JOURNAL OF SCIENTIFIC AND INDUSTRIAL STUDIES

VOL. 4, NO. 3, 2006

An interdisciplinary approach to Scientific and Industrial Research

DUNCAN SCIENCE

Journal of Scientific and Industrial Studies, Volume 3, Number 4, 2005.
ISSN 1117 – 1693

STOMATAL DIVERSITY AND ONTOGENY IN HEINSIA CRINITA (Afzel.) G. TAYL.

Bassey, M. E. and Mesikenor, N. O.
Department of Botany and Ecological Studies
University of Uyo, Uyo, Akwa Ibom State, Nigeria

ABSTRACT

Heinsia crinita (Afzel) G. Tayl. belongs to the family Rubiaceae. It is one of the many leafy vegetables popularly eaten by the people of Akwa Ibom and Cross River States of Nigeria. It is locally known in the two states as "atama". The leaf epidermis in the variety locally known as "afia atama" were investigated. Stomatal investigation showed the leaves to be hypostomatic and the mature sromatal types to be paracytic, brachyparacytic and anisocytic. Paracytic stomata were however more predominant. The Ontogenetic investigation on the other hand, showed that the development of paracytic stomata followed a paramesogenous pathway. The development of the brachyparacytic and anisocytic stomata followed a paramesoperigenous and an anisomesogenous pathway respectively. Similar investigations in order local varieties may help in delimiting the taxa.

INTRODUCTION

Heinsia crinita is called "Atama" by the people of Akwa Ibom and Cross River States. It belongs to the family *Rubiaceae* and is one of the many leafy green vegetables consumed by the people of Eastern Nigeria. It is said to be rich in useful minerals and protein, Etuk *et al.* (1998). They also reported that anaemic patients may benefit from diet containing *H. crinita* because of its high content of dietary iron. The taxonomic importance of stomatal complexes and the determination of their ontogenetic pathway have been stressed by various authors (Fryns-Claessens and Van-Cotthem 1973, Metcalfe & Chalk, 1976). According to Fryns-Claessens and Van-Cotthem (1973), our knowledge of stomatal complexes is highly uneven in different groups of plants. Karatela and Gill (1984) also investigated the mature stomatal morphology and ontogeny for 19 species of Nigerian ferns. Uwah (1998) reported five enthnobotanical varieties of *Heinsia crinita* which included "afia atama" (white variety) 'obubit atama' (black Variety) 'atama idim' (riverine variety) 'atama ekpo' (poisonous variety) and 'atama ekoi' (obtained from the ethnic region called Ekoi which is in Cross River State. The purpose of this investigation was to provide necessary information on mature stomatal structure and their developmental pathway in this very useful plant. The information obtained may help in subsequent investigation to delimit the various ethnovarieties.

MATERIAL AND METHOD

Leaf materials used for the investigation were collected fresh from mature cultivated plants of the ethnovariety of *Heinsia crinita* known as "afia atama" by the Ibibio, at two different locations in Itam, Itu local Government Area and in Uyo metropolis both in Akwa Ibom State. Mature leaves were obtained and used for the investigation of mature stomatal complexes while young leaves from apices of shoots were used for ontogenetic investigations. To obtain the epidermal peel, the median portion of the leaf was placed on a glass slide and irrigated with distilled water. It was then scraped with a new razor blade or a surgical blade until the epidermis beneath was reached. The peels obtained were then fixed in formalin acetic acid alcohol (FAA) in the ratio 1:1:3. Both adaxial and abaxial epidermides were obtained. To view the epidermal peels under the microscope they were first bleached to remove all traces of colour, they were then washed in several changes or water before staining in safranin for 5-10 minutes. Thereafter, the peels were washed again to remove excess stain. It was then mounted in 10% glycerol on a slide ready for observations. The terminology used in this work is after Metcalfe and Chalk (1979) for stomatal complexes and Fryns-Calessens and Van-Cotthem (1973) for Ontogenesis.

RESULTS

More than one type of stomatal complex was observed. They include paracytic, brachyparacytic and anisocytic types. (Fig, 1a,b,c). The leaves were hypostomatic with the stomata found only on the lower surface of the leaf.

DEVELOPMENT OF PARACYTIC STOMATA

The mature paracytic stomata had two subsidiary cells parallel to the long axis of the guard cells (Fig, 1a). The developmental pathway was paramesogenous. As shown in Fig. 2 the protodermal cell, divided into two unequal cells. A bioconcave lenticular cell develops between the two unequal cells and it functions as the guard cell mother cell (gcmc). This divided to form two guard cells. A pore is formed as the stomata become mature. Three divisions occurred before a mature stomata was formed.

DEVELOPMENT OF BRACHYPARACYTIC STOMATA

As shown in fig. 3 this type of stomata developed through the paramesoperigenous pathway. The meristemoid divided into two unequal cells of which the larger one does not undergo another division but enlarges and becomes the mesogeneous-encircling cell forming the guard cell mother cell (gcmc). This is flanked on either side by m2 and m3. The cell m3 divided again perpendicular to the encircling cell by m2 and m3, which become subsidiary cells. The mature stomata was therefore surrounded by a mesogenous encircling cell, two perigenous subsidiaries and one perigenous cell.

DEVELOPMENT OF ANISOCYTIC STOMATA

As shown in fig. 4 the meristemoid was found to be polygonal. It divided unequally into two, the larger cell forming the first mesogene cell (ml) the smaller cell divided again unequally at an angle to intersect the wall of ml. The larger cell becomes the second mesogene cell m2. The smaller cell divided again unequally with the wall intersecting m2 at an angle. Again the larger cell formed the third mesogene cell (m3). The small cell became the guard cell mother cell (gcmc) and divided equally to form the guard cells. Since the guard cell is surrounded by three mesogene cells, the pathway of development is referred to as the anisomesogenous type. These three mesogene cells were unequal and one was distinctly smaller than the other two.

DISCUSSION AND CONCLUSION

Occurrence of stomatal diversity on one and the same surface of a plant part is widespread among the angiosperms (Metcalfe and Chalk, 1979). This has been found to be true for *Heinsia crinita.* According to Pant (1965), it appears that it is appropriate to attribute the stomatal diversity to diverse stomatal pathways, number of cutting faces, angle of cell division and the divisive capacity of the meristemoid. According to Cronquist (1976), paracytic stomata, which is predominant in this work, are primitive within the angiosperms. Adegbite (1995), also stated that stomatal types could be formed via different ontogenetic pathways. When stomata are restricted to the abiaxial Surface, such a leaf is referred to as hypostomatic. Bassey and Sunday (2002) observed this in their work on *Lasianthera africana.* They also observed two kinds of mature stomata in their work (anisocytic and anomocytic). They noted that anisocytic stomata were produced through two different onogenetic pathways. In this work we have not observed differing pathways in the formation of either the paracytic, brachyparacytic or anisocytic stomata. In conclusion it is hereby reported that *Heinsia crinita* is hypostomatic with three different types of stomatal complexes which are paracytic, brachyparacytic and anisocytic. They have been found to be formed through para-mesogenous, paramesoperigenous and anismesogeneous pathways respectively. Similar investigations are necessary for the other local varieties and may help in delimiting the taxa.

REFERENCES

1. Adegbite, A. E. (1985), Leaf epidermal studies in three Nigerian species of Aspilia (Heliantheae - Asteraceae) and two hybrids. *Nigeria Journal of Botany* 8:25-33.
2. Bassey M.E. and Sunday, R. A. (2002) Epidermal Morphology and Stomatal ontogeny in two varieties of Lasianthera africana P. Beau (lcacinaeae). *Trans. Nig. Soc. Boil. Converv.* (Special Edition) 101 - 107.
3. Cronquist, A. (1976). The evolution and classification of flowering plants Nelson, London and Edinburg. pp. 34 - 40.
4. Etuk, E. U. I., Bassey M. E., Umoh, L and Inyang, E. G. (1998). Comparative Nutritional Studies on three local varieties of Heinsia crinita. *Plant variety and seeds*: 11:151-158.
5. Fryns - Classens, E. and Van Cotthem, W. R. (1973). A new classification of the ontogenetic types of stomata. *Botanical Review 39:71-138.*
6. Karatela, Y. and Gill, L. (1984) Structure and ontogeny of stomata on Nigeria ferns Nova Hedwigia. Band 40.
7. Metcalfe, C. R. and Chalk, L. (1979). Anatomy of the dicotyledons vols. 1 and 2 Claredon Press, Oxford. pp. 84-90.

8. Pant, D. D. (1976). The ontogeny of stomata and other homologous studies. *Plant science series, Allhabad 1:1-24.*

9. Uwah, C. E. (1998). Morphological Studies in the genus Heinsia crinita (Rubiaceae) from parts of South Eastern Nigeria B.Sc. Thesis, University of Uyo.

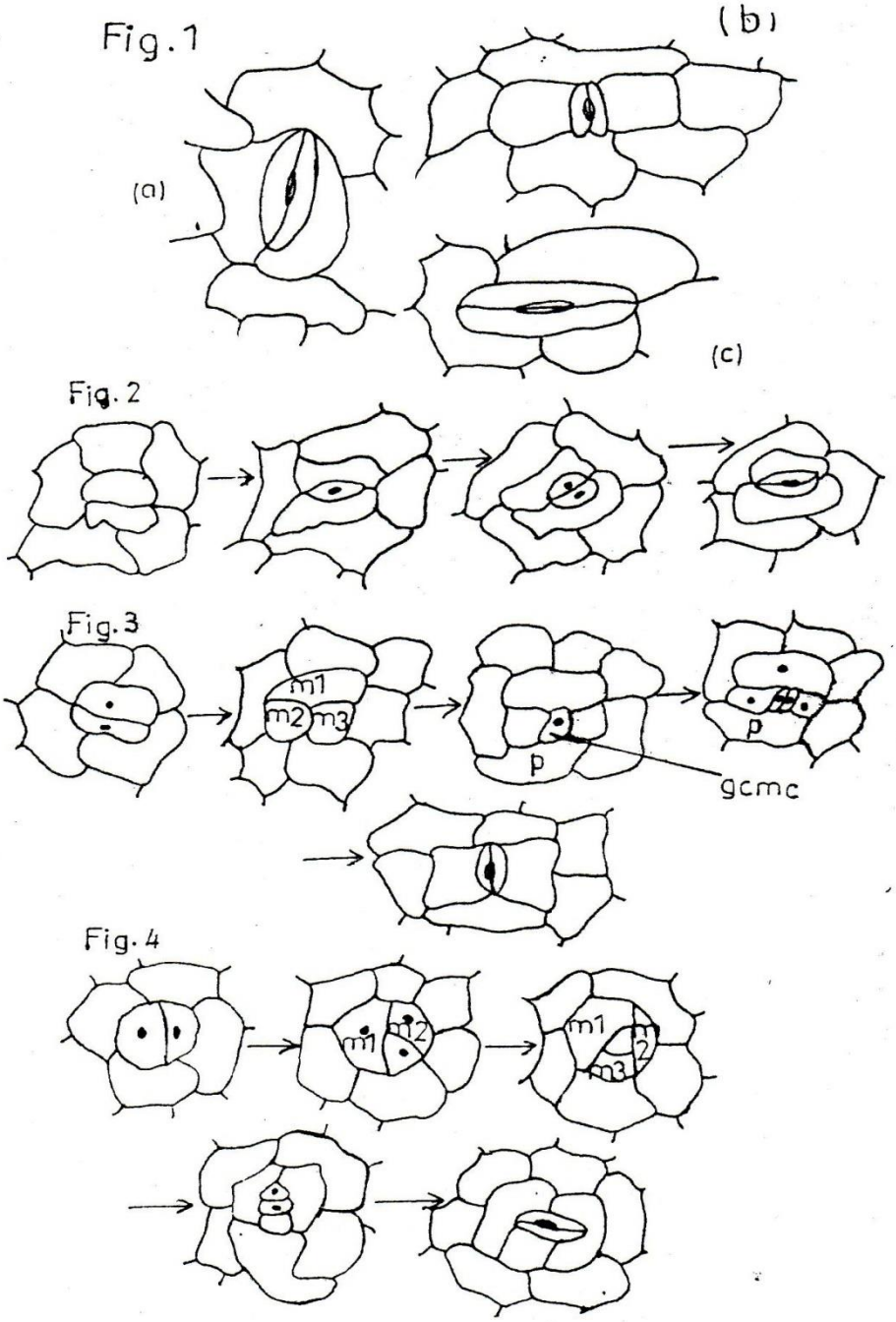

Fig. 1 Mature stomatal complexes
- Paracytic type
- Brachyparacytic type
- Anisocytic type

LEGEND

M1	First formed Mesogene cell
M2	Second formed Mesogene cell
M3	Third formed Mesogene cell

Fig.2 Development of Paracytic stomata

Fig.3 Development of Brachyparacytic stomata

Fig.4 Development of Anisocytic stomata