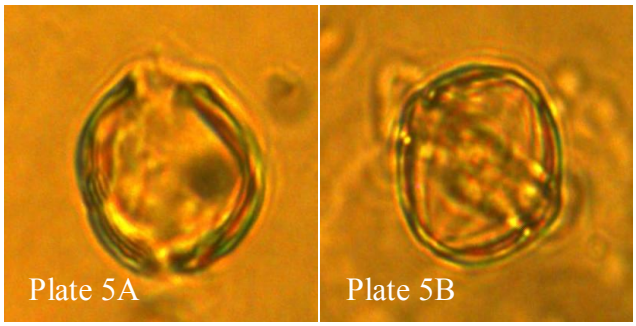


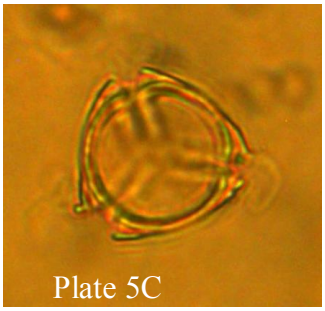




3.5 *Physalis angulata* Linn.

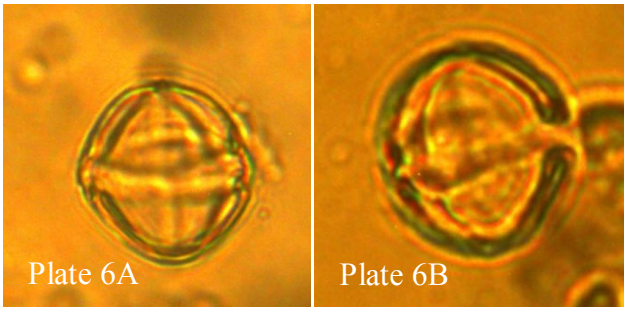
Pollen grain types are bicolpate (Plates 5A & B) and tricolpate (Plate 5C). Pollen shape is prolate spheroidal. Mean pollen diameter is 25.79 ± 0.36µm. Pollen wall thickness is 3.50 ± 0.20 µm.

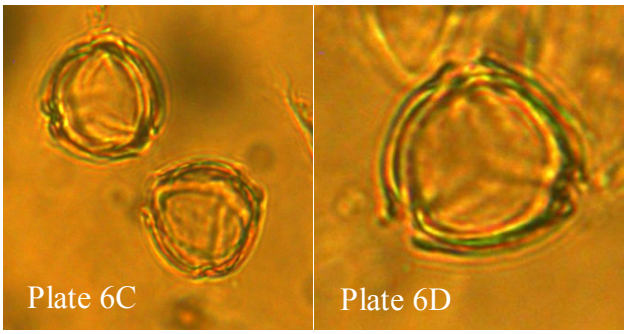




3.6 *Solanum indicum* Linn.

Pollen grain types present are bicolpate (Plate 6A), monocolpate (Plate 6B) and tricolpate (Plate 6C & D). Pollen shape is prolate-spheroidal. Mean pollen diameter is 23.45 ± 0.51µm. Pollen wall thickness is 4.67 ± 0.44µm.

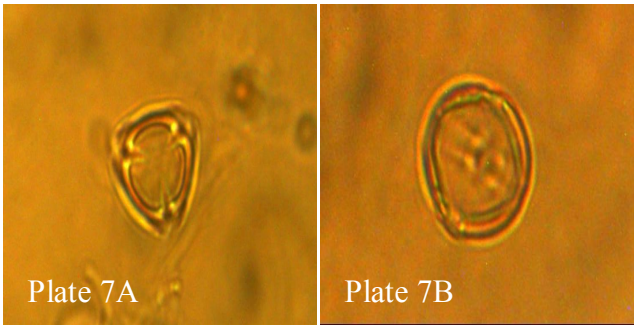




3.7 *Solanum pimpinellifolium* (L.) Mill.

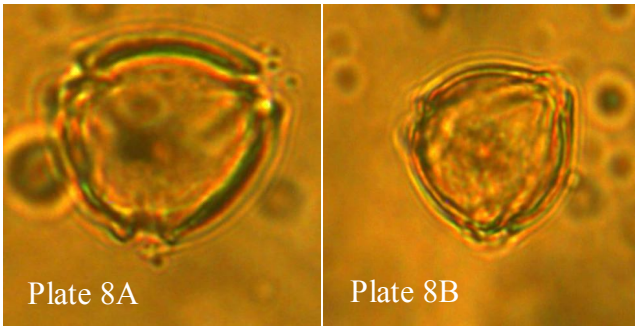
Pollen types are tricolpate (Plate 7A) and bicolpate (Plate 7B). Shape is prolate-spheroidal. Mean pollen

diameter is 20.65 ± 0.39µm. Pollen wall thickness is 4.43 ± 0.41µm.



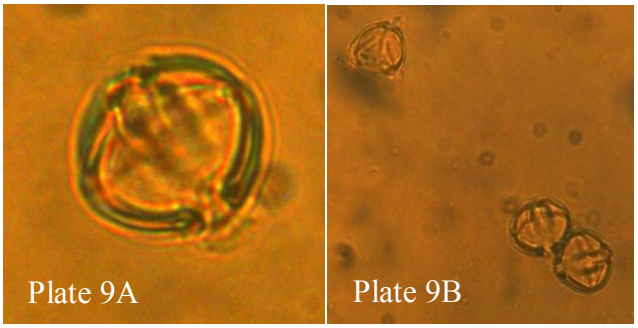
3.8 *Solanum macrocarpon* Linn.

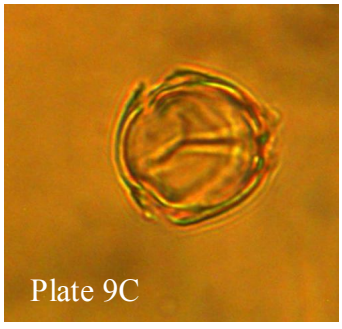
The types of pollen present are tricolpate (Plate 8A & B). Shape is prolate-spheroidal. Mean pollen diameter is 29.87 ± 0.40µm. Pollen wall thickness is 3.97 ± 0.32µm.



3.9 *Solanum torvum* Sw.

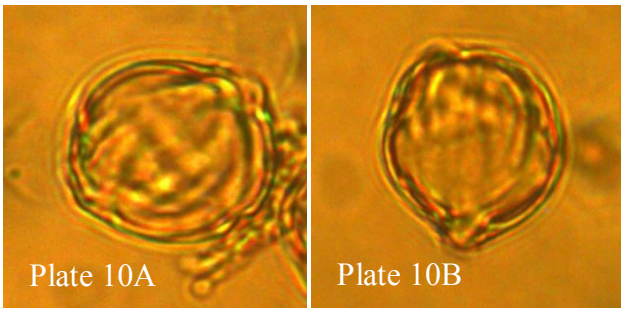
Pollen grain types are bicolpate (Plate 9A & B) and tricolpate (Plate 9C). Shape is prolate-spheroidal. Mean pollen diameter is 27.42 ± 0.37µm. Pollen wall thickness is 4.80 ± 0.47µm.

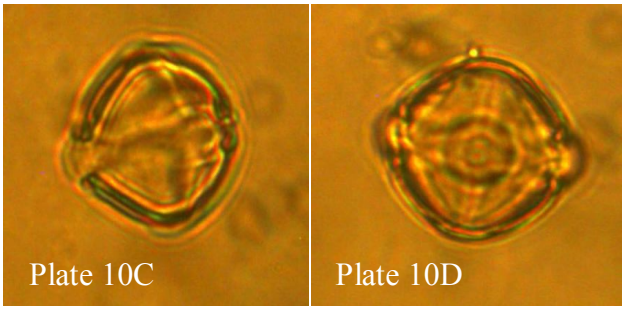


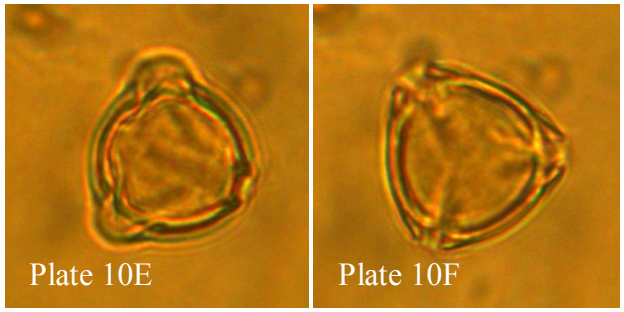


3.10 *Solanum gilo* Linn.

Pollen grain types are acolpate (Plate 10A), monocolpate (Plate 10B & C), bicolpate (Plate 10D) and tricolpate (Plate 10E & F). Shape is prolate-spheroidal. Mean pollen diameter is 28.93 ± 0.34µm. Pollen wall thickness is 3.50 ± 0.25µm.







4. Discussions

The pollen grains of the family Solanaceae are similar with furrows (colpi), no spines and no pores, though there are some differences. The pollen wall has been a subject of considerable attention, especially in an attempt to establish the evolutionary history of angiosperms (Singh, 2006). Number of colpi on pollen grains have been a useful tool in tracing evolutionary relationships among the species of a genus. The advanced dicotyledons have more colpi than the primitive ones, with either a colpus (monocolpate) or none at all (acolpate) (Walker, 1976; Adedeji, 2005). Acolpate pollen grains are observed in *Capsicum frutescens, Datura metel, Nicotiana tabacum* and *Solanum gilo* while monocolpate is observed in *Capsicum chinense, Datura metel, Solanum gilo* and *Solanum indicum*. Bicolpate pollen grains are observed in *Capsicum chinense, Solanum pimpinellifolium, Physalis angulata, Solanum gilo, Solanum indicum* and *Solanum torvum*. Tricolpate pollens are observed in all

the species except in *Datura metel*. *Datura metel* is observed to have only acolpate and monocolpate types of pollen, which indicate that it is a primitive dicotyledon (Walker, 1976; Adedeji, 2005 and Arogundade and Adedeji, 2009), also it has a characteristic thick wall which delimits it from the other species studied. *Nicotiana tabacum* is the only species of the family studied with tetracolpate pollen grains. It can thus be affirmed that the tetracolpate type of pollen grains found in *Nicotiana tabacum* only, is a mark of recent evolutionary development in the species.

The trend in this study with *Datura metel* having only acolpate and monocolpate pollen grains (primitive characters), *Physalis angulata* having only bicolpate and tricolpate pollen grains and *Nicotiana tabacum* having tetracolpate pollen grains (advanced character) supports the observations of Sarkinen *et al*., (2013) who in their work on "the phylogenetic and framework for evolutionary study of the Solanaceae" reported that *Datura* is more primitive than *Solanum, Solanum* is more primitive than *Capsicum, Capsicum* is more primitive than *Physalis* and *Physalis* is more primitive than *Nicotiana*.

Pollen grains have been classified into groups according to their sizes by Erdtman (1952) as perminuta (diameter less than 10µm), minuta (diameter 10-25µm), media (diameter 25-50µm), magna (diameter 50-100µm), permagna (diameter 100-200µm) and giganta (diameter greater than 200µm). Based on this classification, the pollen grains of the species studied belong to groups minuta (diameter 10-25µm) and media (diameter 25-50µm). *Capsicum chinense, Capsicum frutescens, Solanum pimpinellifolium* and *Solanum indicum* belong to the group minuta while *Solanum gilo, Solanum torvum, Solanum macrocarpon, Physalis angulata, Nicotiana tabacum* and *Datura metel* belong to the group media. This grouping supports the findings of Erdtman (1986) who reported that the pollen grains from the Solanaceae vary from 14.5–61.0µm. Adedeji (2010) reported that the three species of the genus *Stachytarpheta* she worked on were in the group size permagna (diameter 100-200µm) and giganta (diameter greater than 200µm). The smallest pollen grain size reported for this family Solanaceae supports the fact that the flowers in the genera are more wind pollinated (that is, the pollens are more wind dispersed) than insect-and-bird pollinated (that is, the pollens are more insect-and-bird dispersed) (Barbola *et al*., 2006).

References

1) Adedeji, O. (2005). Pollen morphology of the three species of the genus *Emilia* Cass. (Asteraceae) from Nigeria. *Thaiszia – Journal of Botany,* 15: 1-9.
2) Adedeji, O. (2010). Palynology of the genus *Stachytarpheta* Vahl. (Verbenaceae). *Notulae Scientia Biologicae,* 2(4): 27-33.
3) Akinwusi, O. and Illoh, H.C. (1996). Pollen grain morphology of some species of *Hibiscus* Linn. *Nigerian Journal of Botany,* 9: 9-14.
4) Arogundade and Adedeji (2009). Pollen grain morphology of three species and a variety of *Ocimum* Linn. (Lamiaceae) in Southwestern Nigeria. *Journal of Science and Technology,* 29(3): 1-7.
5) Barbola, I.F., Laroca, S., Almeida, M.C. and Nascimento (2006). Floral biology of *Stachytarpheta maximiliani* Scham. (Verbenaceae) and its floral visitors. *Revista Brasileira de Entomologia,* 50(4): 498-504.
6) D'Arcy, W.G. (1979). The classification of the Solanaceae. In: J.G. Hawkes, R.N. Lester and A.D. Skelding (Eds). *The Biology and Taxonomy of the Solanaceae.* Academic Press, London, pp. 3-48.
7) D'Arcy, W.G. (1991). The Solanaceae since 1976, with a review of its biogeography. In: J.G. Hawkes, R.N. Lester, M. Nee & N. Estrada (Eds.), *Solanaceae III: Taxonomy, Chemistry, Evolution,* Royal Botanic Garden, Kew, pp. 75-138.
8) Erdtman, G. (1952). *Pollen morphology and plant taxonomy of Angiosperms*. Almqvist and Wiksell, Stockholm, 539 pp.
9) Erdtman, G. (1960). The acetolysis method in a revised description. *Svensk Botanisk Tidskrift*, *Lund* 54 (4): 561-564.
10) Erdtman, G. (1986). *Pollen morphology and Plant Taxonomy. An introduction to Palynology I, Angiosperms*. New York: Hafner, 553pp.
11) He, G., Prakash, C.S., Jarret, R.L. (1995). Analysis of genetic diversity in a sweet potato (*Ipomoea Batatas*) germplasm collection using DNA amplification fingerprinting. *Genome* 38: 938-945.
12) Hutchinson, J. and Dalziel, J.M. (1963). *Flora of West Tropical Africa.* Second edition, Vol. II Crown Agents, London.
13) Sarkinen, T., Bohs, L., Olmstead, R.G. and Knapp, S. (2013). A phylogenetic framework for Evolutionary study of the Knapp nightshades (Solanaceae): a dated 1000-tip tree. *BMC Evolutionary Biology* 13: 1471-2148.
14) Singh, G. (2006). *Plant Systematics*, Theory and Practice, 2nd Edition, Oxford and IBH Publishing Co. New Delhi.
15) Stuessy, T.F. (2009). *Plant Taxonomy: the systematic evaluation of comparative data*. Columbia University Press. 568pp.
16) Walker, I.W. (1976). Evolution of exine structure in the pollen of primitive angiosperms. *Amer. J. Bot.* 61: 891-902.