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Effects of Sawmilling Activities on Vegetation Characteristics in Isokan Area of Southwestern Nigeria

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Abstract: The effects of sawmilling activities on vegetation characteristics were investigated in Isokan Local Government Area of Osun State, Southwestern Nigeria. Six sawmills were randomly selected in the area and from each sawmill, five dominant plant species around the sawmills were also selected at the site at an increasing distance of 0, 50, 100, 150 and 200 m away from the sawmillings. The chlorophyll content, leaf area and stomata number of the selected dominance plant species were studied in dry and rainy seasons. The chlorophyll concentration of the common plants, leaf area and stomata number on both adaxial and abaxial surfaces at various distances starting from 0 to 200 m were subjected to analysis of variance. Some species showed significant difference in the vegetation parameters/characteristics investigated in relation to distances while some did not. The particulate matters generated from the sawmills caused reduction in chlorophyll concentration of most of the surrounding individual plants. The implication of these observations were discussed.

Key words: Vegetation characteristics, sawmills Southwestern Nigeria, Sawdust, plant species

INTRODUCTION

Sawmilling developments are charaterised with a lot of environmental pollution and destroy the beauty of the area. Sawmilling activities constitute a lot of environmental disturbances and stress on the terrestrial ecosystem as well as a vegetation characteristics. The disturbance in plant ecosystem affects the performance and survival of individual plants.

Growing plants are particularly susceptible to pollution with reduction in photosynthesis and growth often occurring before visible symptoms of injury are noted (Hodges, 1977). The concentrated dust particles in the atmosphere surrounding the mill reduce and probably screen out effective light rays reaching the leaves (Singh and Rao, 1981; Odu, 1994) and have direct effects on chlorophyll accumulation. Pollutants produced a complex of physiological effects such as stunted growth and stomatal closure (Hull and Went, 1952). Sawdust particles settled on leaves and many intefere with light required for photosynthesis and thus reduced starch production. Chlorophyll may be destroyed in cells under sawdust cover (Farombi, 2000). Through air pollution vegetation and farmlands become parched and exhibit symptoms such as decreased leaf, reduced chlorophyll content, decrease internode length in some plants and suppressed growth in plants. Particulate pollutants can cause loss of photosynthetic productivity due to carbon-dioxide deprivation arising from stomatal closure.

Retardation in chlorophyll synthesis in the leaves leads to premature leaf yellow and subsequent dropping from the stem (Mudd and Kozlowsk, 1975; Singh and Rao, 1981; Odu, 1994).

The effects of particulate on plant range from observed changes of cellular level and biochemical through overall effects on growth and performance to major alteration in population size, species distribution (Woodwell, 1970), significant changes in structure and composition of the seedling-shrub, sapling and tree strata (Brandt and Rhoades, 1972). Isichei and Sanford (1976) and Odu (1994) in separate studies reported that through air pollution vegetation and farmlands become parched and exhibit symptoms such as decreased leaf, reduced chlorophyll content, decreased internode length in some plants and suppressed growth in plants.

The present study investigates the effects of sawmilling dust on the vegetation characteristics around the sawmills in Isokan Local Government Area of Osun State in Southwestern Nigeria.

MATERIALS AND METHODS

The study was carried out in Isokan Local Government Area of Osun State in Southwestern Nigeria

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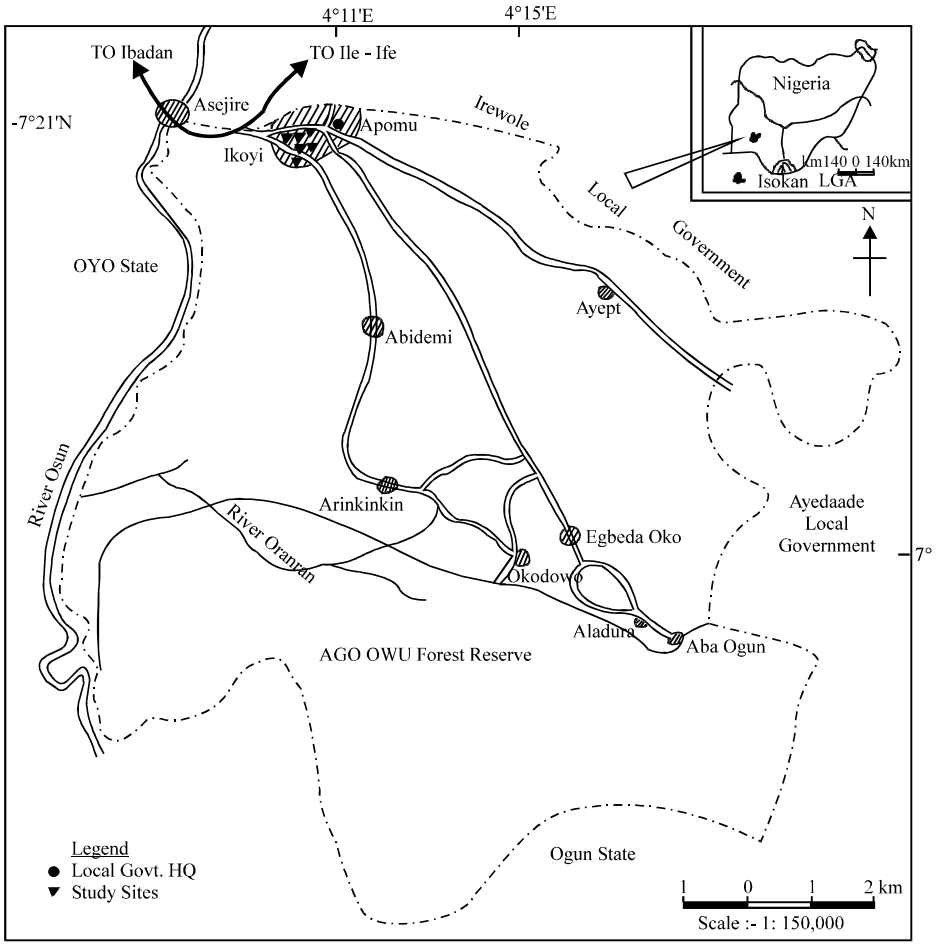

Fig. 1: Map of Isokan Local Government showing the study sites

which lies on Latitude 7°12'N and 7°21'N and Longitude 4°11'E and 4°15'E (Fig. 1).

The climate of the area is humid tropical with distinct dry and rainy seasons. The rainy season starts from around mid March to late October and rainfall pattern is bimodal with peak periods in July and September. Mean annual rainfall at Isokan Local Government is about 1400 mm (five year mean).

The dry season runs from November to March. The atmospheric temperature is moderately high throughout the year. The original vegetation of the area is lowland rainforest as a climax vegetation. However, the climax vegetation has been disturbed by human activities through timber extraction and indiscriminate felling of trees for various purposes.

Sawmill selection: Six sawmills were randomly selected in Isokan Local Government Area of Osun State in Southwestern Nigeria for study and were designated as 1, 2, 3, 4, 5 and 6. The area was chosen because of the large population and concentration of sawmills in the area and the intensity of sawmilling activities in the area. The predominant occupation of the people of the area is sawmilling. In each of the sawmills all timber logs for milling were listed and identified to species level, the girths were measured with measuring tape for subsequent determination of basal area. This was done during the rainy season and during the dry season.

Plant parameters: Leaves of some specific dominant plant species within 0-200 m growing around the sawmills sites at an increasing distance of 50 m starting from 0 m from the sawmills were collected. The leaves were brought to the laboratory for chlorophyll extraction, stomata counting and leaf area determination.

Laboratory studies

Chlorophyll extraction: This was done according to the method of Coombs *et al.* (1985).

Stomata counting: Epidermal peels were prepared using the technique of Metcalfe (1960). In each case the required epidermis were obtained by scraping it from the mesophyll. Epidermal peels of both adaxial and abaxial surfaces were made by placing the epidermal surface face down on a glass slide and scraping off with a sharp blade all the tissues above the epidermis until the epidermis were reached. The leaf material being scrapped was intermittently irrigated with water and the adhering loose tissues were removed with a carmel hair brush (Cutler, 1978). The epidermal surface was placed on a clean glass slide with needed surface placed up. The epidermal surface was stained in 1% aqueous safranin 0 for 5 min and rinsed carefully in water to remove excess tissue. The peels were washed in 3-4 changes of water and mounted in dilute glycerine solution. The stomata numbers were calculated, which is the average numbers of stomata per square millimetre of leaf.

Leaf area: The leaf area was determined using the method described by Osei-Yeboah *et al.* (1983). In each case, the length and width of the leaves were multiplied with the correcting factor (2.326).

Statistical analysis: The confidence limits of all the data were set at 95% confidence interval. Descriptive, means, percentage and comparison were used on the standing vegetation with those on the sawmills. A-one-way analysis of variance (ANOVA) was used to test if there was any significant difference in the chlorophyll concentration, leaf area, stomata number on both adaxial and abaxial surfaces for all the dominant plant species with increasing distances away from the sawmills for both dry and rainy seasons.

RESULTS

Investigated parameters of the vegetation around the sawmills

The dominant plant species: The dominant and common plant species around the six sawmills are: *Ageratum conyzoides*. *Aspilia* spp., *Azadirachta indica, Centrosema pubescens*, *Chromolaena odorata*, *Ficus exasperata*, *Gliricidia sepium*, *Mallotus subulatus*. *Poulzoldia guineensis*. *Sida acuta*, *Tithonia diversifolia* (Table 1). Only few of these plant species were found in all the distances from 0 to 200 m away from the sawmills and in all the sawmills.

Chlorophyll concentration: The chlorophyll concentration of the leaves of common plant species around the sawmills is presented in Table 2. *Azadirachta indica, Centrosema pubescens* and *Chromolaena odorata* were found in all the six sawmills in both dry and rainy seasons and in all the distances 0 to 200 m away from the sawmills. Other species such as *Poulzoldia guineensis*, *Ageratum conyzoides*, *Aspilia* spp., *Sida acuta* and *Tithonia diversifolia* were not found beyond 50 m while *Gliricidia sepium* was found up to 100 m from the sawmill sites both during the dry and the rainy seasons. The chlorophyll concentration of all the leaves of these plant species increases with increasing distances away from the sawmills sites. The highest chlorophyll concentration were observed mostly at 200 m away from the sawmills.

Considering the mean chlorophyll concentration of *Chromolaena odorata* during the dry season, it is observed that the chlorophyll concentration increased with increasing distance from 0 to 200 m away from the sawmills (Table 2). The highest mean chlorophyll concentration 14.14 was recorded at 200 m away from the sawmills while the lowest mean 6.79 was recorded at 0 m away from the sawmills. The total mean of 10.44 chlorophyll concentration was recorded for *Chromolaena odorata* during the dry season. The means along the various distances were subjected to statistical analysis using one-way-analysis of variance. The results showed that the mean chlorophyll concentration of *Chromolaena odorata* (dry season) differs significantly ($p \leq 0.05$) along the distances. The distance had significant effects on the chlorophyll concentration.

In the rainy season, the mean chlorophyll concentration of *Chromolaena odorata* increases from 0 to 200 m away from the sawmills with the lowest 7.37 and 12.99 as the highest (Table 2). The total mean chlorophyll concentration for *Chromolaena odorata* in the rainy season is 9.55. The result of one-way-analysis of variance showed that the mean chlorophyll concentration of *Chromolaena odorata* differ significantly ($p \leq 0.05$) along the distances. The distance had significant effect on chlorophyll concentration. In the dry season there was an increase in the mean chlorophyll concentration of *Centrosema pubescens* from 0 to 200 m away from the sawmills (Table 2). The highest mean was recorded at 200 m (15.17) while the lowest (7.73) was recorded at 0 m. The mean Chlorophyll concentration of *Centrosema pubescens* (dry season) do not differ significantly along the distances. There was no significant effect of distance on chlorophyll concentration of *Centrosema pubescens*.

In the rainy season the highest chlorophyll concentration 7.44 of *Centrosema pubescens* was recorded at 200 m distance while the lowest chlorophyll concentration of 5.52 was recorded at 0 m. The total mean was 6.46 (Table 2). One way analysis of variance showed that the mean chlorophyll concentration of *Centrosema pubescens* do not differ significantly along

Table 1: Distribution of common plant species in relation to varying distances from sawmill sites in Isokan local government area (dry and raining season)

Species	Family	Vegetation parameters	0 m		50 m		100 m		150 m		200 m	
			Dry	Rain	Dry	Rain	Dry	Rain	Dry	Rain	Dry	Rain
Ageratum conyzoides	Asteraceae	Leaf area	+	+	+	+	-	-	-	-	-	-
		Stomata number	+	+	+	+	-	-	-	-	-	-
		Chlorophyll	+	+	+	+	-	-	-	-	-	-
Aspilia spp.	Asteraceae	Leaf area	+	+	+	+	-	-	-	-	-	-
		Stomata number	+	+	+	+	-	-	-	-	-	-
		Chlorophyll	+	+	+	+	-	-	-	-	-	-
Azadirachta indica	Meliaceae	Leaf area	+	+	+	+	+	+	+	+	+	+
		Stomata number	+	+	+	+	+	+	+	+	+	+
		Chlorophyll	+	+	+	+	+	+	+	+	+	+
Centrosema pubescens	Papilionoideae	Leaf area	+	+	+	+	+	+	+	+	+	+
		Stomata number	+	+	+	+	+	+	+	+	+	+
		Chlorophyll	+	+	+	+	+	+	+	+	+	+
Chromolaena odorata	Malvaceae	Leaf area	+	+	+	+	+	+	+	+	+	+
		Stomata number	+	+	+	+	+	+	+	+	+	+
		Chlorophyll	+	+	+	+	+	+	+	+	+	+
Ficus exasperata	Asteraceae	Leaf area	+	+	+	+	+	+	+	+	+	+
		Stomata number	+	+	+	+	+	+	+	+	+	+
		Chlorophyll	+	+	+	+	+	+	+	+	+	+
Gliricidia sepium	Papilionoideae	Leaf area	+	+	+	+	+	+	+	+	+	+
		Stomata number	+	+	+	+	+	+	+	+	+	+
		Chlorophyll	+	+	+	+	+	+	+	+	+	+
Mallotus subulatus	Euphoridiaceae	Leaf area	+	+	+	+	+	+	+	+	+	+
		Stomata number	+	+	+	+	+	+	+	+	+	+
		Chlorophyll	+	+	+	+	+	+	+	+	+	+
Poulzoldia guineensis	Urticaceae	Leaf area	+	+	-	-	-	-	-	-	-	-
		Stomata number	+	+	-	-	-	-	-	-	-	-
		Chlorophyll	+	+	-	-	-	-	-	-	-	-
Sida acuta	Malvaceae	Leaf area	+	+	-	-	-	-	-	-	-	-
		Stomata number	+	+	-	-	-	-	-	-	-	-
		Chlorophyll	+	+	-	-	-	-	-	-	-	-
Tithonia diversifolia	Compositae	Leaf area	+	+	-	-	-	-	-	-	-	-
		Stomata number	+	+	-	-	-	-	-	-	-	-
		Chlorophyll	+	+	-	-	-	-	-	-	-	-

-+ = Present, - = Absent

Table 2: The mean of chlorophyll concentration of the leaves of common plant species around the sawmills

Group distance (m)	Dry season: Common species (mg/g/dry weight)			Rainy season: Common species (mg/g/dry weight)		
	Chromolaena Odorata	*Centrosema pubescens*	*Azadirachta indica*	*Chromolaena odorata*	*Centrosema pubescens*	*Azadirachta indica*
0	6.79±3.67	7.73±4.21	11.51±1.74	7.37±0.00	5.52±0.00	14.94±7.61
50	8.29±3.48	11.52±1.64	15.56±4.01	8.19±2.51	6.34±1.34	16.93±0.00
100	10.31±3.67	11.64±1.74	17.52±0.00	8.74±10.30	8.74±3.84	23.61±8.30
150	12.68±3.33	12.06±13.96	18.32±0.00	10.46±4.67	7.12±0.00	25.98±0.00
200	14.14±4.85	15.17±0.00	24.00±0.00	13.00±11.24	7.44±0.00	31.6±6.40
Total	0.44±3.80	11.12±4.31	16.28±1.34	9.55±7.40	6.46±1.34	20.72±3.41

± Standard deviation

the distances. The distance had no significant effect on the chlorophyll concentration of *Centrosema pubescens* along the distances in rainy season. The mean chlorophyll concentration of *Azadirachta indica* during the dry season revealed the highest mean chlorophyll concentration (24.00) at 200 m and the lowest mean chlorophyll concentration (11.51) at 0 m. The total mean chlorophyll concentration of *Azardirachta indica* for dry season was 16.28. One way analysis of variance results showed that the mean chlorophyll concentration of Azadirachta indica in dry season differed significantly ($p \leq 0.05$) along distances. The distances had significant effect on chlorophyll concentration of *Azadirachta indica*. In the rainy season the highest mean chlorophyll concentration was recorded at 200 m away which was 31.69 and lowest chlorophyll concentration (14.94) was recorded at 0 m. Others had intermediate mean values (Table 2). The result of one way analysis of variance showed that there was no significant difference in the chlorophyll concentration along the distances. The distance had no effect on chlorophyll concentration of *Azadirachta indica* during the rainy season.

Plant species such as *Ficus exasperata* and *Mallotus subulatus* were found in only one sawmill. *Ficus exasperata* had the mean value of 21.31 along the distances 0 to 200 m while *Mallotus subulata* had 25.14 mean value along distances.

Other plant species were found in many sawmills but not in all the distances. However *Ageratum conyzoides* had the mean value of 13.73, *Aspilia* spp. had 6.26 mean value, *Gliricidia sepium* had mean value of 10.48, *Poulzoldia guineensis* had mean value of 7.93, *Sida acuta* had 6.61 while *Tithonia diversifolia* had mean value of 10.44. It was observed that most of the species showed effect of the distance on their chlorophyll concentrations.

Leaf area: The leaf areas of the dominant plant species around the sawmills and the trend of the increase in leaf area in most common plant species in the sawmills in relation to distances is presented in Table 3 for each of the species for the dry and the rainy seasons. The highest mean of leaf area (135.07 cm^2) in *Chromolaena odorata* in the dry season was found at 100 m distance away, and the lowest mean (99.15 cm^2) was recorded at 0 m while other distances had intermediate values. The results of one way analysis of variance showed that the mean leaf area of *Chromolaena odorata* did not differ significantly along the distances. In the rainy season, the highest mean leaf area (138.64 cm^2) of *Chromolaena odorata* was recorded at 0 m while the lowest mean value (118.91 cm^2) was recorded at 100 m away. Other distances had intermediate values as shown in Table 3. The total mean leaf area was 125.17 cm^2. The results of one way analysis of variance showed that the mean leaf area of *Chromolaena odorata* rainy season did not differ significantly along the distances. The distance had no significant effect on the leaf area.

Centrosema pubescens, leaf area during the dry season revealed the highest mean leaf area at 200 m away as 115.55 cm^2 while the least was recorded at 150 m away as 50.81 cm^2, other distances had intermediate values. The mean total was 70.06 cm^2, the results of one way analysis of variance showed that there was no significant difference in the leaf area of the species during the dry season. Therefore, there was no effect of distance on the leaf area

In the rainy season, the highest mean leaf area (125.47 cm^2) of *Centrosema pubecsens* was recorded at 100 m away from the sawmills while the lowest mean value 82.76 cm^2 was at 150 m. Other distances had intermediate mean values.

The results of one way analysis of variance showed that the mean leaf area of *Centrosema pubescens* in rainy did not differ significantly along the distances. There was no significant effect of the distance on the leaf area of *Centrosema pubescens* as one moves away from the sawmills.

Azadirachta indica leaf area in the dry season revealed the highest mean 53.25 cm^2 at 200 m away while the lowest mean leaf area (36.37 cm^2) was recorded at 100 m away. Other distances had intermediate mean values. The mean total value was 48.60 cm^2 (Table 3). The results of one way analysis of variance showed that the mean leaf area of *Azadirachta indica* in the dry season did not differ significantly along the distances. There was no significant effect of the distance on the leaf area as on moves away from the sawmills. In the rainy season, the highest mean leaf area 68.29 cm^2 of *Azadirachta indica* was found at 50 m away from the sawmills while the lowest mean 32.77 cm^2 was recorded at 100 m away. Other mean values were intermediate. The mean total of leaf area was 54.38. The results of one way analysis of variance showed that the mean leaf area of *Azadirachta indica* in rainy season did not differ significantly along the distances. There was no significant effect of the distance on leaf area as one moves away from the sawmills.

Other plant species such as *Ficus exasperata* and *Mallotus subulatus* were found in only one sawmill. *Ficus exasperata* had mean value of 188.16 cm^2 leaf area while *Mallotus subulatus* had mean value of 180.03 cm^2 and cannot be subjected to one way analysis of variance. *Ageratum conyzoides* had mean leaf area of 63.45 cm^2, *Aspilia* spp. had 43 .04 cm^2 while *Gliricidia sepium* had 102.06. Others had intermediate values for dry and rainy seasons. When looking at the trend of the means of each leaf area, few means increased with increasing distance while some did not show any definite trend.

Stomata number: The means stomata number of the plant species around the sawmills sites in relation to distances away from the sawmills for both adaxial and abaxial surfaces of the leaves of *Ageratum conyzoides*, *Aspilia* spp., *Azadirachta indica*, *Centrosema pubescens*, *Chromolaena odorata*, *Ficus exasperata*, *Gliricidia sepium*, *Mallotus subulatus*, *Poulzoldia guineensis*, *Sida acuta*, *Tithonia diversifolia* were estimated. Only few of these plant, species were found in all the distances of 0 to 200 m away from the sawmills. The stomata number of the common plant species *Chromolaena odorata*, *Centrosema pubescens* and *Azadirachta indica* around the sawmills was presented in Table 4.

Considering the adaxial surface of *Chromolaena odorata*, the highest mean stomata value (36.76) was recorded at 200 m away from the sawmills while the lowest mean was (19.75) at 0 m. Other distances have intermediate mean values (Table 4). The abaxial surface

Table 3: The mean of chlorophyll concentration of the leaves of common plant species around the sawmills

	Dry season			Rainy season		
	Leaf area (cm^2)			Leaf area (cm^2)		
	Common species			Common species		
Group distance (m)	*Chromolaena Odorata*	*Centrosema pubescens*	*Azadirachta indica*	*Chromolaena odorata*	*Centrosema pubescens*	*Azadirachta indica*
0	99.15±49.77	58.87±0.00	51.60±0.00	138.64±29.19	82.78±52.04	55.76±37.54
50	111.62±62.43	71.01±0.00	50.03±5.85	125.32±152.73	101.67±173.03	68.293±0.00
100	135.07±26.06	66.62±8.11	36.37±4.81	111.81±62.43	125.47±152.73	32.77±5.04
150	103.21±57.13	50.81±0.00	47.35±0.00	118.91±28.08	82.76±52.04	52.21±6.43
200	109.14±48.96	115.55±65.43	53.25±9.93	131.14±0.00	89.23±41.77	47.58±11.71
Total	11.64±47.67	70.06±175.24	48.60±4.12	125.17±54.482	97.83±94.32	54.38±12.14

± Standard deviation

Table 4: The mean of stomata number of common plant species on the adaxial and abaxial surfaces around the sawmills.

	Adaxial surface			Abaxial surface		
	Common species (mm)			Common species (mm)		
Group distance (m)	Chromolaena *Odorata*	*Centrosema pubescens*	*Azadirachta indica*	*Chromolaena odorata*	*Centrosema pubescens*	*Azadirachta indica*
0	19.75±17.22	23.75±8.31	28.88±0.00	48.08±11.71	42.25±0.00	43.25±2.12
50	22.67±8.41	26.00±0.00	15.56±0.60	53.32±1.06	47.00±9.61	51.50±8.51
100	28.75±0.00	30.00±0.00	18.75±3.20	57.67±0.00	52.60±6.43	48.00±11.71
150	32.42±7.86	31.00±0.00	27.00±2.10	64.67±6.51	54.00±9.32	51.00±0.00
200	36.75±4.81	35.00±8.76	31.00±0.00	67.83±7.91	61.00±5.35	58.50±0.00
Total	28.07±7.66	28.11±1.66	29.25±3.18	58.31±5.44	49.72±6.14	49.57±4.47

± Standard deviation

mean stomata number revealed the same trend with a wider range between the mean stomata number. The highest mean stomata number (69.83) for *Chromolaena odorata* was recorded at 200 m away and the lowest mean (48.08) at 0 m. The trend followed an increase in ascending order from 0 to 200 m as shown in Table 4. The results, of one way analysis of variance showed that the mean stomata number on both adaxial and abaxial surfaces differed significantly along the distance. The distance had significant effect on the stomata number ($p \leq 0.05$) on both the adaxial and abaxial surfaces of *Chromolaen odorata.*

The mean stomata number of *Centrosema pubescens* in the adaxial surface increased with increasing distances. The highest mean stomata number (35.00) was revealed at 200 m while the lowest mean (23.75) was recorded at 0 m. Other distances had intermediate mean values as shown in Table 4. The trend of mean stomata number on the abaxial surface increased with increasing distances away from the sawmills with the highest mean (61.00) at 200 m away and the lowest (42.25) at 0 m (Table 4). The results of one way analysis of variance showed that the mean stomata number on adaxial surface did not differ significantly along the distances while there was significant difference along the distances on the abaxial surface. Hence there was no significant effect of distance on the stomata number on the adaxial surfaces as one moves away from the sawmill while the distance had a significant effect on the stomata number ($p \leq 0.05$) on the abaxial surface of *Centrosema pubescens*.

The mean stomata number of *Azadirachta indica* on the adaxial surface revealed the highest mean stomata number (34.88) at 50 m away while the lowest (18.75) was recorded at 100m away from the sawmills. Other distances had intermediate values (Table 4). On the abaxial surface of *Azadirachta indica,* the highest mean stomata number (58.50) was found in 200 m away and the lowest (43.25) at 0 m. Other distances had intermediate values (Table 4). The results of one way analysis of variance showed that the mean stomata number of *Azadirachta indica* on both the adaxial and abaxial surfaces did not differ significantly along distances. There was no significant effect of distance on the mean stomata number as one moves away from the sawmills.

DISCUSSION

In this study few plant species were found in all the distances from 0 to 200 m away from the sawmills. This presence of few plant species is in agreement with Mudd and Kozlowski (1975) who reported a gradual decline and ultimate death of Brandt and Rhoades (1972) who also observed a significant changes in structure and composition of plant species as a result of effects of dust on vegetation.

The drastic reduction in chlorophyll concentration of the leaves of the vegetation around the studied sawmills compares favourably with similar observation reported by Odu (1994) in his study of *Amaranthus viridis* and

Abelmoscus esculentus. Borka (1980) on *Helianthus annuus* and Singh and Rao (1981) on *Triticum aestivum*. One or two plat species that did not show the drastic reduction in chlorophyll concentration in response to the presence of the sawdust suggested that different plant species were differently immuned to the effect of pollutants from the sawmill activities.

The leaf is the principal photosynthetic organ of the plants and the organ most subject to the influence of air pollutant. It is obvious that the reduction in chlorophyll content of the leaves located in the vicinity of the sawmills as observed in this study could directly or indirectly cause chlorosis, leaf abscussion and necrosis. This observation is in agreement with the conclusion of Gilbert (1969) who worked on bryophytes. Syratt and Wanstall (1969) also found that chlorophyll destruction was greater at higher concentration of dust or particulates, although concentration of particulates was not quantified in this study. It also conforms to the observation of Bohne (1963) who reported a marked reduction of growth of plants located in the vicinity of the sawmills.

None of the plant species showed any significant variation in the leaf area with distance away from the sawmill sites probably because of the genetic factor of most species encountered and investigated in this study. This is similar to the report of Raymond and Nussbaum (1966) who stated that dusts have little effect on wild plants.

Complex physiological effects of dusts/particulates on plants such as stunted growth stomata closure (Hull and Went, 1952). Stomata number, stomatal spacing (Evans and Ting, 1973) in relation to particulate sensitivity and injury was also observed in this study. This result is an indication that effect of particulate matter is felt on some plant species especially *Chromolaena* odorata.

The general trend of chlorophyll concentration, leaf area and stomata number is an indication that there was a decrease in deposition of sawdust as one moves away from the sawmills which reflects less significant effects with increasing distances. This is similar to the findings of Singh and Rao (l981) who observed that damaged chloroplasts by pollutants leads to reduction in total chlorophyll concentration in leaves. Visual observation however reveals that plants within 50 m radius of sawmill sites are mostly chlorotic having dead patches. This was more obvious and pronounced as one moves closer to the sawmill sites. These findings are not far from the report of Hosker and Linderberg (1982) and Hinrichsen (1986) that visible injuries and impairment of physiological functions accompany chronic exposure of plants to pollutants. Similar to the findings are also that of Isichei and Sandford (1976), Egbuna (1987) and Ukegbu and Okeke (1987) that vegetation and farmlands become patched and the effects observed on vegetation include decreased leaf area, chlorophyll content, decreased inter-node length in some plants and suppressed flowering in others.

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