Comparative Anatomical Studies of Epidermis with Different Stomatal Patterns in Some Selected Plants Using Compound Light Microscopy

M. Naeem[1*], A.Hussain[1], U.R.Azmi[4], S.Maqsood[1], U.Imtiaz[2], H.Ali[3], S.U. Rehman[3], Kaleemullah[1], H.M.Munir[5], U.Ghani[1]

[1]Department of Biochemistry, University of Agriculture, Faisalabad, Pakistan
[2]Department of Biochemistry, Government College University, Faisalabad, Pakistan
[3]Department of Applied Chemistry, Government College University, Faisalabad, Pakistan
[4]Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad, Pakistan
[5]Institute of Horticultural Sciences, University of Agriculture, Faisalabad, Pakistan

Corresponding Author: (M.Naeem, naeemsaleem413@gmail.com, biochemist444@gmail.com)

DOI: 10.29322/IJSRP.9.10.2019.p9449
http://dx.doi.org/10.29322/IJSRP.9.10.2019.p9449

Abstract- The leaves of plants have epidermis that provides protection and act as barrier for the entry of pathogens. The epidermis of plants also provides a system to analyze the cell pattern because surface of epidermis and cell pattern can be analyzed in a plane as compared to three dimensions. Plants have specialized cell in epidermis called guard cell that contain special pores called stomata. Epidermis contains different shape and has different number of stomata and subsidiary cell and guard cell. This research was carried out in the old Botanical Garden of the Agriculture University, Faisalabad from January 2019 to June 2019 to examine anatomy and morphology of epidermis and stomata shape of the dicots plants with particular emphasize on leaves using the compound light microscope also to predict algometric relationships between morphologically stomata traits in relation to gaseous exchange in leaf and required allocation of epidermal area to stomata. Epidermal cells varied from round, square to hexagonal with distinctive anticlinical cell wall and sunken stomata distributed on ad axial and abaxial were observed. Stomata are present in the upper and lower surface of the leaves helpful as adaptation for plants during photosynthesis process and stress condition to maintain the water usage.

Index Terms- Dicots, Epidermis, Stomata, Guard cells, Compound light microscope

I. INTRODUCTION

Plants have two types of specialized cell in epidermis one is called guard cell that contain special pores called stomata. Second cell is called trichome that allows exchanges of gas transport in plants. These cells separated from each other and get differentiated by are separated by pavement cells spacing that has prime importance [5].

Epidermis is the outermost layer of the leaf**.** It is waxy in nature and contains a special layer called cuticle that is effective barrier against injury, loss of water and infection. There are modified epidermal cells that are involved in controlling the rate of transpiration, regulate re-absorption of water and section of chemical substances. The terrestrial plants of land have evolved special openings or pores called stomata present on the epidermis of leaf cells that allow exchange of water and carbon dioxide between interior surface of leaf and atmosphere[4].Stomata mostly occurs in land plants especially on sporophyte but stomata also reported on gametophyte also known as prothallus of model fern catoptrics [10].

The pair of guard cells of land plants separated by one pavement cell of epidermis that also follows the rule that one cell line spacing is more favorable as compared to other multi-spacing. The most important type of stomata is paralytic that is more advantageous for plants included in group of angiosperms. On the other hand, lateral subsidiary cells of paralytic stomata has special cells known as subsidiary cells which can be eperigenesenn as in family of grasses also mesogene seen as some angiosperms such as magnolia [10].

In the recent research on physiology and morphological changes in guard cells showed that these specialized guard cells regulate the both extracellular and intracellular signals while in controlling of apertures of stomata. These specialized cells integrate both extra- and intra-cellular signals in the control of stomatal apertures [1].The light and electron microscopy was used to study the morphological changes, microscopic examination in changing the shape of guard cells also development of stomata in one-celled condition in the family of funaria also known as musci . Plants also affected with metals toxicity and resulted severe death of tissues and organs. Growth of plants also decreases due to metals toxicity[11]. In the prophase , microtubules moved toward the in nonstomatal cells of epidermis under normal cytokinesis but possibility is increased that microtubules are possibility absent in parent cells of guard cells[9]. Some plants are affected by cancerous cells

that may damage certain parts of plants and ultimately leads to death [12].

Stomatal Precursor cells of stomata also called meristemoids showed changes in the shape of guard cells by undergoing several asymmetric divisions before going into stages of further differentiation [8]. Recent studies on biological aspects of stomata showed that space in epidermis of leaf to stomata in order to regulate normal balance between carbon dioxide that a plant needs for growth and development and use of water for regulation of transpiration [2].

The main objective of this research work is to examine the morphology of epidermis and stomata shape of the dicots plants with particular emphasize on leaves using the compound light microscope also to predict algometric relationships between morphologically stomata traits in relation to gaseous exchange in leaf and the required allocation of epidermal area to stomata.

II. MATERIALS AND METHODS

The research was carried out in field and laboratory to investigate the epidermis and stomatal shape of the dicots plants that were selected for this research with particular emphasize on leaves. The methods and procedures for each experiment are given below. Here below a detailed of area of study of time, sample collection and description of the experimental site, microscopic examination, description of experimental materials.

Description of the Experimental site

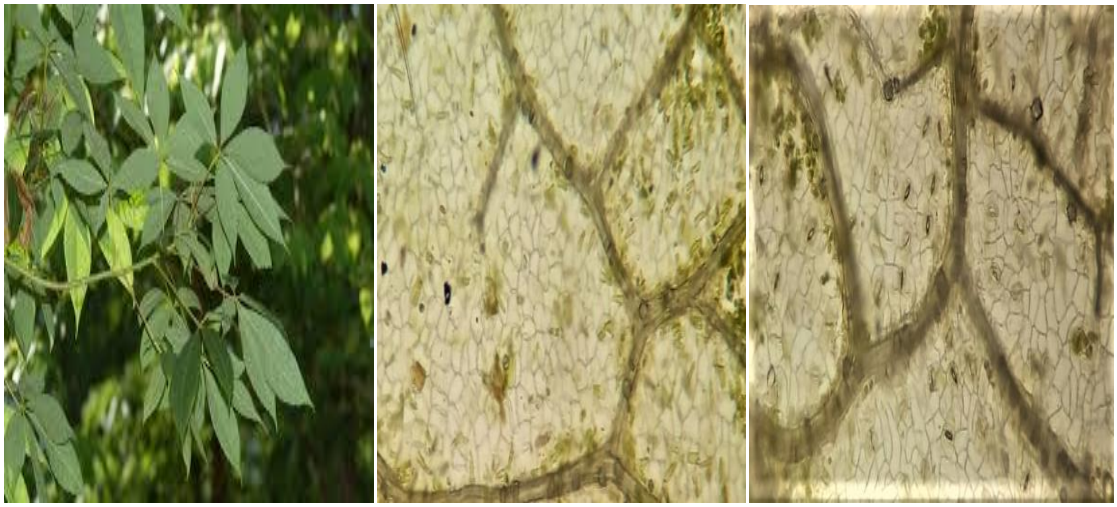
The plants were collected from the old botanical garden of the Agriculture University Faisalabad, Pakistan. The research was time period between January 2019 to june 2019 conducted to investigate the epidermis and stomatal shape of the dicots plants that were selected for this research with particular emphasize on leaves. In the dicots plants the epidermis are the tubular and irregular in shape.

Sampling and Microscopic Examination

Smooth leaves without many leaf hairs were collected. Microscope slides were used for microscopic examination of adaxial and abaxial surface of dicots leaves. Bended the fresh leaves to break the surface or tear the leaf from the edge [13]. After Cut the epidermal layer was carefully separated from the leaf and placed on a microscope slide. Placed a cover slip on the sample and viewed under the compound light microscope according to the procedure [3]. In an unstained epidermis it helps to close the iris diaphragm a little to increase contrast and see the cell walls clearly. Digital camera was used to capture microscope images of the leaf surfaces.

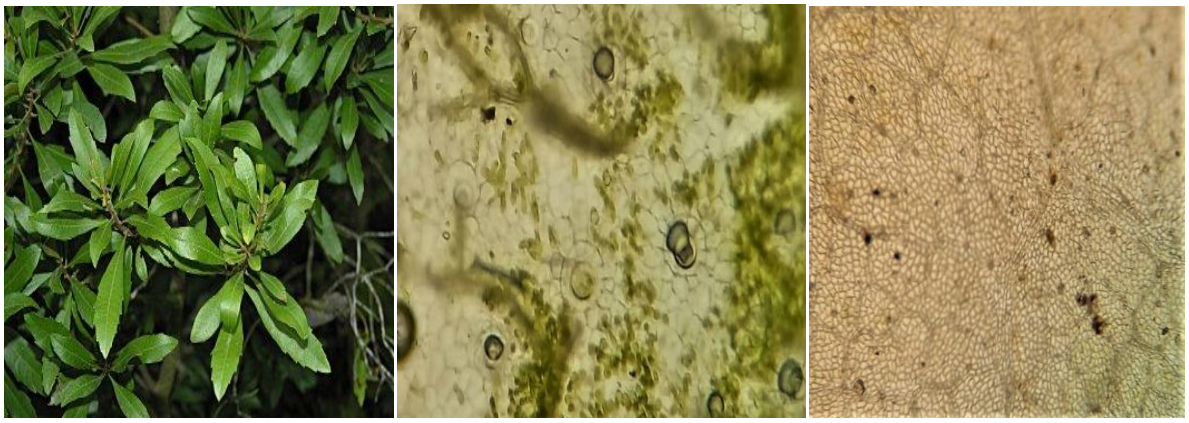
III. RESULTS AND DISCUSSION

On the basis of careful microscopic examination fine and smooth surface of epidemis was observed. Stomatapresent on epidermal cells of leaves evenly distributed on the lower and upper epidermal surfaces. The stomata were very numerous and deeply sunken below the surface of leaf. Different type of stomata carefully observed for microscopic examination of epidermis of the plants. Mesogenous stomata in which the subsidery cells have the cooonorigin with guard cells and other is the perigenous which develop from the protodermal cells. Different type of the stomatal shapes has been observed during the research works that are similar in shape to the shape of the dicots plants epidermis shown. These are like the anomocytic type in that guard cells are surround by many similar in size and shape to the epidermal cells means here no subsidery cells are found. Crucuferious type show that guard cells are surrounded by three subsidery cells of unequal size. Paracytic type show that guard cells accompanied by one or more subsidiary cells parallel to axes. Diacytic type in which stomata surround by the two subsidiary cells. These shapes of the cells are shown under the microscope.



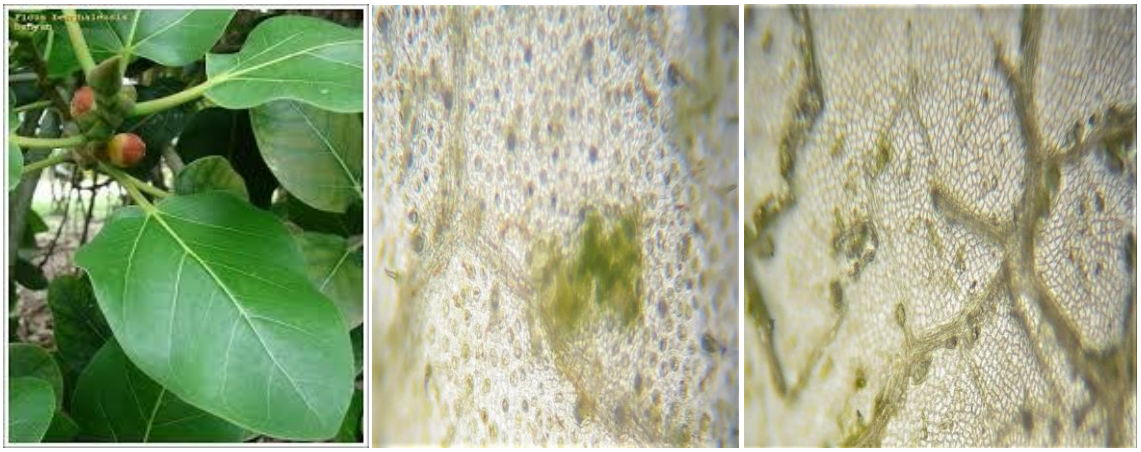
A B C

Fig 1.(A) Leaf shape of Chorisiaspeciosa (B) Stomatal Distribution And Epidermal Cells in Adaxial surface (c) Stomatal Distribution Epidermal Cells in Abaxial surface



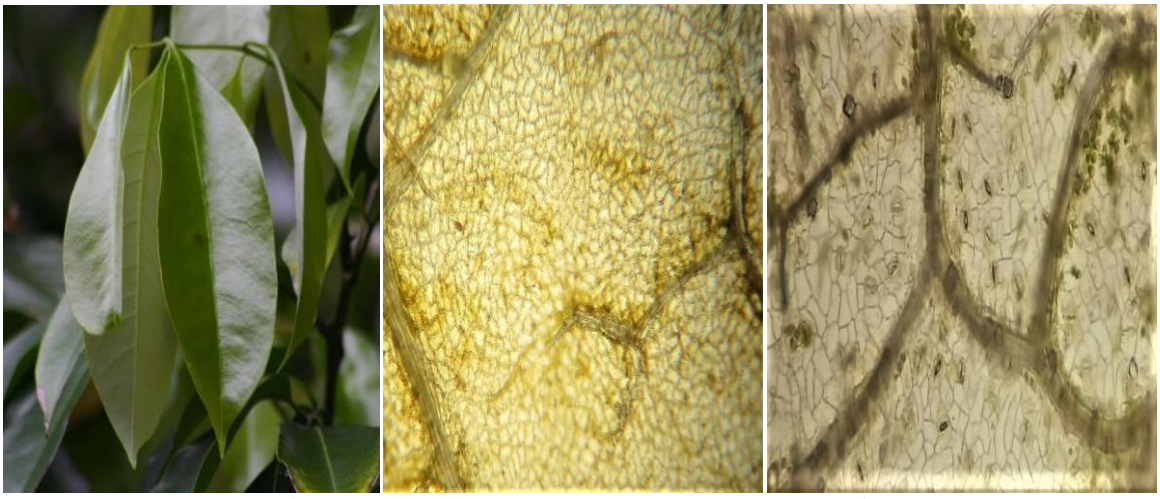
A B C

Fig 2.(A) Leaf shape of Morella cerifera (B) Stomatal Distribution And Epidermal Cells in Adaxial surface (c) Stomatal Distribution Epidermal Cells in Abaxial surface



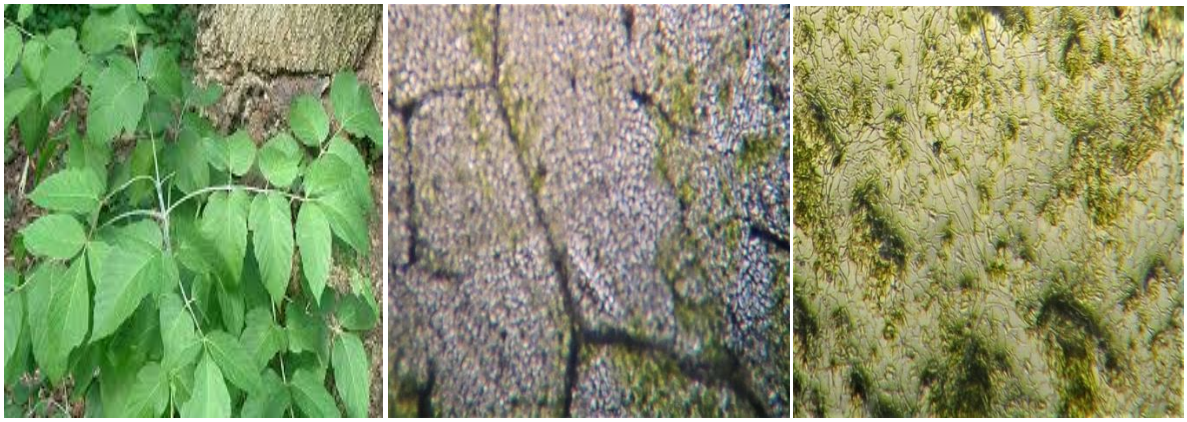
A B C

Fig 3.(A) Leaf shape of *Ficusbenghalensis* (B) Stomatal Distribution And Epidermal Cells in Adaxial surface (c) Stomatal Distribution Epidermal Cells in Abaxial surface



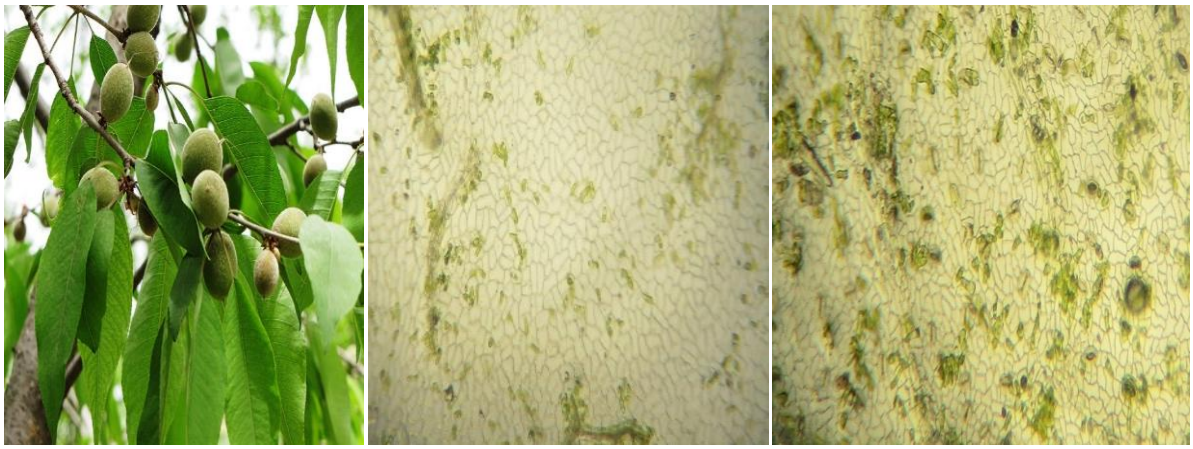
A B C

Fig 4.(A) Leaf shape of Litchi chinensis (B) Stomatal Distribution And Epidermal Cells in Adaxial surface (c) Stomatal Distribution Epidermal Cells in Abaxial surface



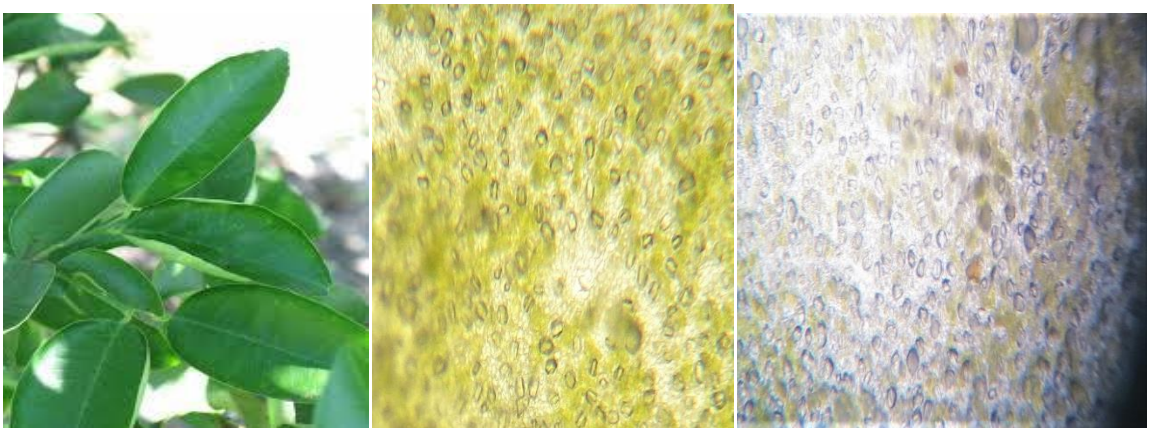
A B C

Fig 5.(A) Leaf shape of *Acer negundo* (B) Stomatal Distribution And Epidermal Cells in Adaxial surface (c) Stomatal Distribution Epidermal Cells in Abaxial surface.



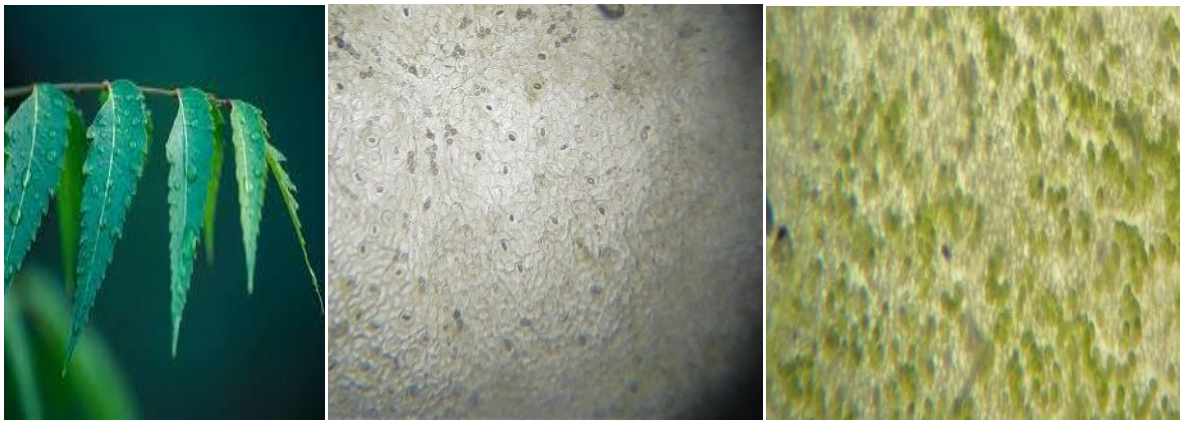
A B C

Fig 6.(A) Leaf shape of Prunusarmeniaca (B) Stomatal Distribution And Epidermal Cells in Adaxial surface (c) Stomatal Distribution Epidermal Cells in Abaxial surface



A B C

Fig 7.(A) Leaf shape of Citrus medica(B) Stomatal Distribution And Epidermal Cells in Adaxial surface (c) Stomatal Distribution Epidermal Cells in Abaxial surface



A B C

Fig 8.(A) Leaf shape of Azadirachtaindica (B) Stomatal Distribution And Epidermal Cells in Adaxial surface (c) Stomatal Distribution Epidermal Cells in Abaxial surface

Our research suggests that gradually changes in shape of stomata traits provide an evidence to increase gaseous exchange capacity of epidermis although deceases the division of the epidermis that is covered with stomata. Several epidermal traits in the bennettitales with the characteristic of thickenings of guard cell wall correspond to both ecologically and physiological character. Epidermal cells that contain anticlinal walls with lobed are extremely indication of adaxial or abaxial differentiated mesophyll with the purpose of balanced the rate of photosynthesis also provides mechanical strength. Bennettite leaves show polarity that influenced by genetic factors alike to those that controlling the polarity of abaxial and adaxial in angiosperm leaves [6].

Cells of epidermis shows various morphological characteristics with variations in size and number and comparable characters experimentally observed in all species with shape of cells and arrangement of anticlinal cells walls among the species. All species included in this research show curved shaped and anticlinical walls shapes of the epidermal cells are irregular. The shape associated with anticlinal walls considered a fundamental adaptation in relation to environment typically curved and straight anticlinal walls[7].

IV. CONCLUSION

The current research work summarizes microscopic examination of epidermis dicots leaves. Different type s of the stomatal shapes observed under compound light microscope included anomocytictype ,crucuferious type, paracytic type and diacytic type . Stomata is present in the upper and lower surface of the leaves observe clearly which help the plants during photosynthesis process and stress condition to maintain the water usage.

Conflict of Interest

The author declared that there is no conflict of interest towards this research. All authors contributed for completion of the research. All authors agreed for publication of this research.

REFERENCES

[1] Acharya BR , Assmann SM. Hormone interactions in stomatal function. Plant Molecular Biology. 2009; 69, 451-462

[2] Boer HJ, Price CA,Wagner F , Dekker SC, Franks PJ ,Veneklaas EJ. Optimal allocation of leaf epidermal area for gas exchange. New Phytologist2016;210:1219-1228.

[3] Coopoosamy MR, Naidoo KK. Anatomical features of medicinal importance of Aloe excels. African Journal of Biotechnology2011; 10(39):7622-7632

[4] CranePR,KenrickP.The origin and early evolution of plants on land. Nature.1997;389:33.

[5] Larkin JC, Marks MD, Nadeau J ,Sackc F. Epidermal Cell Fate and Patterning in Leaves.The plant Cell9. 1997;1109-1120

[6] Mathew H ,Chare P, Cyri D,Giovanni D ,Marcos T ,Gaudio G , Mauro C. An Allocation of the epidermis to stomata relates to stomatal phsiological control:Stomatal factors invoilved in the evolutionary diversification of the angiosperms and development of amphistomaty. Environmental and Experimental Botany2018;151:55-63

[7] Norfaizal G, Noraini T, Latif A, Masrom H , Salmaniza S. Variation in the stomatal types and anticlinical wall pattern in Malaysian Spindaceeae Species. Asian journl of Microbiolology, Biotechnology and Enviroenmtal Sciences. 2018;20(2):387-403

[8] Pillitteri LJ , Sloan DB , Bogenschutz NL , Torii KU. Termination of asymmetric cell division and differentiation of stomata. Nature.2007;445:501-505.

[9] Sack F, Fred D ,Paolillo DJ.Incomplete Cytokinesis in Funaria Stomata. American journal of Botany 2006;72:1325.

[10] Rudall P J, Gardens RB, Hilton J.Tansley review Several developmental and morphogenetic factors govern the evolution of stomatal patterning in land plants. New Phytologist. 2013;200:598-614.

[11] Shafiq S, Adeel M , Raza H, Iqbal R , Ahmad Z , Naeem M, Sheraz M, Ahmed Azmi,UR. Effects of Foliar Application of Selenium in Maize (Zea Mays L.) under Cadmium Toxicity. Biological Forum-An International Journal 2019;11(2): 27-37

[12] Naeem M, Hayat M, Qamar AS, Mehmood T, Munir A, Ahmad G, Azmi UR, Faryad MA, Talib MZ, Irfan M, Hussain A, Hayder MA, Ghani U, Mehmood F. Risk factors, genetic mutations and prevention of breast cancer. Int. J. Biosci.2019. 14(4), 492-496.

[13] Ahsan M, Aslam M, Akhtar M.A, Azmi U.R, Naeem M, Murtaza G, Irfan M, Shafiq S. Effect of inoculation of three rhizobial strains on maize hybrids. J. Bio. Env. Sci. 2019.14(6), 168-177.

AUTHORS

First Author: Muhammad Naeem[1]*, Department of Biochemistry, University of Agriculture, Faisalabad, Pakistan, naeemsaleem413@gmail.com , biochemist444@gmail.com
Second Author: Asim Hussain, Department of Biochemistry, University of Agriculture, Faisalabad, Pakistan, asimhussain206@gmail.com
Third Author: Umair Rasool Azmi , Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad, Pakistan, umairrasoolazmi@hotmail.com
Last Author: Usman Ghani, Department of Biochemistry, University of Agriculture, Faisalabad, Pakistan, ghaniusmankharal579@gmail.com.