A Permineralized Palm Fruit From The Deccan Intertrappean Series Of Pudiyal Mohada In Jivati Taluka Of Chandrapur District, Maharashtra.

Kapgate D.K.[1], Paliwal Pratibha A.[1] & Paliwal Taradevi S.[2]

[1]P.G. Department of Botany, J. M. Patel College, Bhandara (M.S.) – 441904, India.
[2]Nutan Kanya Junior college, Bhandara (M.S.) – 441904, India.

ABSTRACT: The present paper deals with a monocot palm fruit reported from the Deccan Intertrappean Series of Pudiyal mohada (N 19^0 342' & E 79^0 186'**;** 382 m); a new locality in Chandrapur district, It is a sessile, obovoid to slightly trigonous, quandrangular, unilocular drupe with single seed in a locule. It Measures 2.5-0.5 cm long; 1.5-0.3 cm broad & 0.5-0.2cm thick. Fruit wall differ into three zones. Seed is oval, bitegmic, endospermous with central cavity. It show close resemblance with living fruit of Livistona of family Palmae but not in Toto. Hence it is kept in the same form genus Palmocarpon (Miquel, 1853) [16] and a new species is created to accommodate this fruit as **Palmocarpon chandrapurense** sp. nov.

Keywords: – Fossil Monocot Fruit, Palmae, Palmocarpon, Deccan Intertrappean, Pudiyal mohada.

INTRODUCTION:-

The material for the present investigation was collected by us from Pudiyal mohada (N 19^0 342' & E 79^0 186'**;** 382 m); a new locality in Chandrapur district, Maharashtra. Chandrapur is the easternmost district of Maharashtra and lies between 19^0 30' and 20^0 45' North latitudes and 78^0 48' and $80^0$55' east of longitudes. It covers an area of 11,443 sq.km. Geologically this area is well known as Gondwana belt but few Deccan Intertrappean exposures are also found. Some of these are Shankar lodi, Paramdoli, Maraipatan, Lendiguda, Pudiyal mohada, Kakezari, Chikhali, Bhari. Most of these localities consist ill preserved plant materials and gastropods. So far only **Nautiyalocarpon patanii** (Dahegaonkar, 2002 [01]; Kapgate et al.,2006 [05]); **Selaginella homophylii** (Kapgate & Wanjari, 2014) [09]; **Marsilea patanii** (Patil et al.,2014) [10]; **Palmocarpon patanii** (Patil et al.,2016) [11] are reported from Patan (Maraipatan) locality.

Species of **Palmocarpon** have been described from the intertrappean beds by Sahni (1934 [17], 1964 [18]); Sahni & Rode (1937) [19]; Mahbale (1950) [14]; Prakash (1954 [12],1960 [13]); Trivedi & Chandra (1973) [23]; Shete and Kulkarni (1980 [20],1985 [21]); Mehrotra (1987) [15]; Kapgate et al.,(2011) [06]; Patil et. al.,(2016) [11]. Palms occur quite commonly in the Indian Tertiary's especially in the Intertrappean Beds.

The present paper deals with the study of five specimens of monocot palm fruit which are collected from a new locality exposed near village Pudiyal mohada on Gadchandur-Patan road and 25 km away from Gadchandur of Jivati taluka, Chandrapur District. The locality shows well preserved fossil flora of all plant groups belongs to Deccan Intertrappean Beds of India of Uppermost Cretaceous (Danian) to lower Eocene period. Kapgate et al.,(2016) [08] described monocot stem and roots and a dicot flower and capsular fruit from this same locality as named **Palmoxylon sp; Rhizopalmoxylon sp.; Sahnianthus sp.; Enigmocarpon chandrapurense.** One new petrified palm fruit described in this chapter from Deccan Intertrappean beds of Pudiyal mohada locality of Chandrapur district.

MATERIAL AND METHOD:-

The fossiliferous fruits were recovered by physically breaking the chert with hammers, the fruits were exposed in longitudinal and obliquely transverse plane. The study is based on five specimens cut in their longitudinal and obliquely transverse plane. After etching the specimens with hydrofluoric acid (HF), serial peel sections are taken for further study by Cellulose Acetate peel Technique (Darrah, 1936 [02]; Joy et al., 1956 [04]; Stewart and Taylor, 1965 [22]; Holmes and Lopez, 1986 [03]; Kapgate et al., 2012 [07]) and peels were produced. The peels were mounted on microscope slides under cover slips using Canada balsam or D.P.X. synthetic resin and photographed for detailed study of fruit cut in longitudinal plane.

DESCRIPTION:-

The palm fruit described here were based on study of five specimens. It was partly embedded in the rock and was partly exposed. The fruit is a drupe and all the five specimens are of medium size and varying in general size and shape but show common external and internal features. The pericarp of the fruit resembles that of a palm fruit. It is made up of thin epicarp; semifibrous mesocarp and hard endocarp. Seed ellipsoidal and endosperm tough, formed of thick-walled cells. Embryo conical, attached to the apex of seed.

The specimen 1 is cut from the longitudinal plane of the fruit; compressed and slightly elongated antero-posteriorly. It is somewhat obovoid in shape, about 2.5 cm long; 1.5 cm broad & 0.5 cm thick. The fruit showing thin epicarp; semi-fibrous mesocarp and hard endocarp (Plate Fig.1,2,3). The specimen 2 is cut from the obliquely transverse plane of the fruit; it is slightly trigonous, somewhat obovoid in shape, about 1.1 cm long; 0.5 cm broad. Pericarp show ill preserved epicarp; semi-fibrous, thick mesocarp and thin endocarp (Plate Fig.4,5). The specimen 3 is cut from the obliquely transverse plane of the fruit; it is quadrangular throughout it's length, about 1.3 cm long; 0.9 cm broad. Pericarp show ill preserved epicarp; semi-fibrous, thick mesocarp and thin endocarp (Plate Fig.6). The specimen 4 is cut from the obliquely transverse plane of the fruit; slightly trigonous in shape, about 0.7 cm long; 0.6 cm broad. Epicarp is not preserved; semi-fibrous thick mesocarp and thin endocarp (Plate Fig.7). The specimen 5 is cut from the obliquely transverse plane of the fruit; Fruit is trigonous to slightly obovoid in shape, about 0.7 cm long; 0.6 cm broad. Fruit wall (Pericarp) shows similarity as found in other specimens (Plate Fig.8).

All above specimens have same morphological and anatomical structure. The nature of the fruit is drupaceous and of medium size. The pericarp of the fruit is similar to that of a palm fruit**.**

Pericarp (Fruit Wall):-

It is well preserved and differ into thin epicarp, a semifibrous mesocarp and hard endocarp. Thickness varies from top to base and ranges from 0.52mm to 0.56mm. It is more thickened at lower side.

Epicarp- It is the outermost thin layer of 1 to 2 cells in thickness consists of more or less rectangular, compactly arranged parenchymatous cells. It measures 42 to 45 µm in thickness. Each cell measures 23 to 30 µm in size. Epicarp is somewhat wavy in outline.

Mesocarp- Mesocarp fibrovascular present below the epicarp. It is massive, about 408 to 442 µm and 10 to 12 cells in thickness. It contains sclerenchyma and parenchyma with fibrous bundles. Mesocarp contains cavities at intervals where there are ridges and measures 90 to 95 µm in diameter. Different kinds of vascular bundles in different zones. Ground tissue is composed of loose, thin walled parenchymatous cells of various dimensions. Numerous big cells scattered in the mesocarp. Fibrous bundles are more or less oval and measures 45 to 52 µm in size with frequency of 5 per mm^2. Fibrovascular bundles are conjoint, collateral and closed.

Endocarp- It is 3 to 4 layered, hard sclerenchymatous forming hard coating around the seed coat. It measures 73 to 78µm in thickness. Endocarp is separable from mesocarp showing number of canals. Fibrous and fibro-vascular bundles completely absent from this zone. (Plate Fig.10,11).

Seed :– It is a single large oval in shape. It is attached to the basal placenta by stalk. Seed occupies maximum lumen of the fruit. Size of seed measures 5.14mm to 4.90mm. The seed stalk is short. It is well preserved with central hallow cavity called endosperm cavity. Seed coat is about 145 to 148 µm thick, consisting testa and tegmen. Testa is 3 to 4 layers in thickness. Tegmen consists of angular cells of 4-5 layers merged with endosperm tissue. Seed is distinctly grooved with the endocarp ridge dipping into it (Plate figs. 3 & 5).

Endosperm :– It is surrounded by definite layer of seed coat. Endosperm is massive with embryo and endospermous cavity. It is albumenous and solid nearest to the endospermous cavity. Cells in endospermous cavity are irregular loosely arranged confirming fluidy nature. Endosperm is 4.4mm x 3.6mm in size. Endosperm cavity is variable in size.

Embryo :– It is not clearly preserved in the present specimen but at some places few cells shows embryonic nature.

DISCUSSION:-

From the above description following important features confirmed its identification:

a. Fruit is sessile, unilocular single seeded obovoid to slightly trigonous, quadrangular in shape.
b. Fruit wall is wavy, massive where seed is attached by short stalk.
c. Pericarp differentiated into three zones i.e. Epicarp, Mesocarp and Endocarp.
d. Epicarp is thin, Mesocarp is thick and massive containing fibres and fibrovascular bundle and Endocarp is Sclerenchymatous and hard.
e. Seed is oval in shape, bitegmic containing endosperm with endosperm cavity.
f. Embryo could not been observed but might be one.

From above characters the present fruit represents indehiscent monocot drupaceous fruit containing single large seed. It is compared with reported fossils and fruits of modern plant of monocot families.

IDENTIFICATION:-

Comparison with Fossil and Living Plants :–

The present fruit is compared with known species of Palmocarpon. On comparison it does not show close resemblance to any known species of Palmocarpon. P. compressum (Sahni and Rode, 1937 [19]; Sahni, 1964 [18]), differs in size of the fruit and seed, in absence of aborted carpels. Palmocarpon insigne (Mahabale, 1950 [15]), another palm fruit also differs considerably from the present fossil in size and shape and presence of stellete fibres. In the Palmocarpon sulcatum (Prakash, 1960 [13]), fruit is quadrangular with a slight groove, membranous epicarp and are not comparable with the present fossil fruit. In Palmocarpon indicum (Prakash, 1954 [12], 1960 [13]), fruit is ovate with 4-6 longitudinal ridges on surface, hard endocarp. These characters are not seen in the present fossil fruit. Palmocarpon takliensis (Sahni,1964 [18]), is known from the Takli, Nagpur, differs from the present fruit in the shape of the fruit and the presence of numerous very fine ribs on the surface radiating from the apical umbo. Palmpcarpon bracteatum (Sahni, 1964 [18]), differs in the shape of the fruit i.e. sub-spherical and attachment on an axis bearing short, thick, broad, rounded, longitudinal ribbed bracts. Palmocarpon mohgaoense (Prakash, 1954 [12]), is different in trigonous shape with four longitudinal ridges on the surface of fruit. Palmocarpon splendidum (Trivedi and and Chandra, 1973 [23]), is also different from the present fruit. Palmocarpon rodei (Kapgate et al., 2011 [06]) and Palmocarpon patanii (Patil et al., 2016 [08]) differs from present specimen in having apical opening which is not found in present specimen.

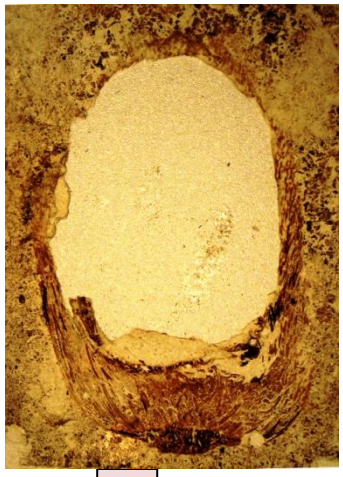
PLATE

1 2 3 4

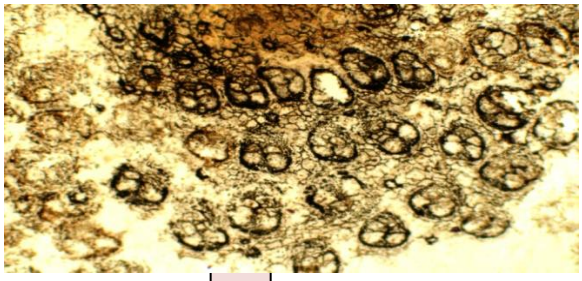
5

6

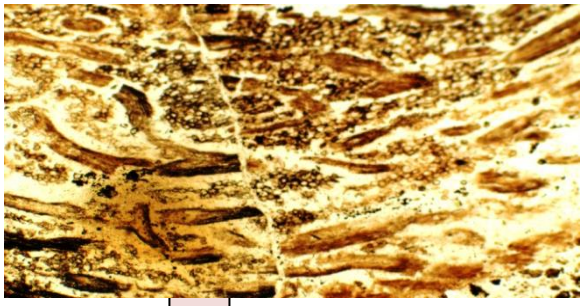
7



8



9



10

Since the present fossil fruit does not show affinities with any of the fossil but nearly resemble with living fruit of Livistona of family Palmae with some differences. Hence, it is kept in the same form genus Palmocarpon (Miquel, 1853) [16] after comparision with recorded fossil fruit and living fruit; all the five specimens were kept under genus Palmocarpon (Miquel, 1853) of family Palmae. As the specimens are collected from the Pudiyal mohada of Chandrapur District.; the present fruit is named as **Palmocarpon chandrapurense** sp. nov.; the species name is after the name of district of locality.

SYSTEMATIC POSITION

Angiosperms
Monocotyledons
Palmae (Arecaceae)
Palmocarpon (Miquel, 1853) [16]

Palmocarpon chandrapurense sp. nov.

Palmocarpon chandrapurense sp. nov.

Monocot palm fruit, sessile, unilocular single seeded drupe obovoid to slightly trigonous, quandrangular in shape. The fruit is medium in size measures 2.5-0.5 cm long; 1.5-0.3 cm broad & 0.5-0.2cm thick. Fruit wall measure 0.52 mm to 0.56mm in thickness and divided into thin epicarp, massive mesocarp and thick endocarp; epicarp 42- 45 µm thick, parenchymatous; mesocarp fibrous; fibrovascular and with stalk vascular bundles; mesocarp measured 408 to 442 µm in the thickness, sclerenchymatous; endocarp measured 73–78 µm thick contains sclerenchymatous tissue; endosperm solid measured 4.4mm x 3.6mm with central endospermous cavity, endosperm cavity is variable in size and fluidy in nature; seed covers with bitegmic seed coat measuring 145 to 148 µm thick; size of the seed 5.14mm to 4.90mm in diameter; Embryo is not clearly observed.

Holotype:- PAP/Ang/Mfr2/ Deposited at Botany Dept. J. M. Patel College, Bhandara, M.S. India.
Horizone:- Deccan Intertrappean Series of India.
Locality:- Pudiyal mohada, Chandrapur Dist. (M.S.)

Age :- ?Uppermost Cretaceous to lower Eocene.

Plate Fig.1-11: **Fig.1** - Fruit in L. S. towards one side of the median line with seed cavities. Embryo is seen at the apical end of the well-developed seed. (Sp.no.1).**Fig.2** - Basal half of the longitudinally cut fruit magnified to show epicarp, mesocarp and endocarp of specimen no.1. **Fig.3 -** Magnified seed showing endosperm & seed of specimen no.1. **Fig.4** - *Palmocarpon* fruit on chert (Sp. no.2).**Fig.5** - Fruit in obliquely transverse section (Sp. No.2).**Fig.6** - Fruit in obliquely transverse section (Sp. No.3).**Fig.7** - Fruit in obliquely transverse section (Sp. No.5). **Fig.8** - Median L.S. of the fruit. **Fig.9** - T.S. of the mesocarp showing a Transversely cut bundle embedded in loose parenchyamatous ground tissue. **Fig.10**- L.S. of the mesocarp showing a fibro-vascular bundles.

REFERENCES:-

[1] Dahegaonkar R R (2002) : Investigation of fossil flora from the Deccan Intertrappean Beds of Chhindwara (M.P.) and Yeotmal District (M.S.).**Ph.D. Thesis,Nagpur University**, Nagpur.
[2] Darrh H.C.(1936). **A Peel Method in Palaeobotany.** Harward Uni. Bot. Nus. Leaflet 4: 69-85.
[3] Holmes, J & Lopez, J (1986). The disappearing peel technique: an improved method for studying permineralized plant tissue. **Palaeontology** 29: 66-70.
[4] Joy K.W., Willis A. J., & Lacey W.S. (1956). A rapid cellulose peel technique in Palaeobotany. **Annals of Botany** (N.S.) 20: 635-637.
[5] Kapgate, D.K.; Dahegaokar, R.R. and Sheikh, M.T. (2006). Report of a bilocular capsular fruit from the Deccan Intertrappean Beds of Patan, Chandrapur dist.,Maharastra,India. **Int. Conf. on Changing scenario in Palaeobotany & allied subjects**- Lucknow (Abs): 63
[6] Kapgate, D.K. Kolhe, P.D. and Gedam, V.B. (2011). Fossil Drupe Palmocarpon rodei from Deccan Intertrappean Beds of Mohgaonkalan, Madhya Pradesh, India. **Gond. Geol. Mag**. 26(1): 67-72.
[7] Kapgate, D.K. 2012. Plant Preservation and Paleobotanical Techniques Employed to study them. Motivational Workshop on **"Techniques in Taxonomy: Classical to Molecular Approach" Nagpur** :46-52.
[8] Kapgate, D.K. Patil, S.P. and Gedam, Y.B. (2016). Report of some fossil angiosperm flora from the new exposure at Pudiyal Mohada in Jivati Taluka of Chandrapur District, **Int. Journ. Of Researches In Biosci., Agri. & Tech.**: 72-74.
[9] Kapgate, D.K. & Wanjari M.H. (2014). Selaginella Remains from the Deccan Intertrappean Beds of Patan, Chandrapur District (M.S.), India. **Int. J. of Researches In Biosci., Agri. & Tech.**: 43-48.
[10] Patil, S.P., Kapgate, D.K. & Zilpe S.K. (2014). Report of a fossil Marsilea petiole from the Deccan Intertrappean Beds of Maraipatan, Chandrapur District (M.S.). **Pteridological research** 3(2): 10-14.
[11] Patil, S.P., Zilpe S.K. and Kapgate, D.K. (2016). Report of a Palm fruit from the Deccan Intertrappean series of Maraipatan, Chandrapur District, M.S. **Int. Jour. Of Researches in Biosciences, Agri. & Tech.**spl. issue: 166-170.
[12] Prakash, U. (1954). Palmocarpon mohgaoense sp. nov. a new palm fruit from the Deccan Intertrappean series of India.
Palaeobotanist. 3: 91-96.
[13] Prakash, U. (1960). On two palm fruits from the Deccan Intertrappean beds of Mohgaonkalan.**Curr. Sci**. 29: 20-21.
[14] Mahabale, T.S. 1950. Some new fossil plants from the Deccan Intertrappeans. Palaeobotany in India-VII. **Journal of the Indian Botanical Society** 29(1): 31-33.
[15] Mehrotra, R.C. 1987. Some new fossil palm fruits from Deccan Intertrappean beds of Mandla Distt., M.P. **Geophytology**
17(2): 204-208.
[16] Miquel F.A.W. (1853). De fossiele Planten van het Krinjt in het Hertogdom. **Geol. Kaart Nederlandsche Verh**., 35-56.
[17] Sahni, B. (1934). The silicified flora of the Deccan Intertrappean series Part II, Gymnosperms and Angiosperms fruits. **Proc. 21st Ind. Sci. Congr**. **Bombay,**: 317-318.
[18] Sahni, B. (1964). Revision of Indian fossil plants part III Monocotyledons, monograph. **B. S. I. P. Lucknow** 1: 1-8.
[19] Sahni, B. & Rode K.P. (1937). Fossil plants from the Intertrappean beds of Mohgaonkalan, in the Deccan, with a sketch of Geology of Chhindwara distt. **Proc**. **Nat.Acad. Sci. India** 7(3):165-174.
[20] Shete, R.H. and Kulkarni, A.R. (1980). Palmoxylon hyphaeneoides sp.nov. from the Deccan Intertrappean beds of Wardha District, Maharashtra, India. **Palaeontographica** 172B: 117-124.
[21] Shete, R.H. and Kulkarni, A.R. (1985). Palmocarpon coryphoidium sp. nov., a coryphoid Palm fruit from Deccan Intertrappean beds of Wardha Distt., Maharastra. **J. Indian Bot. Soc.** 64: 45-50.
[22] Stewart W.W. & Taylor T.N. (1965). The peel technique. In handed B. s. book of Palaeontological Technique, **Kummel & D. Raup.** San Francisco. 224-232.
[23] Trivedi, B.S. and Chandra, R. (1973). Palmocarpon splendidum sp. nov. from the Deccan Intertrappean beds of Mohgaonkalan, Chhindwara District, M.P. **Palaeobotanist** 20 (3): 339-343.