GLOBAL JOURNAL OF PURE AND APPLIED SCIENCES VOL.12 NO 4. 2006: 457 - 459

 ISSN 1118-0579

GROWTH RESPONSE OF MAIZE (*ZEA MAYS* L.) TO GAS FLARING IN DELTA STATE

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(Received 9 August, 2005; Revision Accepted 1 March, 2006)

ABSTRACT

An investigation was carried out in 2003 and 2004 cropping seasons on the growth response of maize seedlings to gas flaring in Warri, Delta State. Maize seeds (Hybrid 3X - YX) were sown in plastic containers and the seedlings were allowed to establish for 4 weeks in a nursery. The potted plants were later placed at intervals of 50 m, 100 m 150 m, 200 m along a straight line from the flare site. A control was placed 1,000 m away from the flare site. There were therefore, five treatments replicated thrice. The experiment was laid out in a randomized complete block design (RCBD). Growth variables measured on weekly basis were plant height, number of leaves and leaf area. The results showed a significant ($P > 0.05$) decrease in the performance of the maize seedlings in terms of plant height, number of leaves and leaf area as the distance from the flare site decreased. The control plants showed a significant higher ($P< 0.05$) plant height value when compared with their counterparts exposed to the flare. The present study suggests that gas flaring has a significant effect of reducing the growth and development of maize.

KEYWORDS: Growth response, maize, gas flaring, Delta State.

INTRODUCTION

Nigeria is a major crude oil and natural gas exporter as well as an important agricultural nation in the West African sub-region. In the same vein, economic benefits accruable from oil and natural gas have in no doubt, left negative impact on the biotic and abiotic components of the Nigerian environment (Agbogidi *et al.*, 2005a). Natural gas found with petroleum varies in composition, ranging from almost pure mixture of hydrocarbon to gases that are free of organic constituents (Abudulin, 1985). Nigeria flares more gas than any other country in the world (Daniel - Kalio, 1992). Daniel – Kalio (1992) maintained that of the 88 % of the gas flared in Nigeria, only about 12% is effectively utilised. Pollution results when a change in the environment negatively impacts the quality of human life and has adverse effects on plants, agricultural lands and animals. Gas flaring, one of the exploration and production activities of crude oil usually impacts negatively on the aquatic and terrestrial ecosystems of host communities thereby affecting their socio-economic activities (Stanley, 1990; Ogri, 2001; Agbogidi *et al.*, 2005a; Onwuka, 2005).Flared gas according to Daniel - Kalio (1992) contains carbon ii oxide, carbon iv oxide, fumes / thick smoke, oxides of sulphur and nitrogen as well as metal oxides including lead oxide. He maintained that gas flaring produces suspended particulate matter (SPM), volatile organic compounds (VOC) and associated gas (AG). Daniel – Kalio (1992) reported that gas flare exposes plants around the vicinity of the flaring to excessive radiation, extremely high temperature, excessive light and dust deposits. Gas flaring is a veritable source of fire outbreak in the affected area (Pezeshki and Delaune, 1993). Plants affected by gas flare exhibit such symptoms as scorching, brown colouration, desiccation of leaves, chlorosis, reduced yields and death.

Many researchers have reported on the effects of oil activities on crop plants (Anoliefo, 1991; Anoliefo and Vwioko, 1994; Anoliefo, 1998; Asuquo *et al.*, 2002; Oghoghodo *et al.*, 2004). The effect of gas flaring on the performance of maize, a major cereal crop (FAO, 2002) widely grown in the Niger Delta area is however, scarce. Field studies to ascertain the effects of gas glaring on agricultural crops and environments are few. The present study investigated the growth response of maize to gas flaring.

MATERIALS AND METHODS

Study area
The experiment was conducted in Warri, Delta State. Warri is a wetland area located at $5^{o}30^{1}$ N and 6^{o} E. It lies at the boundary between the lowland tropical rainforest zone and mangrove swamp. The rainy reason occurs between March and November, with annual rainfall ranging between 2040mm and 3000 mm. The mean temperature is $28 \pm 6\ ^{0}C$ with a maximum temperature of 38.3^{o} C. The relative humidity is 65-80 % for most part of the year while the monthly sunshine is 4.2 hours during the rainy season (Warri Meteorological Station, 2003). Warri and its environs in Delta State are rich in crude oil and this necessitated the presence of large-scale petroleum oil and gas exploration and transportation activities.

Source of seed

The maize seeds (Hybrid 3X - YX) were purchased as a single batch from the Delta State Agricultural Procurement Agency (DAPA), Ibusa. Pre-germination test was carried out on the maize by simple flotation technique. The seeds that sank in water were adjudged viable seeds and were used for planting. Three seeds were planted in the plastic containers and left in a nursery for germination. Maize seedlings wer thinned to one per plastic container when they were two weeks of age. The seedlings were then allowed to establish for 4 weeks.

Experimental design and measurements

The experiment was laid out in a randomized complete block design (RCBD). The potted plants were placed at intervals of 50 m, 100 m, 150 m and 200 m along a straight line from the flare site. A control was placed 1,000 m away from the flare site. There were, therefore, five treatments replicated three times. Each treatment consisted of 5 plastic containers.

Growth responses of the maize plants were measured on weekly basis. Parameters measured were plant height, number of leaves and leaf area. Plant height was determined with a metre rule at the distance from soil level to the tip of the terminal bud while the number of leaves was determined by visual counting of the leaves. Leaf area was by tracing the margins of the leaf on a graph paper and the total leaf area / plant was obtained by counting the number of 1-cm squares (Bamidele and Agbogidi, 2000).

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Data collected were subjected to analysis of variance while the Duncan's multiple range tests was used to evaluate statistical differences among each treatment using SAS (1996).

RESULTS AND DISCUSSION

At all ages of growth, significant reductions at $P < 0.05$ were observed in height of maize seedlings that were closer to the flare site when compared with their counterparts that were far away (Table 1). The nearer the maize plants were to the flare site, the shorter their heights. Growth stagnation and stunting were observed for seedlings placed 50 m and 100 m away from the site as from the third and fourth weeks respectively after exposure to gas flare (WAEGF).

The observed reduction in the plant height of maize seedlings as the distance between the plants and the flare site decreased could be attributed to the high temperature consequent upon the flaring as well as the absorption into the plant tissues of some toxic compounds present in the gases flared. This could have affected vital metabolic processes in the plant body including transpiration, photosynthesis and respiration. Udo and Oputa (1984) reported that the disturbance of the plant-water relationship bringing about interference in the nutrient supply of plant as the primary cause of the poor plant growth in oil and gas polluted soils.

The number of leaves of the maize plants as affected by gas flaring is presented in Table 2. There was no significant ($P<0.05$) effect on the number of leaves at the first week after exposure to gas flare site. From two weeks of exposure to gas flaring, more leaves were produced the farther the seedlings were from the flare site. This observation indicates that oil and gas flaring had a damaging effect on leaf initiation and production. The finding is in line with the reports of Lawn and Inrie (1991), Agbogidi and Ejemete (2005) and Agbogidi and Eshegbeyi (2006) who noted leaf depression in crude oil contaminated soils.

The mean leaf area of seedlings of the control plants differed significantly at $P< 0.05$ from their counterparts subjected to shorter distances from the flare site. The leaf area of the plants grown at 50 m and 100 m away from the site were stunted, chlorotic and dusty. The significant reduction in the leaf area of maize plants grown at shorter distances from the flare site as observed in the present study could be due to high heat intensity and the uptake of toxic substances including heavy metals which could have caused leaf shrinkage. Baker (1970) attributed reduced leaf area to reduction or delay in cell expansion. The results of the present study where significant reductions were recorded for leaf area of maize seedlings grown at distances closer to the flare site confirmed the reports of Sharma *et al.*(1980), Anoliefo and Vwioko (1994) and Agbogidi *et al.* (2005b).

CONCLUSION

The present study has demonstrated that gas flaring has a significant effect of reducing the growth responses and development of maize.

Table 1. Plant height (cm) of maize seedlings as affected by gas flaring

Distance from flare site (m)	Weeks after exposure to gas flare site				
	1	2	3	4	5
1,000 (control)	76.7a	84.9a	100.0a	109.8a	112.4a
200	70.0b	76.8b	79.4b	87.4b	89.2b
150	64.6c	72.3c	73.8c	78.6c	80.5c
100	58.4d	60.5d	64.2d	64.6d	64.6d
50	56.2e	57.7e	58.4e	58.4e	58.4e

Means with different superscripts in the same WAEGF/column are significantly different at P=0.05, using the Duncan's multiple range tests.

Table 2: Number of leaves of maize seedlings as influenced by gas flaring

Distance from flare site (m)	Weeks after exposure to gas flaring				
	1	2	3	4	5
1,000 (control)	5.2a	7.2a	9.8a	10.7a	11.8a
200	5.1a	6.2b	8.5b	8.9b	9.5b
150	5.1a	6.1b	7.5c	7.7c	8.0c
100	5.1a	6.0b	7.2d	7.4d	7.5d
50	5.0a	6.0b	6.3e	6.3e	6.3e

Means with different superscripts in the same WAEGF/column are significantly different at P=0.05, using the Duncan's multiple range tests.

Table 3: Leaf area (cm^2) of maize seedlings as influenced by gas flaring

Distance from flare site (m)	Weeks after exposure to gas flaring				
	1	2	3	4	5
1,000 (control)	78.4a	85.4a	101.8a	109.3a	110.6a
200	78.0a	83.1b	95.4b	100.6b	101.3b
150	76.5b	80.0c	87.9c	92.4c	93.4c
100	75.4b	78.7d	80.4d	84.2d	84.8d
50	74.2c	75.6e	77.4e	77.6e	77.9e

Means with different superscripts in the same WAEGF/column are significantly different at P=0.05, using the Duncan's multiple range tests.

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