ISSN: 0975-833X

Available online at http://www.journalcra.com

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

International Journal of Current Research
Vol. 4, pp. 087-090, May, 2010

RESEARCH ARTICLE

EXOMORPHOLOGY OF LEAF EPIDERMIS OF SOME NIGERIAN *CAPSICUM* (SOLANACEAE)

Edeoga, H.O., Omosun*, G. O. and ThankGod, L.I.

Department of Biological Sciences, Michael Okpara University of Agriculture, Umudike, P. M. B. 7267, Umuahia, Abia State, Nigeria

ARTICLE INFO

Article History:
Received 3rd April, 2010
Received in revised from
17th April, 2010
Accepted 28th April, 2010
Published online 2nd May, 2010

Key words:
Leaf epidermis,
Capsicum,
Solanaceae,
Taxonomy.

ABSTRACT

The present study deals with the foliar characteristics of two varieties of *C. annum* (Danjarawa and Nsukka Yellow) and two of *C. frutescens* (Langalanga and Tatashi) common in Nigeria. Significant epidermal characteristics that could contribute to the taxonomy of the genus *Capsicum* have been revealed. These include the presence of stomata on the upper epidermis of *C. annum* varieties and the straight walled upper epidermis of *C. annum* var. Nsukka Yellow. Equally, important was the presence of a single mesogene cell in the two varieties of *C. frutescens*. The relevance of these observations has been discussed in relation to the taxonomy of these taxa.

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INTRODUCTION

The *Capsicum* species are members of the Solanaceae, a large tropical family that has other members such as tobacco (*Nicotiana tabacum*), sweet potato (*Solanum tuberosum*). They are believed to have originated from tropical America in the western hemisphere (Heiser and Smith, 1953). The genus name *Capsicum* is most likely from the Latin word, "capsa" meaning to bite, in allusion to the hot pungent properties of the fruit and seeds. *Capsicum* species appeared in Miller's Garden Dictionary in 1771 (Grieve, 1998). In West Africa, peppers are widely grown and are used in a number of ways. They are the third in Nigeria among the cultivated vegetables being utilized in the dry state as spice due to the capsaicin content, an alkaloid which is a digestive stimulant, and as vegetable when supplied for their vitamin content and aroma (Purseglove, 1987). The crop is employed both as condiment and food, the thick sweet fleshy or non pungent varieties are used in salads or stuffed with meat and cooked (Heiser and Smith, 1953).

As a medicinal plant, the *Capsicum* species has been used as a carminative, digestive irritant, stomachic stimulant and tonic. Body temperature, flow of saliva and gastric juices may be stimulated by *Capsicum* peppers (Bosland, 1996). *Capsicum* species are also used in asthma, coughs and sore throats. The pharmaceutical industry uses capsaicin as a counter-irritant balm for external application (Carmachael, 1991).

***Corresponding author:** *omosun@yahoo.co.uk*

The *Capsicum* has been regarded taxonomically as a difficult genus by many workers (Pickersgill *et. al*., 1978; Eshbaugh, 1970, 1975, 1980; Heiser and Pickersgill, 1975). In fact, much of the proliferation of synonyms in *Capsicum* is based on differences in fruit characters. There is no agreement yet among workers with regard to the number of species of *Capsicum* present in West Africa. Wilson (1959, 1961) agreed to the presence of only two species, *C. annum* and *C. frutescens,* George (1985) accepts the proposal of Pursglove (1987) that all other species are all forms of either *C. annum* or *C. frutescens*. *C. annum* is an herbaceous annual that reaches a height of 1 meter and has glaborous or pubescent lanceolate leaves, white flowers and fruits that vary in length, colour and pungency depending on the cultivars. *C. frutescens* is a short-lived perennial with woody stems that reach a height of 2 meters. It has glaborous or pubescent leaves, two or more greenish white flowers per mode and extremely pungent fruits (Dupriez and Deleener, 1989).

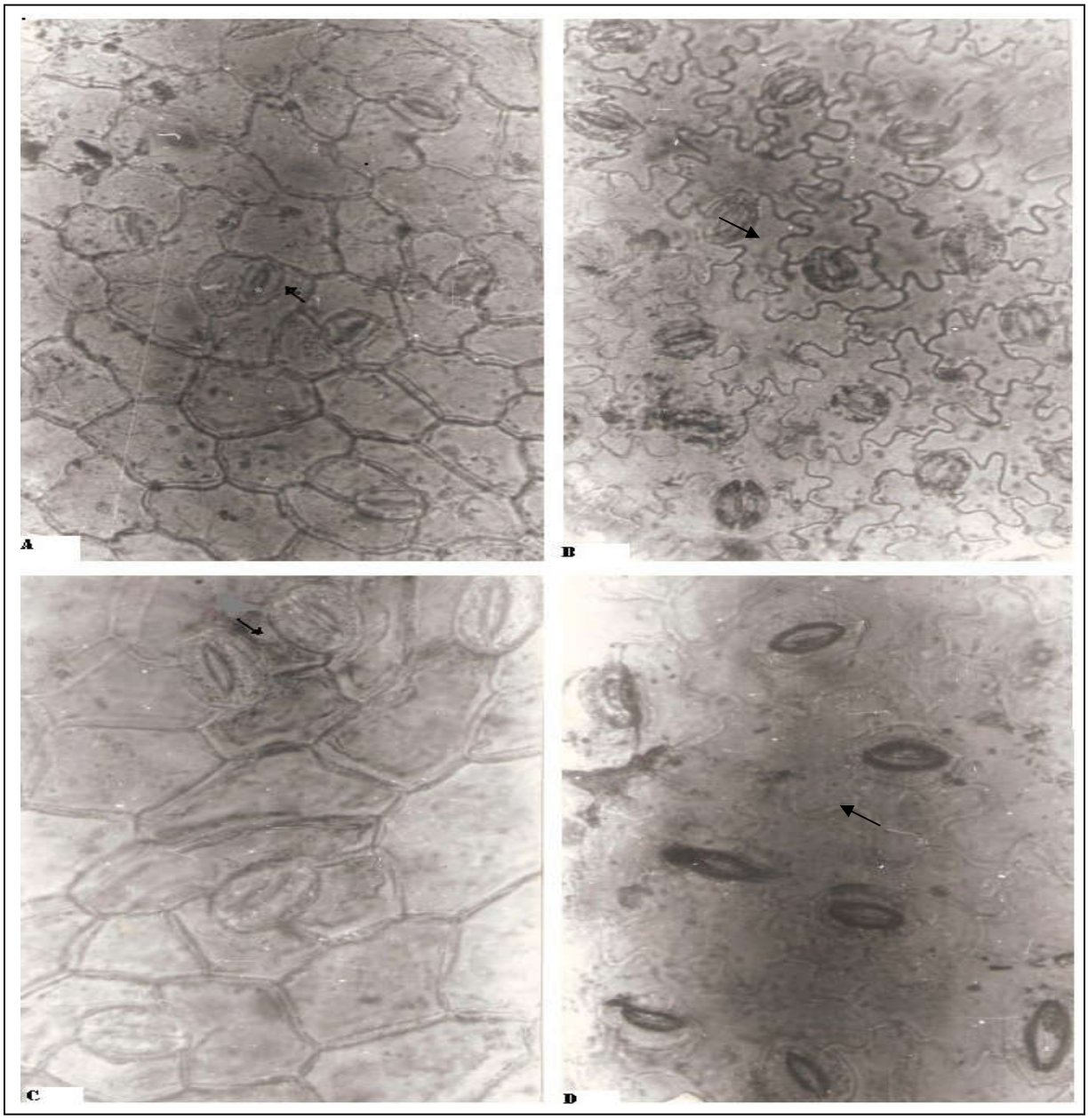
The use of stomatal characters of leaves has been used as excellent taxonomic markers (Das *et al.,* 2004; Parveen *et al.,* 2000; Ogundipe and Akinrinlade, 1999; Edeoga and Ogbebor, 2001; Adedeji and Faluyi, 2001). Four varieties, two each of *C. annum* and *C. frutescens* were chosen for study of their foliar characteristics. This is because of their economic importance. The present study has therefore been undertaken with a view to show the role of leaf exomorphology in the taxonomy of *Capsicum.* This is also with the aim of providing data that will assist in revealing the abundant germplasm existing in these economically important taxa. The bioderversity existing among the co-specific peppers in Nigeria will also be classified from this study.

MATERIALS AND METHOD

Fresh leaves of the four varieties of *Capsicum* were collected from the types in regular cultivation by local farmers. Samples of the fresh specimens were fixed in formalin-alcohol-acetic acid (FAA) for 24 hours and washed in 70% ethanol. Epidermal peels were obtained by holding a leaf between the left thumbs of the index finger on one hand and obtaining strips of epidermis using a pair of forceps held in the other hand. The epidermal peels were stained with 1% safranin for about three minutes. Excess stain is washed off and mounted in glycerine on glass slides for microscopic study. Photomicrographs were taken using a Leitz Wetzler Ortholux microscope fitted with a Vivitar-V335 camera.

RESULTS

The major characteristic of the exomorphology of the leaf epidermis are summarized in Table 1 and illustrated in Fig. I. The leaves were amphistomatic in all the varieties. Anomocytic and anisocytic stomata were found on both the upper and lower epidermis in the four *Capsicum* varieties investigated. The shapes of the epidermal cells were mostly irregular and sinuous in nature (Fig. 1b and 1d). However in the upper epidermis of *C. frutescens* var. Langalanga and *C. annum* var. Nsukka Yellow, the anticlinal cell walls of the epidermis are straight walled and varied from rectangular to polygonal in shape (Fig. 1a and 1c). The upper epidermal cell walls of *C. annum* var. Danjarawa though sinuous in nature was not as that of the



(a) Upper epidermis of C. frutescens var. Langalanga showing presence of a mesogenous subsidiary cell with two normal subsidiary cells. (b) Sinuous anticlinal cell walls of lower epidermis of C. frutescens var. Tatashi. (c) Presence of adjacent stomata with cytoplasmic bridge on C. annum var. Nsukka Yellow (d) Lower Epidermis of C. annum var. Nsukka Yellow with sinuous anticlinal cell walls

Table 1: Epidermal characteristics of the *Capsicum* varieties

Character		*C.frutescens* Var. Langalanga	*C. frutescens* var. Tatashe	*C. annum* var. Danjarawa	*C. annum* var. Nsukka Yellow
*Stomatal Index (%)	Upper epidermis	13.46±1.09	14.51±0.08	6.98±1.24	16.63±2.11
	Lower Epidermis	26.42±2.35	29.31±1.12	27.59±0.18	20.93±2.09
Wall Pattern	Upper epidermis	Straight	Sinuous	Sinuous	Straight
	Lower epidermis	Sinuous	Sinuous	Sinuous	Sinuous
Shape of Epidermal Cells	Upper epidermis	Rectangular/ Polygonal	Irregular	Irregular	Irregular - Polygonal
	Lower Epidermis	Irregular	Irregular	Irregular	Irregular
Stomatal abnormality		–	–	–	+
Single Mesogene Cell		+	+	–	–

+ = Present - = Absent * Mean values

lower epidermal cell walls in which the sinuosity was more pronounced.

The distribution of stomata in both the upper and lower epidermis was observed to be varied among the investigated varieties of *Capsicum*, the stomatal index ranging from 6.98% to 16.67 % (*C. annum* var. Danjarawa, *C. annum* var. Nsukka Yellow) on the upper epidermis and 20.93 % (*C. annum* var. Nsukka Yellow) to 29.31 (*C. frutescens* var. Tatashe) on the lower epidermis.

Two guard cells of adjacent stomata with a cytoplasmic bridge in between were present in *C. annum* var. Nsukka Yellow (Fig. 1c). Observed on the adaxial epidermis of *C. frutescens* var. Langalanga was a smaller single mesogenous subsidiary cell with two normal subsidiary cells (Fig 1a). This arrangement was also observed on *C. frutescens* var. Tatashe. Trichomes were not observed in any of the four varieties.

DISCUSSION

The four varieties of *C. annum* and *C. frutescens* had epidermal features typical of the Solanaceae family. These *C. annum* and *C. frutescens* varieties have basic epidermal characteristics that could aid in recognizing the individual varieties and also in separating them from other varieties and species of the genus *Capsicum*.

All the collections studied were all amphistomatic. The presence of stomata on the abaxial epidermis of *C. annum* collection is a first report, since earlier workers reported a hypostomatic nature for *C. annum* (Gill and Nyawuame, 1990; Ahmad, 1964a). The role of this character in the taxonomic separation of the taxa is evident. This corroborates the earlier finding by other workers (Edeoga and Ogbebor, 2001; Karatela and Gill, 1986, 1988). Cytoplasmic connection between the guard cells of adjacent stomata has been recorded in six taxa distributed in three families - Gentiaceae, Oleaceae and Solanaceae Gill and Nyawuame, 1990). Such cytoplasmic connections have earlier been recorded in *C. annum* (Karatela and Gill, 1988) and in Chilli and Brinjal (Patel and Shah, 1971). Karetela and Gill (1986) and Ahmad (1964b) have reported the presence of mesogene cells involved in the formation of stomata complex in *C. annum* and *C. nocturnum*. The presence of a single mesogene cell in the two varieties of C. fructescens has not been reported.

The absence of trichomes in the two species of *Capsicum* studied confirms the earlier report of other workers (Chandra, 1967; Metcalfe and Chalk, 1950). There is a relatively close range of stomatal indices in both the upper and lower epidermis in all the *Capsicum* collections investigated except in the upper epidermis of *C. annum* var. Dangarawa. The stomatal index varied widely from that obtained from the upper epidermis of other varieties (Table 1). The occurrence of these characters in these taxa supports the fact that they could be used in the taxonomic consideration of plants. These reports are in support of the previous assertions that leaf epidermal micro-morphology has contributed immensely in the phylogenetic and systematic evaluation of different groups of flowering plants (Gill and Nyawuame, 1990; Eshbaugh, 1980).

The results on stomatal characters of these varieties of Capsicum investigated are of interest and they could be vital in their systematic identification. It is pertinent to note also that these characters could be used in clarifying the relationship of these varieties with other varieties, species and sub-species of the genus *Capsicum*. Investigations in other lines of taxonomic reasoning are suggested. This is with a view of combining them in efforts to achieve a natural classification of the different taxa investigated.

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