and asiaticoside and a faster moving saponin. Arabinose was present in the samples 5 and 7 which contain brahmoside and brahminoside besides asiaticoside[14] as the saponin constituents.

Hydrolysis of the various saponin mixtures with alkali yielded madecassic and asiatic acids thus confirming that the saponins were of ester type. Acid hydrolysis of the saponin mixtures however gave besides the above, one more compound whose methyl ester agreed with the physical constants of anhydromethyl madecassate reported by Pinhas *et al.*[12] We could not however detect the presence of indocentoic acid,[7] thankuniside and isothankuniside[8] in our samples.

The above results indicate large variations in the yield of saponins depending on habitat; this is fairly common in plant drugs. The sample from Jammu was the richest. Considering the nature of the saponins there seems to be two varieties; the more common one contains asiaticoside and madecassoside whereas the less common one is characterised by the additional presence of arabinose in the saponins, thus forming brahmoside and brahminoside. The sapogenins are the same in both and similarly are the flavonoid components.

ACKNOWLEDGEMENTS

Our thanks are due to Dr. C. Dwarakanath for procuring various samples of plant material, Shri V. P. Mahajan, for a sample of material from Jammu area, Dr. H. Pinhas for samples of asiaticoside, madecassoside, methyl asiatate and methyl madecassate and for comparing our sapogenin methyl ester with methyl madecassate, Dr. R. P. Rastogi for samples of brahmoside, brahminoside and methyl brahmate, and the Indian Council of Medical Research for financial assistance.

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17. Our sapogenin methyl ester was compared with methyl brahmate as well as methyl madecassate by Drs. Rastogi, R. P. and Pinhas, H. and were found to be identical.
18. "Paper chromatography on Whatman No. 1 filter-paper; *n*-butanol : pyridine: water, 6 : 4 : 3; Aniline hydrogen phthalate spray."

RANGE OF STRUCTURAL AND ONTOGENETIC STOMATAL VARIATIONS IN THREE SPECIES OF *OCIMUM* (LABIATAE)

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THOUGH several workers[2-4,6] have reported structural and developmental variations of stomata occurring in the same species, none seem to have studied them for the entire stomatiferous area of the plants investigated. Importance of such an information needs no emphasis for, apart from giving an idea of the behaviour of a given plant part relating to its stomatal variations, it will enable to formulate criteria for utilising even the variable stomata for taxonomic purpose. Tognini, who was the first to describe organographic stomatal variations, based his conclusions from a study of comparatively larger number of plant parts (cotyledons, leaf, stipule, calyx, corolla and fruit; *See* in Gupta *et al.*[2]) than others;[2-4,6] even so he left from consideration quite a few parts as the hypocotyl, stem, bracts, peduncle, pedicel, floral disc, stamens, carpels and seedcoat all of which also usually possess stomata. The purpose of this paper is to bring to the fore the full extent of structural

and developmental variations of stomata for the entire plant surface in *Ocimum adscendens*, Willd., *Ocimum basilicum* L. var. *pilosum* Benth., *Ocimum sanctum* Linn. (the usual cultivated form characterised by green stem), belonging to the family Labiatæ, the anatomy of which is being studied in this laboratory. The terms used are as defined by Pant[5] and Ramayya and Rao.[7]

The stomata observed are of two kinds the diacytic and anomocytic (Figs. 1 and 6). The diacytic are haplocyclic (Fig. 1 A) or at times amphicyclic (Fig. 5) or with only three subsidiaries (Figs. 1 M_1, M_2 & M_3). In two peelings, one from the stem of *O. basilicum* and another from the hypocotyl of *O. sanctum*, a paracytic stoma was also observed (Fig. 11).

The stomata are irregular in their distribution. They are mostly diacytic mixed with few anomocytic forms in the appendicular structures, *viz.*, cotyledon, leaf, bract and calyx in all the three species. They, however, differ in their structure on the cauline parts from one to the other species. They are mostly diacytic on the hypocotyl, stem and peduncle in *O. basilicum*, predominantly diacytic on the above parts in *O. adscendens* and mostly anomocytic in *O. sanctum*. The pedicel hardly bears a stoma or two in the three species and they are of the anomocytic type. The floral disc in all of them is unique in that all its stomata are anomocytic (Fig. 20), thus being absolutely different from the stomata of the leaf. On the disc, the stomata are confined to its distal margin on either side in *O. adscendens* and *O. basilicum*, whereas just restricted to its rim in *O. sanctum*. No stomata occur on the corolla, stamens, ovary, style and stigma nor on the seed as it is coalescent with the wall of the nutlet.

In each of the three species stomatal development has been studied on the hypocotyl, cotyledons, leaf, stem, peduncle, calyx and floral disc. It could not be followed on the pedicel in any of them due to the scarcity of the stomata; on the floral disc of *O. sanctum* also the ontogeny was not studied as the stomata are borne on its rim and hence inconvenient to manipulate. Thus barring the above, the observations cover the entire stomatiferous area in the three species and hence suffice to get an idea of the patterns of stomatal development prevalent in them.

The development of the stomata is diffuse in all the parts studied and are derived from single protoderm initials. The diacytic stomata are dolabrate and mesogenous in development wherever they occur in the three species. Their development as seen on the hypocotyl in *O. sanctum* and cotyledons and leaves in *O. adscendens* is illustrated by the Figs. 2-4 and 10, 13. The diacytic stomata which have two subsidiaries on the same side or which are amphicyclic result from the meristemoid cutting off twice on one or both of its faces respectively (Fig. 13).

The anomocytic stomata observed, however, show varied patterns of development. On the hypocotyl, they are usually unilabrate mesoperigenous, with one or more subsidiaries of perigenous origin (P). This happens because of the meristemoid directly dividing into the guard cells after cutting the first subsidiary (M 1) (Figs. 8 and 9). Rarely, the anomocytic stomata are dolabrate mesoperigenous in their origin. This results from the non-intersection of the partitions towards one of the poles of the meristemoid (Fig. 7) which allows the perigenous cell (P) lying on that side to remain in contact with the stoma.

The anomocytic stomata of the stem and peduncle and those occasionally seen on the leaf, cotyledons, leaves and calyx unlike those on the hypocotyl are dolabrate mesogenous, thus resembling the diacytic stomata of the leaf and other parts in origin. Their anomocytic condition is due to secondary divisions in their mesogene subsidiaries (Figs. 15, 14, 12 and 6).

The anomocytic stomata of the disc are, however, peculiar in that their development is quite in contrast with those occurring on other parts. They are wholly perigenous, being derived directly from the meristemoid. The first subsidiary, (M 1) so rapidly differentiates into a normal epidermal cell that even before the guard cell mother cell (GMC) has divided into guard cells, it is not recognisable (Figs. 16-20). This is comparable to the situation recently described in the Rubiaceæ[1] where the disc stomata are perigenous unlike the paracytic type of the other parts.

From the data collected it is clear that stomata are fairly stable in their structure and ontogeny on all the appendicular parts of the plant in the three species investigated. They are mostly diacytic in structure and dolabrate mesogenous in their development. Though few anomocytic forms occur particularly more on the cotyledons, they are also dolabrate mesogenous in their ontogeny.

FIGS. 1–20. Figs. 1, 13, 16–20, *Ocimum adcendens*. Fig 1. Mature stomata. Fig. 13. Guard cell mother cell just divided, both from leaf lower epidermis Figs 16–20. Development of anomocytic stomata from the disc abaxial surface. Figs. 2, 3, 6-9. *Ocimum sanctum*. Figs. 2, 3, 7-9. Developmental stages of stomata from the hypocotyl. Fig. 6. Anomocytic stomata from stem. Figs. 4, 5, 10–12, 14, 15. *Ocimum basilicum* var. *pilosum*. Fig. 4. Diacytic stomata from the hypocotyl. Fig. 5. Amphicyclic diacytic stomata from the stem. Figs. 10, 12, 14, 15. Developmental stages from the cotyledons. Fig. 11. Paracitic stomata from the stem. (M1, M2, M3 & M4 = Mesogenes of the diacytic stomata; M = Meristemoid · GMC = Guard cell mother cell; P = Perigene).

The stem and peduncle, though they have relatively more anomocytic forms unlike in the foliar appendages, in ontogeny, they too are dolabrate mesogenous like the diacytic forms.

The hypocotyl and floral disc, however, stand out from the other plant parts in regard to their stomatal structure and ontogeny. On the hypocotyl some of the anomocytic stomata are uni- or dolabrate mesoperigenous. On the floral disc, the stomata are further deviated, for all of them are anomocytic in structure and perigenous in origin.

From the above generalisations it is clear that stomata, despite differences in their structure, are stable regarding the origin of their subsidiaries on the different foliar appendages as well as the stem and peduncle. Thus the mode of origin of the subsidiaries of the stomata of the above parts suggests to be of taxonomic value in the three species studied. Further work would be of importance in showing upto what taxonomic level does this character remain constant in the family.

From the phylogenetic and morphogenetic viewpoint too, the occurrence of highly contrasting stomata confined to specific parts in the same plant is of significance. If perigenous stomata are regarded phyletically to have originated from the mesogenous ones through suppression of the meristematic capacity of their meristemoids as previously hypothesized by Pant,[5] the stomata of the floral disc represent derived forms. The immediate cause which may have brought about this modification is considered to be the localisation of hormones at a higher gradient in the floral disc which would inhibit meristematic activity; or it could be that the nectar in the disc acts as an inhibiting influence on the stomatal meristemoids.

ACKNOWLEDGEMENTS

The authors' gratitude is due to Prof. M. R. Suxena, Department of Botany, Osmania University, for keen interest and encouragement.

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OPEN SPIKELET—A RADIATION INDUCED MUTANT CHARACTER IN RICE

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THE note records the isolation of a new mutant character, open spikelet, in R_2 generation of a cross, *viz.* Jhona 349 × T(N)1 following irradiation of its seeds. The mutant is characterised by open spikelets in which the lemma and palea are unable to close after they have opened for blooming (Fig. 1); 80 to 85% of the spikelets remain sterile; and the remaining spikelets contain only partially developed kernels.

Five hundred dormant F_2 seeds of the cross were treated with 30 KR of gamma-rays from the Co^{60} source and were grown in R_1 generation during *kharif* 1966. Out of 500 seeds, 467 seeds germinated and seedlings grew to maturity. The main panicle in each plant was bagged just after heading to avoid natural crossing. On ripening the panicles were harvested and threshed individually. The seed from these panicles was grown in single separate rows in R_2 generation during *kharif* 1967. In progeny No. 10, two out of 8 plants had panicles in which spikelets remained open upto ripening. In one of these two plants some of the panicles were bagged immediately after heading. It was observed that all the spikelets in the selfed panicles remained open; majority of them were sterile; in few the kernels were partially developed. Similar condition was also observed in the remaining panicles of this plant, and those of the other plant.

The partially developed kernels collected from the selfed panicles were grown in R_3 generation during *kharif* 1968. This progeny, designated as Mutant No. 1002, bred true showing complete penetrance and expressivity of the mutant character. The main panicle of each plant was selfed, while others were left as such to mature. After harvest the spikelets