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The effects of gaseous pollutants from the exhaust- pipe of power generators on the epidermis of leaves of *Elaeis guineensis* Jacq

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Abstract: The length and width of ten leaves, each of both polluted and non-polluted populations, of Elaeis guineensis (Tenera hybrid) were measured. Their average leaf areas (LA) were 69.70 ± 0.5 for the polluted populations and 102.41± 0.6 for the non-polluted populations. The stomatal pores of the polluted populations were plugged by pollutants while those of the non-polluted populations were opened. Also, the outer leaf surface of the polluted populations was glued with tiny particles of pollutants which had penetrated the cell walls and settle in the protoplasms of the cells. Such were not observed in the leaves of the non polluted population. Results from this study tend to suggest gaseous pollutants might have considerable effects on Elaesis guineensis.

Key words: Gaseous pollutants, exhaust- pipe, epidermis, *Elaeis guineensis*.

Introduction

Elaesis guinenesis Jacq. generally known as the oil palm is a monocotyledonous plant that belongs to the family Palmae (Irvine, 1961, Gill, 1988). In West Africa the family is represented by 12 genera and about 24 species. In Nigeria and elsewhere in the world, oil palm is domesticated as Ornamentals, hedge plants, boundary markers and as source of oil for local consumption. Also, large scale oil palm estates exist for industrial and commercial purposes.

It is now a common occurrence to see black soot particles deposited on the leaves and stem of the oil palm growing very close to the sites of the exhaust-pipe of power generator used in homes. Previous study by Sylvia et. al. (2005) asserted that smokes and other air pollutants are generated in homes where they cause serious health problems and damages to plants. The activities of such gaseous pollutants had been elucidated by Socha (2002) who reported that pollutants such as Sulphur dioxide (SO_2), Nitrogen oxides (NO_x), Ozone and Peroxy acetyl nitrates (PAN_s) caused direct damages to leaves of some botanicals when they enter leaf pores (stomatas) and break down the waxy coating that helps prevent excessive water loss and damage from diseases, pests, drought and frost.

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Also dusts, apart from screening out sunlight on leaves, have been observed by Bonnie and Joel (2000) to block stomata and lowers their conductance to carbon IV Oxide (CO_2) thus interfering with photosystem II. Thus the study being reported was undertaken to reveal the stomatal and epidermal cell aberrations caused on the leaves of this economic plant as a result of gaseous pollutants from exhaust-pipe of power generators used in homes. The study also attempt to explain the physiological implications of deposits of the pollutants in the cells of the leaves

Materials and Methods

Leaves of matured hybrid tenera palm (NIFOR, 1995) were colleted from polluted and non-polluted microhabitats in Benin-City and Ekosodi Village respectively, both of Edo State, Nigeria. Ten leaves per population were measured for their sizes and their leaf areas were determined according to Duncan and Hesketh (1968) and Remison and Lucas (1982). The epidermal peels for cuticular studies were obtained following the method of Metcalfe and Chalk (1988).

The leaves were placed with the outer surface facing downward on a flat surface and flooded with commercial bleaching agent. The epidermis was gently, carefully and gradually peeled off from the mesophyllic tissues of the leaves with the aid of a sharp razor blade. The peels were stained with combination of safranin and Delafield's haematoxylin and mounted temporarily on slides. 10 slides (each of adaxial and abaxial surfaces) were prepared per population. The slides were examined under the light microscope and data were collected from 10 microscopic fields selected at random from each slide.

The length and width of stomata pores and guard cells were measured and data were collected from 25 stomata per leaf surface. This was done in 10 replications and their means and stomatal index were determined. Data were analyzed statistically.

Result and Discussion

The leaf size, area and epidermal characteristics of Tenera hybrid of *Elaeis guineensis* were summarized in Table 1. The leaf surface of the polluted population was glued with soot particles and had average leaf area of 69.70±0.5 while the non polluted populations had no soot particles and measured 102.41± 0.6 average leaf area.

The anticlinal and periclinal walls of the upper epidermal cells were found to be straight but curved in some cells while they were straight in the non-polluted population. In the lower epidermis, on the other hand, both walls were straight in the polluted and non polluted populations except in the periclinal walls which were slightly curved in some cells.

Elaesis guineensis is epistomatic and possessed anomocytic stomata. The polluted population had stomata index of 25% in adaxial epidermis while the non polluted population had 45.45% in the adaxial epidermis. Epidermal hairs were absent in the leaves of both populations. Plugged stamatas were observed in the polluted population. However, the mean width and mean length of 0.65µm and 2.44 µm were obtained for the stomatal pores respectively in the non-polluted population. Some guard cells that were not covered by thin particulates of pollutants in the polluted populations had 2.79 µm and 1.74 µm as their mean length and mean width respectively, while the guard cells of the non polluted populations were measured to be 3.56 µm and 1.97 µm as their mean length and width respectively. Opened stomatal pores were observed in the non polluted population as oppose to those found in the polluted ones.

The epicuticular wax (Upper and Lower) of the polluted population were completely eroded and glued with tiny soot particulates while those of the non polluted population had uneroded cuticules which were free from soot. Pollution activities such as plugging of stomatal pores, coating of guard cells by tiny particulates (Black Soot), destruction of stomatal hedges, interference of protoplasm and erosion of epicuticular wax by pollutants could be the cause of the reduction in size of the leaves of the polluted population since they could not trap the sun light to manufacture their food as a result of the coverage of the leaf surface by black soot .

Table 1. Leaf size and Epidermal Characteristic of both populations of Tenera hybrid of *Elaeis guineensis* Jacq (Palmae).

DESCRIPTION	**POPULATIONS**	
	POLLUTED	**NON-POLLUTED**
A. Leaf Dimension:		
Mean Length (cm)	49.70± 0.4	54.62 ± 0.1
Mean width (cm)	1.87 ± 0.2	2.50 ± 0.3
Average Leaf Area (cm^2)	69.70 ±0.5	102.41 ±0.6
B. Leaf epidermal characteristics:		
Nature of epidermal cell wall		
U	Anticlinal and periclinal walls are straight, though curved in some cells	Anticlinal and periclinal walls are straight.
L	Anticlinal and periclinal walls are straight	Anticlinal walls are straight while periclinal walls are slightly curved.
Type of stomata		
U	= Anomocytic	Anomocytic
L	= NIL	NIL
Stomata index (%)		
U	25%	45.45%
L	NIL	NIL
Types of epidermal Hair	Absent	Absent
U	Absent	Absent
L		
Mean width of stomatal pore (µm)		
U	Plugged	
L	-	0.65
Mean Length of stomatal pore (µm)		-
U	Plugged	
L	-	2.44
Mean Length of guard cells		-
U	2.79	
L	-	3.56
Mean width of guard cells (µm)		-
U	1.74	
L	-	1.97
Status of stomata pore		-
U	Plugged by pollutants	
L	-	Open and not plugged
Integrity of epicuticular wax		-
U	Eroded	
L	Eroded	Present
Leaf surface appearance		Present
U	Glued with soot	
L	Glued with soot	Absence of soot
		Absence of soot

The eroded epicuticular wax could be attributed to heat that characterized effluents from the exhaust-pipe of the generator. This condition is capable of exposing the epidermal cells to opportunistic infections, cause damages of cells and also increase the rate of transpiration in the leaves. This tend to confirm the view of Socha (2002) that pollutants such as Surphur dioxide, Nitrogen Oxides, Ozone and Peroxyacetylnitrates (PANs), cause direct damages to leaves of some botanicals when they enter leaf pores (stomates). And that, chronic exposure of leaves to these air pollutants can also break down the waxy coating that helps prevent excessive water loss and damage from disease, pest, drought and frost.

Furthermore, the plugging of stomatal pores and blockage of guard cells could hamper photosynthetic activities of the polluted leaves. This assertion tend to confirm the earlier reports of Eduardo (2002) that dust on leaves blocks stomata and lowers their conductance to CO_2 and interfered with photosystem II. He contended further that exposure of leaves to pollutants such as SO_2 and NO_X had been found to cause stomatal closure and curtailed photosynthesis.

The presences of foreign bodies (pollutants-black carbon) in the protoplasm of epidermal cells could interrupt catabolic and anabolic activities of the cells. This might be the cause of the low percentage of stomata in the leaves of the polluted populations when compared with that of the non polluted populations. The leaves of the populations that were not affected by pollutants had opened stomatas, large size, clear protoplasm and absence of soot particles on the surface. These conditions afford the non-polluted leaves the advantages of normal photosynthetic and transpiration activities and ecological balance. Hence, they were able to exhibit those characteristics different from their polluted counterparts (See Table I). Thus pollution activities on this economic plant might make it difficult for it to produce oil (palm oil) at the rate the non polluted ones will do, since palm oil production is dependent on the health status of the plant. We are inclined to advise that this plant should be prevented from source of pollutants generated by power generators.

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