

Ethnobotanical Leaflets 12: 553-56. 2008.

Global Warming and Stomatal Complex Types

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Issued 25 July 2008

Ozone depletion and its ultimate effect, global warming are main concerns in climate change in the world today. The phrase 'climate change' is growing in preferred use to 'global warming' because it helps convey that there are changes in addition to rising temperatures. Accumulation of greenhouse gases in the atmosphere depleted the ozone layer and consequently causes global warming. Gases that trap heat in the atmosphere are often called greenhouse gases. That the Earth has warmed by 0.74°C over the last hundred years and that around 0.4°C of this warming has occurred since the 1970s is unequivocal fact that leaves little room for doubt that human activity is the primary driver of these changes (May, 2006). Among factors that emit the greenhouse gases into the atmosphere are burning of woods (fuel woods) and deforestation. Removal of plants on the surface of planet Earth is no doubt contributing greatly to the accumulation of greenhouse gases and thus the global warming.

World leaders, public health specialists, engineers, atmospheric chemists, hydrologists, quantum physicists, mathematicians, botanists, zoologists, have all been striving to stop further release of more greenhouse gases into the atmosphere, and in the occurrence of these gases, they are trying to purify or cleanse them. One of the cleaners or purifiers that can be employed is stomata. Figures 1 to 8 showed different types of stomatal complex systems in some species of *Amaranthus*. Stomata are microscopic openings or pores located majorly on the abaxial or lower, and adaxial or upper surfaces of leaves of plants. Though sometimes, stomata are present on the stems, petioles and sepals but in very small number.

Meanwhile, plants have the ability to absorb carbon dioxide for carbonxylation and subsequently for production of carbohydrates (especially by the tuberous plants) and for production of woods and fibres (by trees) through photosynthesis. Photosynthesis is the major process by which plants produced carbohydrates, and the major ingredient in this process is carbon dioxide. Unfortunately, carbon dioxide is one of the greenhouse gases (other examples include methane [CH₄], nitrous oxide [N₂O], fluorinated gases – hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride). The accumulation of these gases in the atmosphere strengthened the greenhouse effect, which occurs when the heat produced by the sun's rays entering the atmosphere is retained, causing global warming. Some greenhouse gases such as carbon dioxide occur naturally and are emitted to the atmosphere through natural processes and human activities. Other greenhouse gases (e.g. fluorinated gases) are created and emitted solely through human activities. About 99% carbon dioxide used in photosynthesis is absorbed through stomata (lenticels and cuticles also absorb carbon dioxide to lesser extent). Earlier studies by Carr and Carr (1990), Obiremi and Oladele (2001) and Oyeleke et al. (2004) had confirmed that the more the subsidiary cells surrounding the guard cells, the faster the opening of the stoma (i.e. pore between the two guard cells) and vice versa.

In relation with this, plants that possessed stomata with many subsidiary cells (e.g. tetracytic and anomocytic types) will play important role in reducing greenhouse gases especially carbon dioxide. To prove this fact, Obiremi

and Oladele (2001) and Oyeleke et al (2004) studied the relationship between the stomatal complex types and transpiration rate in some selected *Citrus* species and some afforestation tree species respectively. In both studies, stomatal complex types with many subsidiary cells transpired higher than those with less number. This translates to mean that the latter opens faster to allow carbon dioxide to enter the leaves and water vapour to escape to the atmosphere via the stomatal openings than the former. More over the other aspect of stomatal opening that favour water loss to the atmosphere (i.e. encouraging high rate of transpiration) is also advantageous by humidifying the atmospheric air.

However, to achieve reasonable atmospheric purification, plants with hypostomatic nature of the leaves (i.e. stomata being found or located on the abaxial surface only), lower frequency of stomata with many subsidiary cells (e.g. anisocytic, tetracytic and anomocytic), higher frequency of stomata with frequency of stomata with little subsidiary cells (e.g. cyclic, paracytic and diacytic), less heterogeneous composition of stomatal complex types, less stomatal density and index (i.e. less distribution of stomata on the surface of leaves), and lastly, probably occurrence of trichome (Figures 9 – 11) may be more suitable for afforestation in dry locations. Plants with opposite conditions of the above stomatal features may be more suitable for afforestation in wet environments. These conditions had earlier identified by Oyeleke et al. (2004) and AbdulRahaman and Oladele (2003; 2004).

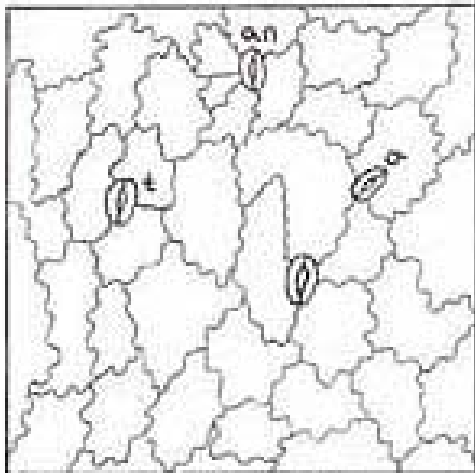


Figure 1: Abaxial surface of *A. spinosa* showing anisocytic(a), anomocytic(an) and tetracytic(t) stomata x600

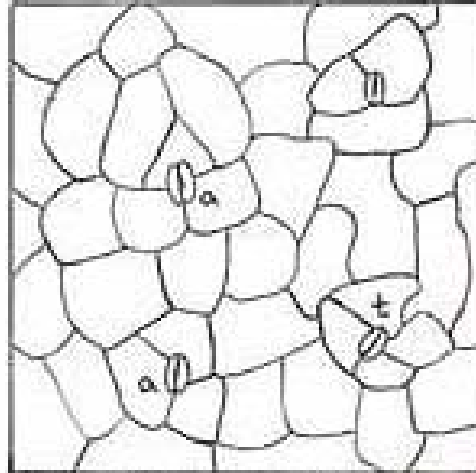


Figure 2: Abaxial surface of *A. rosulata* showing anisocytic(a) and tetracytic(t) stomata x600

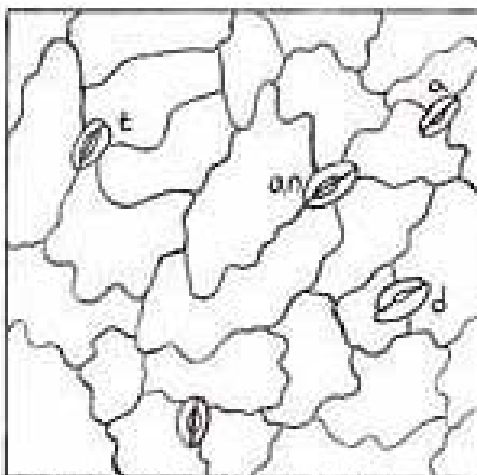


Figure 3: Abaxial surface of *A. graciliant* showing anisocytic(a), anomocytic(an), diacytic(d) and tetracytic(t) stomata x600

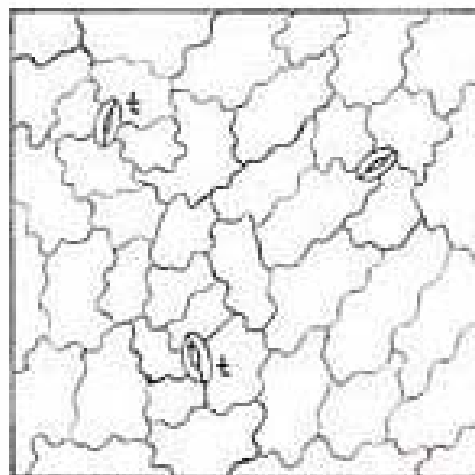


Figure 4: Abaxial surface of *A. dubius* showing tetracytic(t) stomata x600

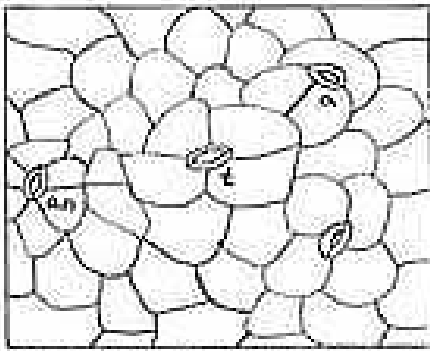


Figure 3. Abaxial surface of *A. roseum* showing anisocytic (a), anisocytic (av) and tetracytic (t) stomata. $\times 600$

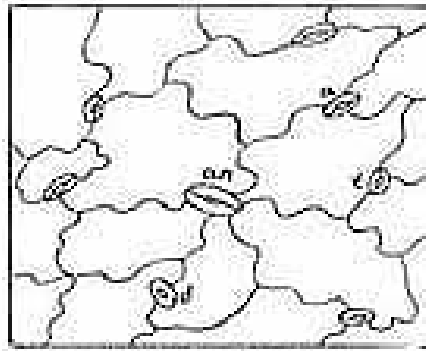


Figure 4. Abaxial surface of *A. roseum* showing anisocytic (a), anisocytic (av), diacytic (d) and tetracytic (t) stomata. $\times 600$

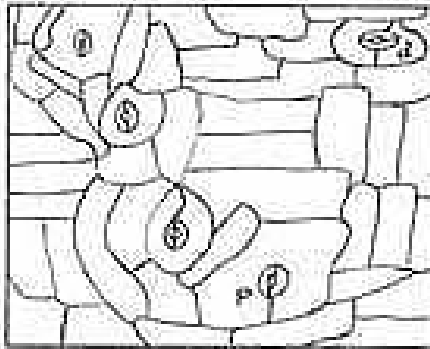


Figure 5. Abaxial surface of *A. roseum* showing diacytic (d) and tetracytic (t) stomata. $\times 600$

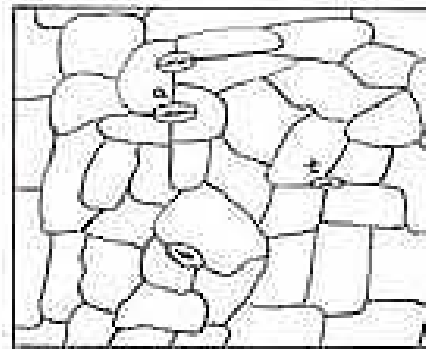


Figure 6. Abaxial surface of *A. hololepis* showing anisocytic (a) and tetracytic (t) stomata. $\times 600$

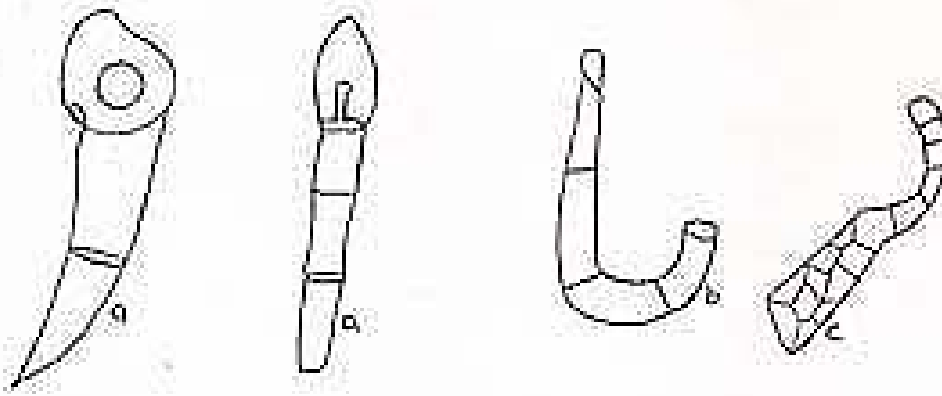


Figure 9. Capitate glandular (a), unicellular (b) and multicellular (c) trichomes in *E. melanos* x600.

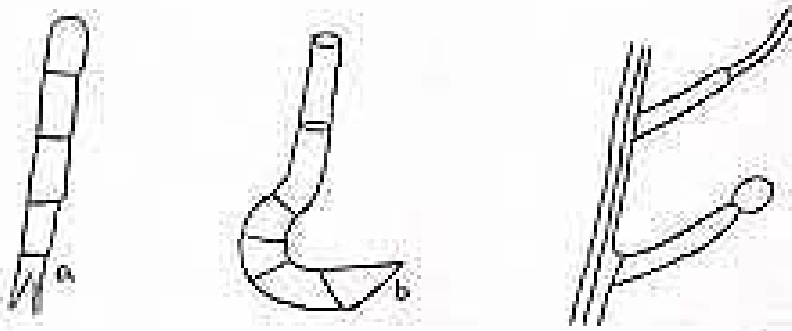


Figure 10. Mangrovia (a & b) trichomes in *E. apocynum* x600.

Figure 11. Side trichomes along the leaf vein in *E. glabrum* x600.

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