Further contribution towards petrified flower “Sahanianthus” from the Deccan Intertrappean Beds of India.

Dr. Pratibha Ashishji Paliwal

Assistant Professor
Department of Botany
J. M. Patel Arts, Commerce & Science College
Bhandara (M.S.) – 441904, India.

INTRODUCTION:
The present chapter deals with the further investigation of a contribution to the knowledge of a Sahanianthus flower, the specimens collected from the Deccan Intertrappean series of Mohgaonkalan, M.P., India. Flowers, being delicate structure, are of rare occurrence in fossil floras. So, from the Deccan Intertrappean series some flowers so far have been reported, they are- Sahanianthus (Shukla, 1943[23]; 1944[24]; Chitaley, 1955[2]); Sahanianthus parijai (Shukla, 1948[25]; Dwivedi & Shukla, 1958[10]; Paradkar & Senad, 1984[18]; Sakundarwar et al., 2012[21]); Sahanianthus dimeterium (Shukla, 1958[27]; Dayal, 1967[7]); Sahanipushpum (Shukla, 1950[26]); Sahanipushpum shukla (Verma, 1956[29]); Prakash & Jain, 1964[20]; Chitaley, 1964[3]; Ambwani et al., 2001[1]; Kapgate et al., 2011[12]); Sahanipushpum glandulosum (Prakash, 1955[19]) Chitaleypushpum mohgaoense (Paradkar, 1971[17]; Kokate et al., 2011[15]); Deccananthus savitri (Chitale & Kate, 1972[4]); Raoanthus intertrappea (Chitale & Patel, 1975[5]); Flosfemia intertrappea (Kar et al., 2003[9]); Flosvirulis deccanensis (Kar et al., 2003[9]); Mohgaoanthus deccanii (Dixit, 2003[8]); Chenopodiaanthus mohgaoense (Kapgate et al., 2006[13]); Tetranplasandranthus deccanii (Kapgate et al., 2009[14]). The present flower specimen described here is collected from well known locality Mohgaonkalan, and other such as Keria and Paladaun near Mohgaonkalan, Chhindwara Dist. M.P., India. All the specimens are well preserved, and similar to Sahanianthus parijai but exhibits some new characters & hence it is studied out and considered for further study.

MATERIAL AND METHOD:-
The specimens of this flower had been collected from the Deccan Intertrappean beds of India. The fossils were recovered by physically breaking pieces of chert with hammers, there by exposing three specimens of the flowers longitudinal fractures, unfortunately the counter part of one specimens was missing. Serial sections from each broken surface were prepared by the Cellulose Acetate peel technique. The exposed surface of the specimen was first smoothed by rubbing on a glass plate using a slurry of fine grade carborandum powder. It was then etched with a few drops of 40% hydrofluoric acid and then dust free environment. The peel was removed by starting an edge with a scalpel or razor blade and then carefully pulling it off by hand. Resulting peels were immediately placed under pressure in a clamp to flatten. By repeating the same technique a succession of peels were produced. In other instances, peels were prepared from sliced surfaces of the chert by the standard cellulose acetate method (Darrh H.C. [6]). The peels were mounted on microscope slides under cover slips in the usual manner using Canada balsam or D.P.X. synthetic resin and photographed. The camera lucida sketches of the slides were drawn for detailed study of flower cut in transverse and longitudinal plane.

DESCRIPTION:-
Specimen No. 1 (L.S. flower no.1)
Locality - Mohgaonkalan
The petrified fossilized specimen is nicely preserved and exposed longitudinally. Serial longitudinal peel section was taken only through its part because as its counter part is missing. This flower from its longitudinal plane showing well preserved ovary with ovules, perianth and pedicel but stamens are not observed, (Plate I Fig.1) as observed in other specimens. The flower shows following anatomical details:-

Flower:- A flower is 1.5 mm wide (Plate I Fig.1) it’s length is not possible to measure unfortunately it’s upper part is missing.
Pedicel:- Long and prominent; slightly bent on a side. It is 3.5mm long and 0.38mm wide, thick with vascular tissues seen in L.S. Pedicel has a central vascular cylinder, the detailed structure is clearly visible (Plate I Fig 2). The vasculature and cortical zone is well preserved. They are elongated and straight walled lie in longitudinal rows. No stomata are seen and there is no evidence of any emergence (Plate I Fig 5).

Bract:- Not preserved.

Bracteole:- Not preserved.

Perianth:- It is well preserved but only towards surrounding the ovary so not possible to count the length but it’s width is 0.12-0.15mm. Cellular structure fairly well preserved. Outermost is epidermis, this is followed by layers of parenchymatous. The vasculature supply of the calyx is not well observed.

Androecium:- Not preserved.

Gynoecium:- A carpel consist of spherical ovary and small part of style, the stigma is not preserved. The preserved style part is very soft so not possible to measure exact length, it is 0.14 mm wide. The ovary is stalked, superior and 0.95mm in diameter. Ovary is raised on a thick short stalk in which the vascular bundles can be seen. The ovary wall measures 0.13 mm in thickness, differentiated into an outer thick-walled and inner thin-walled region. The ovules are attached to the central axis of the flower indicating the axile placentation, the septa extending upto the base of the style and thus partitioning the ovary completely (Plate I Fig.2). The axis of the placenta is a cylindrical about 0.5 mm in diameter, consisting of a parenchymatous pith (Plate I Fig 2) and cortex. The ovules are arranged in two vertical rows. Ovules are long raised on a short funicle and each on an average is 0.16 mm long.

Specimen No. 2 (L.S. flower no.2)

Locality - Keria

The longitudinal description of the flower is based on both of sections (part and counterpart) showing nicely preserved gynoecium, perianth, pedicel and ill preserved androecium. The flower is long styled.

Flower:- The flower is long, stalked, with nicely preserved gynoecium showing stigma, style and ovary but observed ill-preserved androecium as observed in other specimens. A flower is 8 mm in length and 2.75mm in breadth at the centre.

Pedicel:- It is not observed in part section because the section is obliquely longitudinally cut but it appear in counterpart part section. It is 1.38mm long and 0.45mm thick in L.S. It consist of epidermis followed by thick walled parenchymatous tissue with centrally situated vascular supply.

Bract:- Not preserved.

Bracteole:- Not preserved.

Perianth:- It is well preserved and measures 6.00 mm long and 0.25 mm broad at base with narrow towards the tip. It is tubular. Cellular structure fairly well preserved. Outermost is epidermis, this is followed by outer 3-4 layers of thick-walled parenchymatous cells and inner 4-5 layers of thin walled parenchymatous cells (Plate I Fig.9). The epiphyllous condition of androecium is observed by identifying the remnant of filament attached the perianth wall at one place. (Plate I Fig.8)

Androecium:- Single ill preserved androecium is found near the style and stigma region of the flower (Plate I Fig.6,11).

Pollen grains:- Some ill preserved pollen grains are observed inside the anther. The detailed structure is not clear (Plate I Figs.11,12,13).

Gynoecium:- It is 4.5 mm in total length comprising a stalked spherical ovary, the elongated style and a capitates stigma. The ovary is raised on a stalk about 0.5 mm long and 0.35 mm in average diameter. Vascular supply is visible in the stalk of the ovary. Style 1.38 mm in length and 0.13 mm in diameter. Stigma oval, 0.75 mm in length and 0.5 mm in diameter. The ovary wall measures 0.14 mm in thickness, differentiated into an outer thick-walled and inner thin-walled layers of parenchymatous region. Placentation is in continuation with the style and appears to be axile. The ovules are arranged in two vertical rows. Ovules are long and narrow, about eight in each row. The ovules are attached to the central axis of the flower indicating the axile placentation, the septa extending upto the base of the style and thus partitioning the ovary completely. The axis of the placenta is a cylindrical about 0.5 mm in diameter, consisting of a parenchymatous pith (Plate I Fig.10) and cortex. The ovules are arranged in two vertical rows. Ovules are long; it is raised on a short funicle and each on an average is 0.16 mm long.

Specimen No. 3 (L.S. flower no.3)

Locality - Paladaun

The specimen was found longitudinally, the following description of the flower is based on the two sections (part and counterpart) are showing gynoecium, perianth and pedicel. The flower is short styled.

Flower:- The flower is medium sized, it is 7.5 mm long and 1.85 mm wide at the middle (Text III Fig.5). After observing both part and counterpart the gynoecium region, perianth and pedicel are fairly well preserved and some ill-preserved part of androecium was observed (Plate II Fig.16).

Pedicel:- The stalk is not observed on the part section, but on counterpart the stalk is clearly seen and its length increases as further the continuous peel section. It is quite prominent and bent on one side. It measures 1.65 mm long and 0.45 mm in thickness. The cellular structure is clearly observed as observed in other specimens (Plate II Fig.11).
Bract:- Not preserved.
Bracteole:- Not preserved.
Perianth:- It is well preserved and measures 5.75 mm long and 0.26 mm broad at base with narrow towards the tip; it is tubular. Cellular structure fairly well preserved. Outermost is epidermis, this is followed by outer 3-4 layers of thick-walled parenchymatous cells and inner 4-5 layers of thin walled parenchymatous cells (Plate II Fig.12).
Androecium:- Not well preserved. But some blackish structure showing the appearance of pollen grains (Plate II Fig.16).
Gynoecium:- It is 1.58 mm in total length comprising a stalked spherical ovary , the short style and a capitates stigma . Vascular supply is visible in the stalk of the ovary (Plate II Fig.13). Style short and 0.47 mm in length and 0.35 mm in diameter. Stigma capitae 0.42mm in length and 0.38 mm in diameter. The ovary wall measures 0.1 mm in thickness, differentiated into an outer thick-walled and inner thin-walled layers of parenchymatous region. Placentation is not well preserved but appears axile. The ovules are not observed.

DISCUSSION, IDENTIFICATION AND COMPARISION:-
The three specimens described above are similar in structure but none of them is quite complete, so all 3 specimens give a connected account of the flower as a whole.
- Flower is pedicellate, actinomorphic, bisexual.
- Perianth gamophyllous of 6-8 members arrange in one whorl, valvate aestivation.
- Anthers 8-12, epipetalous, protandrous, arising from near the top of the calyx tube, some opposite and some of them alternating with perianth, filament short, dorsifixed with four elongated pollen sacs dehiscing longitudinally
- Pollen grains round, tricolpate and psilate.
- Gynoecium with simple stigma; long and short length style and a spherical ovary on a short stalk.
- Ovary superior.

Comparison with reported fossil dicot flowers:-
The present flower is compared with the reported fossil dicot flowers:-
As evident from the above description, the present flowers show following important common characters shared by this flowers & Sahnianthus parijai.
- Flower is pedicellate, bisexual, actinomorphic, heterostylos, hypogynous.
- It is observed that the three longitudinal specimens described above are varying 5.5 mm to 8 mm in length and 1.5 mm to 2.75 mm in breadth.
- The perianth lobes are 8, arranged in one whorl, gamophyllous but upper 1/3rd free with valvate aestivation.
- Stamens are 11-12 and epipetalous and are of unequal in length because of their insertion on throat of calyx tube at various heights. Filaments are short and curved inwards. Anthers are dorsifixed with two lobes and 4 pollen sacs.
Connective situated 1/3rd the distance from the top end of the anther, dehiscence by longitudinal slits. Pollen grains were 41 \( \mu \text{m} \) in size, smooth, tricolporate, psilate and subprolate.

- Pollen grains are tricolporate and psilate.
- Gynoecium total length 4.4 mm in long styled flower and 1.6 mm in short styled flower. Ovary superior, short stalked. 1.5 mm in diameter, 8 locular, axile placentation, placenta continuous up to the base of the style, ovary completely septate from top to bottom, 2 ovules in each locule.
- Stigma is capitate, styles of varying length; 0.42 mm long in short styled flower and 1.4 mm long in long styled flower.

Apart from these similar features there are certain differences observed between them. *Sahnianthus parijai* has bracts & bracteoles whereas these structures are not observed in present flowers. *Sahnianthus parijai* has nectary at the base of ovary which is not observed in present flower.

Another interesting feature is noted regarding the development of anthers i.e. protandrous nature (as stated by Chitaley, 1955[2]) is observed in present flowers. It is observed that the anthers develop earlier than the maturation of ovary, thus exhibiting clear protandrous condition of flower (T.S. Sp. no.2), shows mature well developed dehisced anthers with pollen grains, but the is young, immature. Similarly, in L.S. flowers (L.S. Sp. no. 1,2,3) & in T.S. flower (T.S. Sp. no.1), the all 4 specimens shows matured ovary with well developed ovules, but no observation of anthers; only some traces is found in L.S. Sp. no. 2 & 3. Thus a flower show a clear protandrous condition.

The present fossil flower is compared with another species of *Sahnianthus* flower i.e. *Sahnianthus dinectrianum* but it is different from present flower because of the presence of two nectarines, an epicalyx and probably a corolla; such structures are absent in present flowers.

It is also compared with *Sahanianthus parijai* (Paradkar and Senad, 1984[17]) in all general character. The zygomorphic condition shown by their specimen, is not observed in my all five specimens. I agree in actinomorphic condition given by others. So, It is compared with tribe Nesaceae of family Lythraceae.

The affinities are also discussed with modern families for taxonomy of *Sahnianthus*. The flower genus of *Sahnianthus* was assigned by Shukla (1944[23]) to the tribe Nesaceae of Lythraceae); because the flower was considered by him as actinomorphic, heterostylous, having episepalous stamens, tubular calyx and superior ovary.

Mahabale and Deshpande (1957[16]) while discussing the affinities of Sonneratia with fossil fruit *Enigmocarpon* and flower *Sahnianthus*. There is no gibbous calyx in Sonneratia and indefinite stamens are situated on a definite in projected ridge of hypanthium tissue while in *Sahnianthus* stamens of unequal length arise from the calyx (episepalous) but are not situated on an inner ridge of hypanthium tissue. Indefinite stamens distinguish Sonneratiaeae from the Lythraceae.

Thus, it is observed that *Sahnianthus* is not a flower of Sonneratiaeae as stated by Mahabale and Deshpande.

If the fixed character of axile placentation, superior ovary raised on a stalk, the no. of stamens (much less than Sonneratiaeae) are taken into account it is evident that *Sahnianthus* represents a flower of Lythraceae.

Thus the above described 3 specimens, collectively give an idea of the different parts of the same flower. On the basis of this data, a tentative floral formula has been reconstructed.

**FLORAL FORMULA:**

\[ \Theta, G, P_{(6-8)}, A_{8-12}, G_{(6-12)} \]

**REVISED DIAGNOSIS:**

*Sahnianthus*

Stalk 3.5x 0.38 mm in size, slightly bent, flower heterostylos, bisexual, hypogynous, actinomorphic, gamophyllous about 5.5 to 8 mm long & 1.5 to 2.75 mm broad at middle. Perianth lobes are 6-8 arranged in one whorl, tubular, valvate and gibbous, dicotyledonous nature. Androecium at least 8-12, protandrous, epipetalous, dorsifixed, 2-lobed, connective situated 1/3 rd the distance from the top end of the anther, dehiscence by longitudinal slits; measures 0.65 - 1 mm long & .25- 40 mm thick. Pollen grains spherical, 41 \( \mu \text{m} \) in size, smooth, tricolporate, psilate and subprolate. Gynoecium stalked, superior. Styles are of varying length; it is short styled or long styled; Long style 1.4 mm x 0.13; short style 0.42 x 0.35 mm in size. Stigma capitates, slightly swollen thorn style, papilllose 0.6 to 0.75mm in length and 0.5 to 0.7 mm in diameter.
REFERENCES:


PLATE - II (L.S. Sp. no. 3)

Specimen No. 1 [L.S. flower no.1 (Fig. 1-5)]
Fig.1 - Flower exposed on fossiliferous chert, cut longitudinally showing pedicel (S), perianth (P), part of Style (St) and ovary (Ov) with ovule (O).

Fig.2 - Upper part of the flower magnified showing perianth (P), and ovary (Ov), ovary wall (Ow) with it’s internal structure ovules (O) on central axis (A) and it’s basal part ovary stalk (Os) with vasculature (V).

Fig.3 - Few ovules (O) in Magnified showing its attachment i.e. funicle (f).

Fig.4 - Basal part of ovary showing ovary stalk (Os) with vasculature (V).

Fig.5 - Pedicel of flower in L.S. showing it’s internal structure pith (Pi); vascular bundle (Vb); Epidermis (E) and cortex (C).

**Specimen No. 2 [L.S. flower no.2 (Fig. 6-13)]**

Figs.6-7 - Various stages of Flower cut in L.S. exposed on fossiliferous chert showing Pedicel(S), Perianth(P), Stigma(Sg), Style (St), ovary (Ov) and ill preserved Anthers(An).

Fig.8 - Magnified perianth lobe showing attachment of anther filament (F).

Fig.9 - Magnified perianth lobe showing epidermis (E) and vasculature (V).

Fig.10 - Ovary with numerous ovules (O) on central axis (A) showing ovary wall (Ow); ovary chamber (Ch) and it’s basal portion ovary stalk (Os).

Fig.11 - Magnified view of anther (An) with pollen grains (Pg).

Fig.12 - Few pollen grains inside the pollen sac (Ps).

Fig.13 - Pollen grains (Pg) in Magnified view.

**Specimen No. 3 (L.S. flower no. 3):**

Figs.1-10 - Various stages of Flower cut in L.S. exposed on fossiliferous chert showing Pedicel (S), Perianth (P), Stigma (Sg), Style (St), Ovary (Ov) and ill preserved pollen grains (Pg).

Fig.11 - Pedicel of flower in L.S. showing it’s internal vasculature (V).

Fig.12 - Perianth (P) lobe showing epidermis (Epi) and vasculature (V) magnified.

Fig.13 - Ovary in magnified view showing ovary wall (Ow), ovary chambers (Ch) and it’s basal part ovary stalk (Os) and vasculature (V).

Fig.14 - Magnified view of ovary wall (Ow).

Fig.15 - Magnified view of stigma (Sg).

Fig.16 - Pollen grains (Pg) in magnified view.