PALYNOLOGICAL STUDIES OF SOME BEE-FORAGE PLANTS FROM SAGARMAL, MAHARASHTRA, INDIA

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ABSTRACT

Pollen morphological studies of 57 common species of flowering plants constituting bee-forage plants on the plains of Sagarmal have been presented, along with a note, in each case, as to their food utility to the bees by way of nectar or pollen, or both. Importance of such studies has been discussed.

INTRODUCTION

Pollen morphological investigations of bee-forage plants of Sagarmal plains, which is on the south-eastern side of Kolhapur city (74°14′ E.L., 16°43′ N.L., 557.21 m above M.S.L.), were conducted with a view to help the identification of honey obtained from the bee colonies maintained in this area as well as those that are migrated to this plain from the nearby forested areas of Western Ghats, due to the heavy rains during the monsoon season.

MATERIAL AND METHOD

Honey samples and pollen loads were collected at fortnightly intervals during January to December 1980, from different bee colonies kept on this plain. They were analysed by the method of MAURIZIO (1951) for their pollen contents. The flowering plants visited by bees in this area were collected for herbarium and pollen slides were prepared for reference in glycerine-jelly (WODEHOUSE, 1935). The pollen grains obtained from the analysed honey samples and pollen loads were identified with the help of the reference pollen slides as well as reference monographs on the family Acanthaceae (CHAUBAL, 1966) and Compositae (CHAUBAL, 1976).

OBSERVATIONS

Morphological characters of 57 pollen grains identified from the honey samples and pollen loads have been presented. Information, whether they are pollen or nectar sources, and their available period, i.e. flowering duration, has been added. The arrangement of the pollen species is given in the alphabetical sequence.

Abelmoschus esculentus Linn. (Malvaceae) : Pollen and nectar source throughout the year under cultivation. Pollen panporate, spheroidal, 123-130 μm. Pore circular, diameter 12 μm, inter-pore distance 22 μm. Exine 3.0 μm thick, echinate ; spines 2.5 μm long, 7 μm broad at the base, tip acute, inter-spine distance 25 μm.

Acacia farnesiana Willd. (Mimosaceae) : (Fig. 4)—Pollen and nectar source from August to April. Pollen united in polyads of 16 cells, 60-66 μm. Individua grains 3-4-syncolpate. Exine 3.0 μm thick, faintly granulate.

Adhatoda vasica Nees. (Acanthaceae) : (Fig. 7)—Pollen and chiefly nectar source from August to November. Pollen 2-colporate, subprolate, 50 × 33 μm. Pore lalongate. Exine reticulate, heterobrochate.

Ageratum conyzoides Linn. (Asteraceae) : Pollen and nectar source from November to March. Pollen 3-colporate, spheroidal, 17-21 μm, planaperturate. Exine echinate ; spinule length 1.7 μm, basal breadth 2.2 μm, inter-spinule distance 3.8 μm.

Albizia lebbek Benth. (Mimosacae) : Chiefly nectar source from March to June. Pollen grains in polyads of 16 cells, size range 69-75 μm. Individual grains with indistinct apertures. Exine 1.5 μm thick, faintly granulate.

Allium cepa Linn. (Liliaceae) : (Fig. 18)—Pollen and nectar source from September to October and February to March. Pollen grains 1-colpate, 20×41×24 μm. Colpus narrow, tenuimarginate. Exine 1.4 μm thick, faintly granulate, bacula faintly visible.

Amaranthus blitum var. **oleracea** Hook.f. (Amaranthaceae) : Pollen source almost throughout the year. Pollen grains panporate, spheroidal, diameter 29 μm. Pore circular, diameter 2-4 μm, crassimarginate, inter-pore distance 4 μm. Exine 1.6 μm thick, areolate.

In the following species of *Amaranthus*, only those characters which are different from the above species are mentioned.

A. paniculatus Linn. : Pollen diameter 27 μm. Pore diameter 3 μm, inter-pore distance 3 μm. Exine 2.8 μm thick, coarsely granulate.

A. spinosus Linn. (Fig. 28)—Pollen diameter 26 μm. Pore diameter 2.3 μm, inter-pore distance 8 μm. Exine 3 μm thick, more or less psilate.

A. tenuifolius Willd. : Pollen diameter 27 μm. Pore diameter 2.8 μm, inter-pore distance 3.9 μm. Exine 3 μm thick, granulate.

Azadirachta indica A. Juss. (Meliaceae). : (Fig. 11)—Chiefly nectar source from March to May. Pollen 3-(4)-colporate, subprolate, 50×35 μm. Pore lalongate 3×13 μm. Exine 1.4 μm thick, faintly reticulate.

Bidens bipinnata Linn. (Asteraceae) : Pollen and nectar source almost throughout the year. Pollen grains 4-pororate, oblate spheroidal, 24-26×32-34 μm. Exine echinate; spine length 4.7 μm, basal breadth 4.6 μm, inter-spine distance 6 μm.

Brassica juncea Hook. f. (Brassicaceae) : (Fig. 20)—Pollen and nectar source from September to December. Pollen 3-colpate, subprolate, 37×32 μm. Exine 1.6 μm thick, broadly reticulate, heterobrochate; bacula well-defined.

Cajanus indicus Spreng. (Fabaceae) : Pollen and nectar source from September to October and January to February. Pollen 3-colporate, oblate spheroidal, 36×38 μm. Exine reticulate.

Capsicum annuum Linn. (Solanaceae) : Nectar source throughout the year. Pollen grains 3-colporate, subprolate to oblate spheroidal, 34×30-30×38 μm. Colpi tenuimarginate. Exine 1.6 μm thick, psilate or faintly granulate.

Carthamus tinctorius Linn. (Asteraceae) : (Fig. 24)—Pollen and nectar source from August to November and January to April. Pollen 3-colporate, spheroidal, 47-51 μm. Exine echinate; spine length 2.4 μm, basal breadth 4.3 μm, inter-spine distance 8 μm.

Celosia argentea Linn. (Amaranthaceae) : (Fig. 31)—Pollen and nectar source from September to December. Pollen grains panporate, spheroidal; diameter 28 μm. Pore circular, diameter 2.6 μm, inter-pore distance 7.5 μm. Exine 1.0 μm thick, granulate.

Chenopodium album Linn. (Chenopodiaceae) : (Fig. 15)—Pollen and nectar source from October to December. Pollen grains panporate, spheroidal, diameter 28

μm. Pore circular, diameter 3.2 μm, inter-pore distance 3.5 μm. Exine 3 μm thick, granulate.

Cicer arietinum Linn. (Fabaceae) : Pollen and nectar source from October to March. Pollen 3-colporate, subprolate, 38×34 μm (size range 33-40×29-36 μm). Exine faintly reticulate.

Coriandrum sativum Linn. (Apiaceae) : (Fig. 5)—Pollen and nectar source throughout the year. Pollen grains 3-colporate, dumb-bell-shaped, 26×13 μm. Exine finely reticulate.

Cucumis momordica Linn. (Cucurbitaceae) : (Fig. 30)—Pollen and nectar source from January to March. Pollen grains 3-colporate, spheroidal, diameter 26 μm. Pore circular, diameter 3.8 μm. Exine 1.0 μm thick, granulate.

Cuscuta reflexa Roxb. (Convolvulaceae) : (Fig. 13)—Pollen source from December to February. Pollen 4-5-colpate, subprolate, 38×28 μm. Exine 4.5 μm thick, granulate.

Cyperus rotundus Linn. (Cyperaceae) : (Fig. 6)—Pollen source from September to November. Pollen spheroidal, diameter 22-27 μm, 1-colpate. Colpus 21 μm long. Exine 1 μm thick, faintly and finely reticulate.

Delonix regia Desf. (Caesalpiniaceae) : (Fig. 29)—Pollen and nectar source from March to July. Pollen grains 3-colporate, prolate, 65×48 μm. Exine 9.5 μm thick, reticulate.

Gossypium arboreum Linn. (Malvaceae) : (Fig. 17)—Pollen and nectar source from July to November, and January to May. Pollen panporate, spheroidal, diameter 50-110 μm. Exine 5.8 μm thick, echinate; spine length 6 μm, pointed, with a basal cushion.

Gossypium herbaceum Linn. (Only the characters different from the above species have been given) : Diameter 90-100 μm. Spine length 6.6 μm.

Guizotia abyssinica Cass. (Asteraceae) : (Fig. 22)—Pollen and nectar source from August to October and January to March. Pollen 3-colporate, spheroidal, diameter 22-28 μm. Exine echinate; spine length 3.5 μm, basal breadth 3.5 μm, inter-spine distance 5.5 μm.

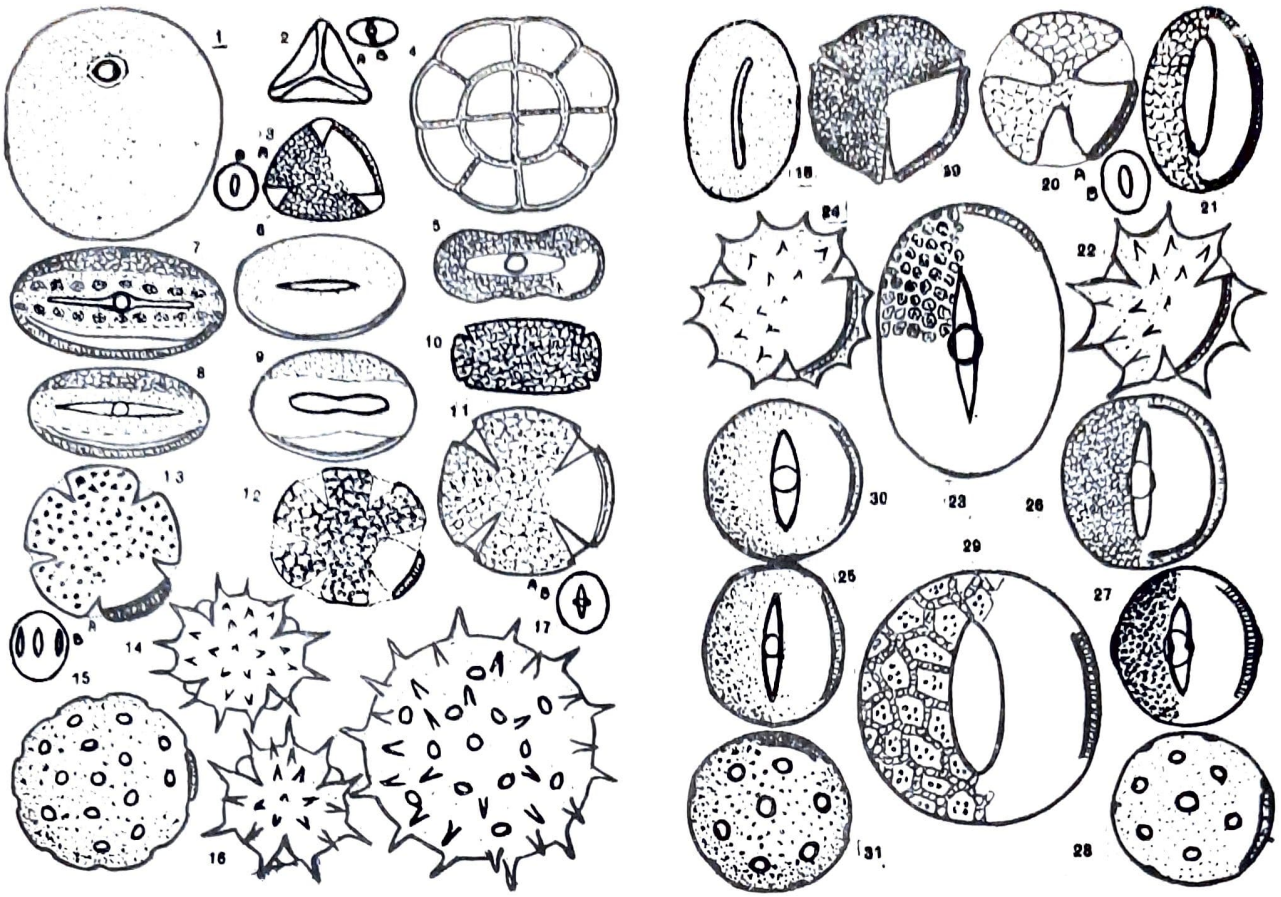
Helianthus annuus Linn. (Asteraceae) : (Fig. 16)—Pollen and nectar source from July to October, and January to March. Pollen grains 3-colporate, spheroidal, 22-29 μm. Exine echinate; spine length 5.6 μm, basal breadth 2.6 μm, inter-spine distance 5.5 μm.

Ipomoea leari Paxt. (Convolvulaceae) : Pollen and nectar source almost throughout the year. Pollen grains pantoporate, spheroidal, size range 105-129 μm. Pore circular, diameter 5.5 μm, inter-pore distance 10 μm. Exine 8.5 μm thick, echinate; spine length 8.5 μm, tip acute, base bulbous, basal cushion undeveloped. Columella compact.

Impatiens balsamina Linn. (Balsaminaceae) : (Fig. 10)—Pollen and nectar source from July to September. Pollen 4-colpate, rectangular, 20×10 μm, angulaperturate. Exine reticulate.

Justicia simplex D. Don. (Acanthaceae) : (Fig. 8)—Pollen and nectar source from July to November. Pollen 3-colporate, prolate, 32×21 μm. Exine reticulate, heterobrochate.

Lagasca mollis Cav. (Asteraceae) : Pollen and nectar source throughout the year. Pollen grains 3-colporate, spheroidal, size range 22-25 μm, amb subtriangular. Exine echinate; spine length 4 μm, basal breadth 3.4 μm, inter-spine distance 6.2 μm.



Figs. 1—17 : 1. *Zea mays* (surface view), 2. *Syzygium cumini* (polar view), 3. *Leucas aspera* (polar view), 4. *Acacia farnesiana* (polyad view), 5. *Coriandrum sativum* (equatorial view), 6. *Cyperus rotundus* (equatorial view), 7. *Adhatoda vasica* (equatorial view). 8. *Justicia simplex* (equatorial view), 9. *Vitex negundo* (equatorial view), 10. *Impatiens balsamina* (polar view), 11. *Azadirachta indica* (polar view), 12. *Plectranthus coesta* (equatorial view), 13. *Cuscuta reflexa* (polar view), 14. *Tridax procumbens* (polar view), 15. *Chenopodium album* (surface view), 16. *Helianthus annuus* (polar view), 17. *Gossypium herbaceum* (surface view).

Figs. 18—31 : 18. *Allium cepa* (surface view), 19. *Ricinus communis* (polar view), 20. *Brassica juncea* (polar view), 21. *Raphanus sativus* (equatorial view), 22. *Guizotia abyssinica* (polar view), 23. *Pisum sativum* (equatorial view), 24. *Carthamus tinctorius* (polar view), 25. *Zizyphus mauritiana* (equatorial view), 26. *Moringa oleifera* (equatorial view), 27. *Pongamia pinnata* (polar view), 28. *Amaranthus spinosus* (surface view), 29. *Delonix regia* (equatorial view), 30. *Cucumis momordica* (equatorial view), 31. *Celosia argentea* (surface view).

(All figures are semidiagrammatic).

Leucas aspera Spreng. (Lamiaceae) : (Fig. 3)—Chiefly nectar source from September to December. Pollen grains 3-colpate, subprolate, 30×24 μm. Exine reticulate, lumina small, circular.

Lepidagathis cristata Willd. (Acanthaceae) : Pollen and nectar source from September to March. Pollen grains 3-colporate, prolate, size range 38-40×26-29 μm, amb circular or subtriangular, planaperturate. Exine reticulate, heterobrochate. Muri simplibaculate, lumina circular to polygonal, psilate or with baculoid processes.

Mangifera indica Linn. (Anacardiaceae) : Pollen and nectar source from December to February. Pollen grains 3-colpate, prolate, 34×20 μm. Exine 1.0 μm thick, granulate.

Medicago sativa Linn. (Fabaceae) : Pollen and nectar source from August to

September. Pollen grains 3-colporate, subprolate, size range 25-28×15-20 μm. Pore lalongate, 4-6 μm, lateral ends rounded. Exine reticulate.

Melilotus alba Desr. (Fabaceae) : Pollen and nectar source from August to September. Pollen grains 3-colporate, subprolate, size range 27-32×21-26 μm. Pore lalongate, 4×8 μm, lateral ends rounded. Exine reticulate.

Moringa oleifera Lamk. (Moringaceae) : (Fig. 9) : Pollen and nectar source from October to May. Pollen grains 3-colporate, spheroidal, diameter 33 μm. Pore lolongate, 7×3.5 μm. Exine 1.5 μm thick, faintly and minutely reticulate.

Pisum sativum Linn. (Fabaceae) : (Fig. 23)—Pollen source from October to January. Pollen grains 3-colporate, prolate, 54×28 μm. Pore slightly lolongate, 7×6.5 μm. Exine reticulate.

Plectranthus coesta Buch.-Ham. (Lamiaceae) : (Fig. 12)—Chiefly nectar source from October to January. Pollen grains 6-colpate, subprolate, 35×29 μm. Colpus long, broad. Exine 2.3 μm thick, areolate, baculate.

Pogostemon parviflorus Benth. (Lamiaceae) : Pollen and nectar source from November to March. Pollen grains 3-colporate, spheroidal, diameter 25 μm, amb spheroidal. Exine reticulate.

Polygonum chinense Linn. (Polygonaceae) : Pollen and nectar source from August to January. Pollen grains 24-colporate, prolate, 44×33 μm. Pore more or less rectangular type, size 4×3 μm. Exine 1.5 μm thick, granulate. Columella indistinct.

Pongamia pinnata Pierrei. (Fabaceae) : (Fig. 27)—Pollen and nectar source from March to June. Pollen grains 3-colporate, spheroidal, diameter 26-28 μm. Pore lalongate, 5.5×7.5 μm. Exine granulate.

Raphanus sativus Linn. (Brassicaceae) : (Fig. 21)—Pollen and nectar source from August to September, and February to March. Pollen grains 3-colpate, prolate, 30×21 μm. Exine 3 μm thick, reticulate; lumina small, bacula well-defined.

Ricinus communis Linn. (Euphorbiaceae) : (Fig. 19)—Pollen source from November to April. Pollen grains 3-colporate, spheroidal, diameter 36 μm. Pore lolongate, 4.1×5.1 μm. Exine 1.7 μm thick, finely reticulate.

Rungia elegans Dalz. (Acanthaceae) : Pollen and nectar source from September to January. Pollen grains 2-porate, prolate, size range 22-41×15-26 μm, amb oval. Exine reticulate, heterobrochate.

Sida acuta Burm. (Malvaceae) : Pollen and nectar source from August to April. Pollen grains panporate, spheroidal, size range 85-106 μm. Pore circular, diameter 7-8 μm, inter-pore distance 34 μm. Exine echinate, 3.8 μm thick; spines closely placed, spine length 3.8 μm, tip acute, basal breadth 2.0 μm, bulbous at the base, columella of basal cushions free.

In the other species of *Sida*, only such pollen characters are mentioned which are different from those of *S. acuta*.

Sida rhombifolia Linn. : Pollen size range 50-85 μm. Pore diameter 9 μm, inter-pore distance 2.0 μm. Exine 2.8 μm thick; columella fused in the basal cushion.

S. spinosa Linn. : Pore diameter 9.6 μm. Exine 5.5 μm thick; columella composing basal cushions are fused.

Solanum nigrum Linn. (Solanaceae) : Pollen and nectar source throughout the year. Pollen grains 3-colporate, prolate spheroidal, size range 25-33×21-29 μm. Colpi narrow, tenuimarginate. Pore lalongate, 4×12 μm, lateral ends rounded. Exine 1.6 μm thick, psilate.

Syzygium cumini Skeels. (Myrtaceae) : (Fig. 2)—Pollen and nectar source from March to May. Pollen grains 3-syncolporate, oblate, 20×26 μm. Exine 1.5 μm thick, psilate.

Tamarindus indica Linn. (Caesalpinioideae) : Pollen and nectar source from April to July. Pollen grains 3-colporate, spheroidal, size range 36-40 μm. Pore circular, diameter 8.5 μm. Exine 3.0 μm thick, reticulate.

Trigonella foenum-graecum Linn. (Fabaceae) : Chiefly nectar source from August to April. Pollen grains 3-colporate, prolate; size range 27-37×16-25 μm. Pore circular, diameter 4 μm. Exine reticulate.

Tridax procumbens Linn. (Asteraceae) : (Fig. 14)—Pollen and nectar source throughout the year. Pollen grains 4-colporate, spheroidal, diameter 30 μm. Exine echinate, spines length 4 μm, basal breadth 3 μm.

Vitex negundo Linn. (Verbenaceae) : (Fig. 9)—Pollen and nectar source from July to May. Pollen 3-colpate, subprolate, 23×19 μm. Exine 1.0 μm thick, granulate.

Zea mays Linn. (Poaceae) : (Fig. 1)—Pollen source almost throughout the year. Pollen 1-porate, spheroidal to elongate, 96×105 μm. Pore circular, diameter 8 μm, annulus well-developed. Exine granulate, 1.5 μm thick.

Ziziphus mauritiana Lamk. (Rhamnacaae) : (Fig. 25)—Pollen and nectar source from September to October. Pollen 3-colporate, subprolate, 26×22 μm. Pore diameter 3.0 μm. Exine granulate.

DISCUSSION

Pollen studies of similar type have been carried out by Deodikar *et al.* (1958) from Mahabaleshwar hills, Chaubal and Deodikar (1965) from Western Ghats, and Chaubal (1980 a, 1980 b) from Sagarmal and Padgaon, respectively. These studies are necessary for identifying the honeys from different areas, in order to name them according to their pollen composition and percentage. Such studies also help in deciding whether the honey is of unifloral or multifloral type, depending upon its pollen contents (Chaubal & Deodikar, 1965) and whether the honey is adulterated. It can also be decided whether there are any poisonous pollen grains present, and the honey is fit for consumption or otherwise (Deodikar *et al.* 1958 a, 1958 b; Chaubal & Deodikar, 1963).

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