The Effects of Waste-Gas Flares on the Surrounding Cassava Plantations in the Niger Delta Regions of Nigeria

Authors: A.O. Lawanson, A.M.A. Imevbore and V.O. Fanimokun, University of Ife, Ile-Ife, Nigeria.

ABSTRACT

The retardation of tuber yield of Manihot esculenta Crantz due to waste-gas flares, which has been frequently observed by local farmers, is described. Cassava tubers decreased in length and in weight as the distance from the flares decreased. Such decreases were also correlated with decreases in the content of starch and ascorbic acid (vitamic C) in the tubers. In addition, the amino acid and total sugar contents of the tubers increased with decreasing distance from the flares. The high levels of amino acids and sugar in tubers closer to the flares suggest reduced synthesis, or increased degradation of tuber proteins and insoluble carbohydrates, respetively. Of all the environmental factors examined, only soil temperature increased as the distance from the flares decreased.

It is concluded that the waste-gas flares, most probably through their effect on the surrounding soil temperature, reduce the quantity and quality of tuber yield on cassava plantations.

Introduction

Development of the oil industry in Nigeria dates back to the 1950's. Since that time, this industry has played a dominant role in the general economic development of Nigeria. All the oil is produced in the Niger Delta region of Nigeria, from both inland and offshore oil fields. Despite tremendous benefits that Nigeria has derived from the oil industry in terms of improvement in quality of life and enhancement of the rate of economic development, serious attendant disadvantages have arisen from development of this industry. One problem is environmental pollution.

Environmental pollution associated with the oil industry is a consequence of either:

(a) the discharge of oil and oil products into the environment from the oil fields, or from the extensive network of pipelines through which oil is transported between the production wells and the terminals from where it is exported or transported to the points at which it is distributed for consumption. Such discharges have been referred to as oil spills, or,

(b) burning in the atmosphere of waste gases which accumulate as a result of activities in the production fields and the refineries. Burning these gases produces what are commonly referred to a waste-gas flares.

The present report deals with effects of these waste-gas flares on performance of crops in farmland vegetation in the vicinity. There is no doubt that pollution associated with these flares can affect man and his environment in many ways. Isichei and Sanford were the first to demonstrate in 1976 that the growth of plants was generally surpressed, and that the flowering process in certain species of plants was retarded by these gas flares. They also found that the flares diminished the value of agricultural productivity. Similar observations have been made by others workers on okro plants and palm trees, but the retarding effects were not clearly defined and characterized.

In the studies now being reported, the major physical environmental factors that are affected by the gas flares have been characterized and the extent of retardation of growth and yield of farmland vegetation has been fully defined. Changes in quantities of certain nutrient constituents of cassava was also determined.

Materials and Methods

Physical Environmental Factors. Temperature, moisture, and intensity of illumination of atmosphere and soil were measured at various distances from the gas flares.

Temperature measurements. Atmospheric temperatures were measured by exposing the mercury ends of thermometers to air for 2 minutes. An average was obtained from simultaneous readings with three different thermometers. Soil temperatures were measured by dipping the mercury end of the thermometer into the soil for 2 minutes and taking an average from simultaneous readings of three different thermometers.

Moisture determinations. Soil moisture was measured by drying soil samples, obtained at specific distances from the flares, to constant weight and determining the percentage water content. The atmospheric humidity was determined by means of a wet-bulb hygrometer. An average of three readings was also taken for both atmospheric and soil moisture.

Light intensity was taken at vegetation levels with a photometer.

Physical Measurement of Plants. Whole plants, leaves or tubers were used, as appropriate.

In the case of cassava (*Manihot utilissima* Pohl.) tubers, the length of each tuber and its diameter at the thickest point were measured. Each tuber was weighed fresh soon after harvest, and later dried in a Gallenkamp oven at 90°C to constant weight, and the dry weight was recorded. Measurements in respect of height, diameter, fresh weight and dry weight were carried out in quintuplicate.

Chemical Analysis. Changes in quantities of certain nutrient constituents, with increasing distance from the gas flares, were studied in cassava tubers. Three major nutrients obtainable from plants were considered: carbohydrates, amino acids, and ascorbic acid.

Carbohydrates. The starch and total sugar contents of cassava tubers were determined.

Starch. Starch content of the tubers was determined by the direct acid hydrolysis method in which starch is hydrolysed into sugar by means of hydrochloric acid, and the sugar produced is determined as dextrose by the Lane and Eynon (1923) procedure.

Total sugar. Total sugar content of tubers was estimated by the anthrone colorimetric procedure (Clark, 1964).

Amino acid. Amino acids were quantitatively estimated by method described by Balogun (1971).

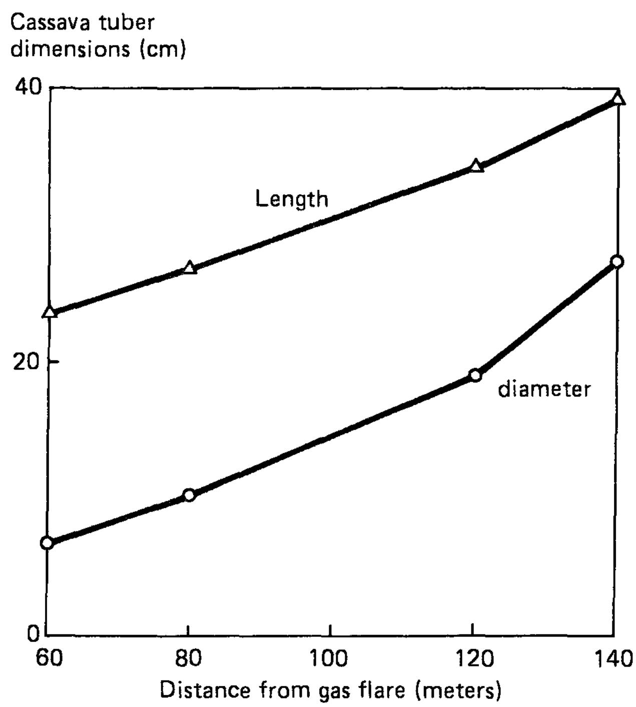
Ascorbic acid. The ascorbic acid concentration in each sample was determined by comparing optical density values with a standard curve for pure ascorbic acid.

Discussion

Results of the present studies confirm observations of previous workers that growth of farm crops is retarded by waste-gas flares. Such retardation of growth, measured as decreases in the dimensions of cassava tubers, corresponds with decreases in the levels of certain nutrient constituents, such as starch and ascorbic acid (Vitamim C). It is thus clear that, in addition to causing an overall retardation of the growth of plants, waste-gas flares also reduce the nutritional quality of the crop harvest. Since the only physical environmental factor that was found to increase as the distance from the flares decreased is soil temperature, it is concluded that the gas flares exert their effects, at least in part, through their effect on the temperature of the surrounding soil. Such heat-induced retardation of growth in plants has been frequently reported (Oswueme and Lawanson, 1973).

The following uncaptioned charts show trends in cassava tuber dimensions, weight, starch content, abscorbic acid content, amino acids contents, and total sugars as distance changed from crop to gas flare. Figure 7 shows the changes in temperature.

Figure 1.



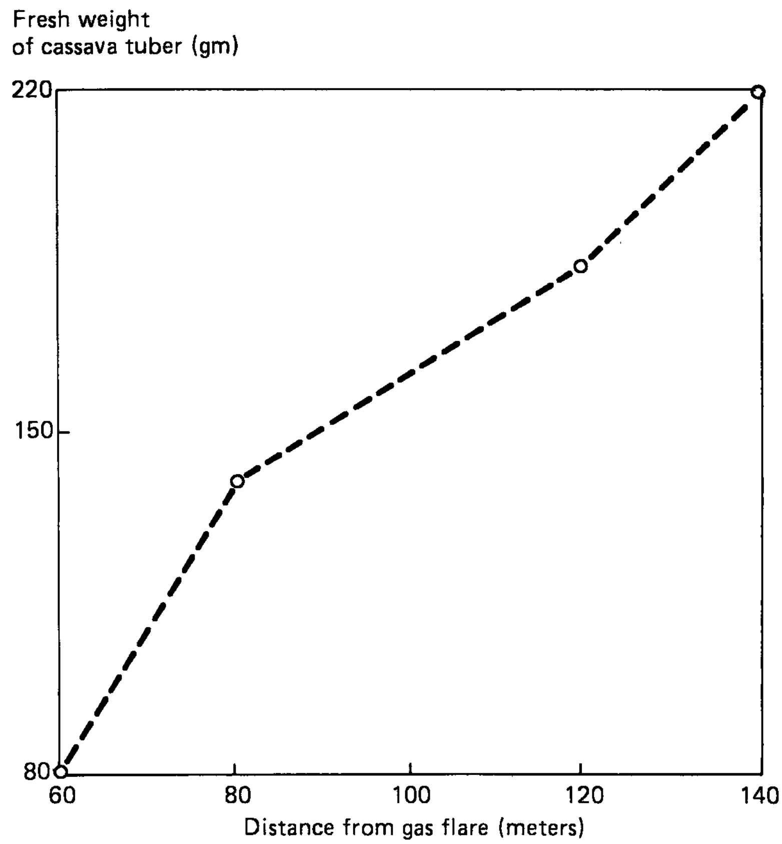


Figure 2.

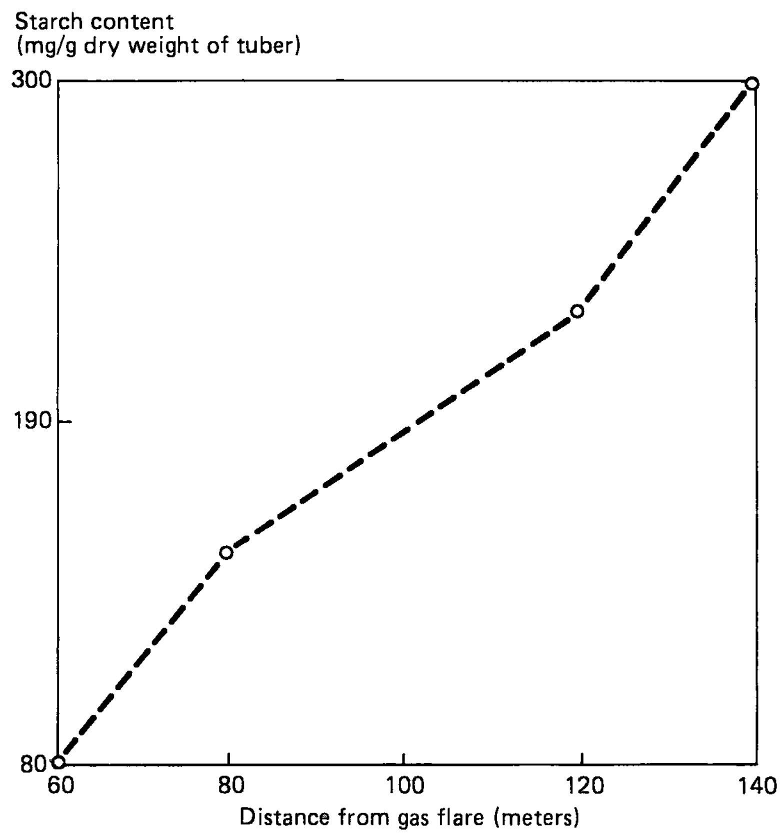


Figure 3.

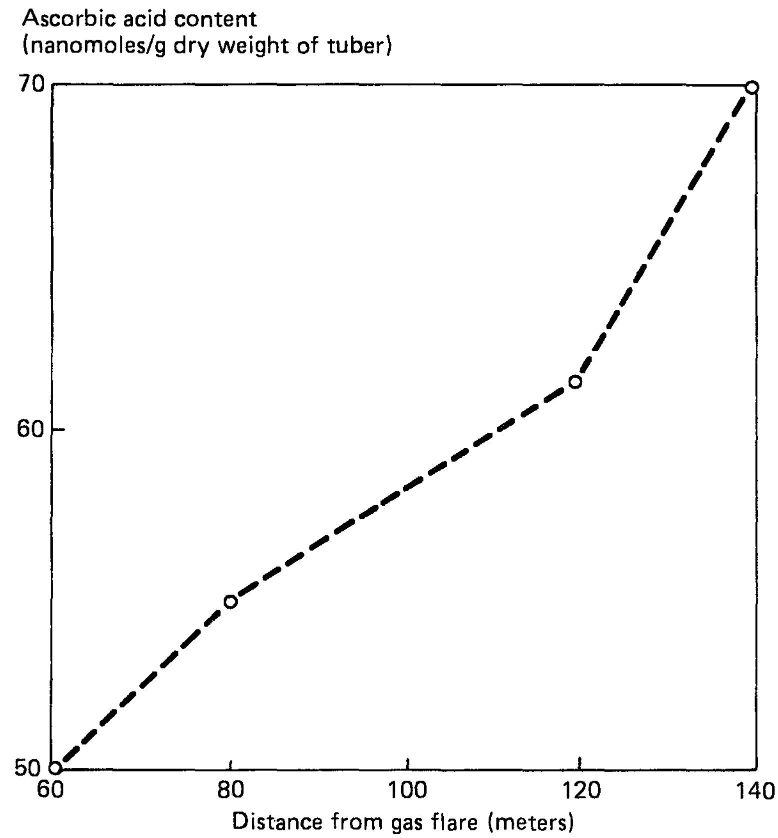


Figure 4.

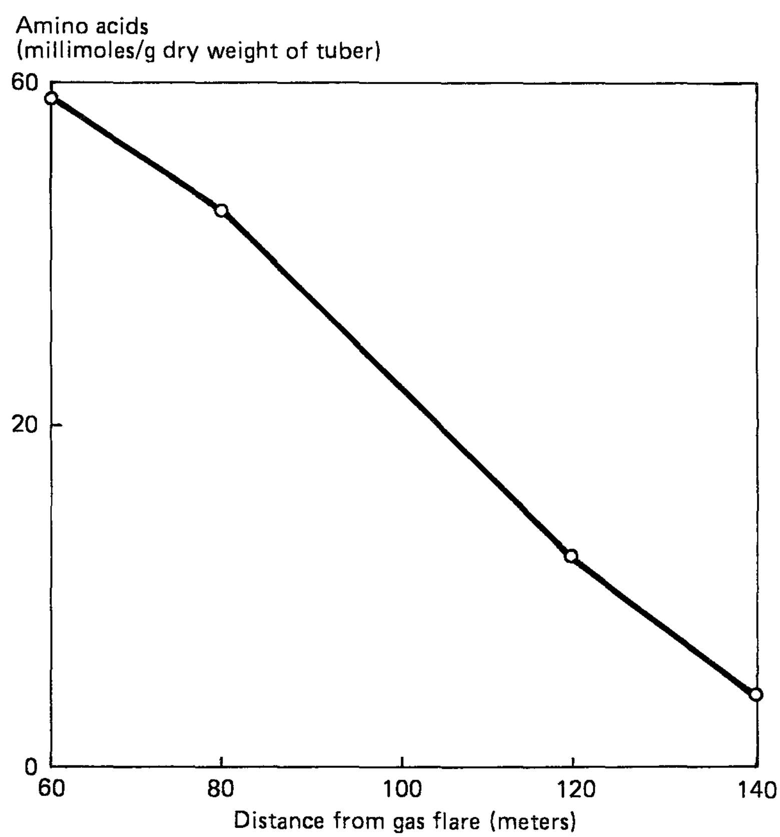


Figure 5.

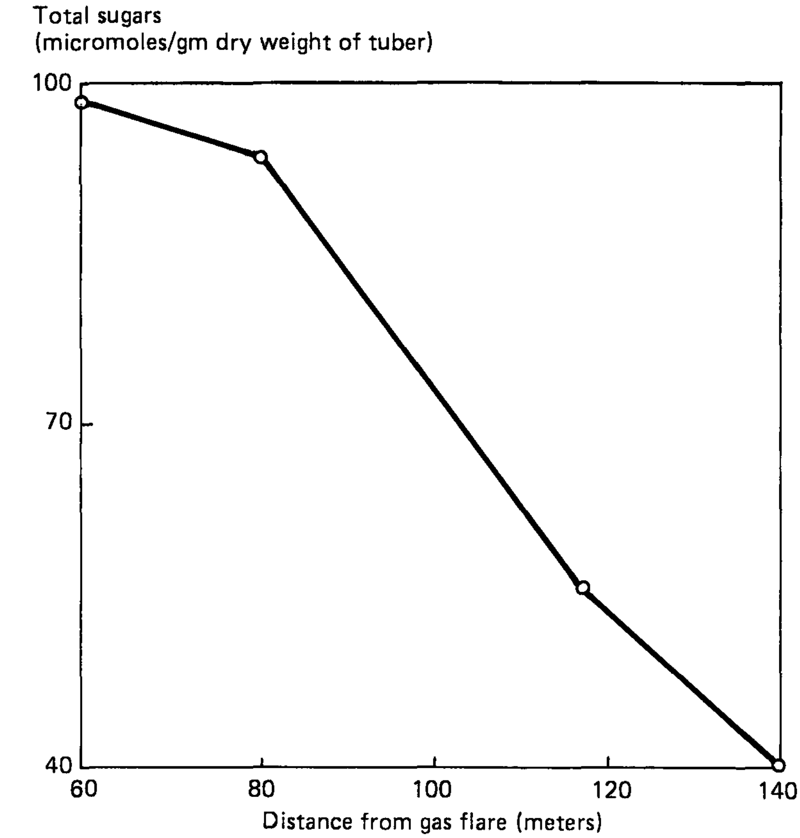


Figure 6.

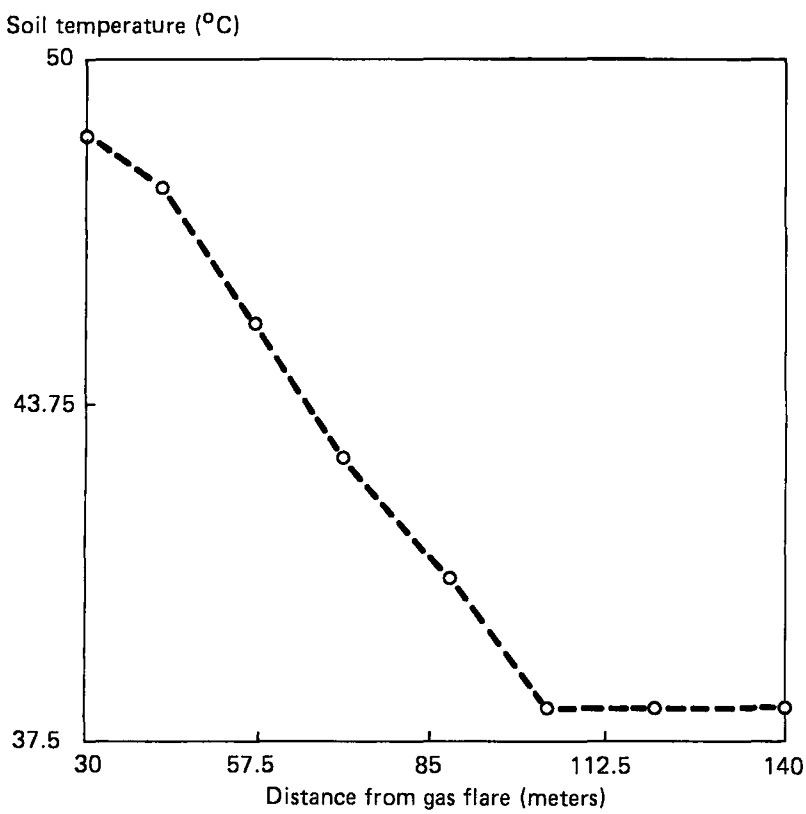


Figure 7.

Literature Cited

Adelusi, S.A. and A.O. Lawanson. Heat-induced changes in dry weight, leaf size and number of chloroplasts per cell in maize and cowpea shoots. J. Agric. Sci., Camb. 91, 349-357 (1978).

Balogun, R.A. Studies on the protein metabolism of *Glossina palpalis*: Quantitative differences in free amino acids between male and female adult tsetse flies. Comp. Biochem. Physiol. 38B, 347-352 (1971).

Clark, M.J. *Experimental Biochemistry* pp. 12-14. W.H. Freeman and Co. Ltd. San Francisco and London (1964).

Isichei, A.O. and W.W. Sanford. The effects of waste-gas flares on the surrounding vegetation in South-Eastern Nigeria. *J. Appl. Ecol.* 13, 177-187 (1976).

Kent-Jones, D.W. and A.J. Amos. *Modern Cereal Chemistry* 6th. Ed. p. 563. Food Trade Press Ltd. London (1967).

Lane, J.H. and L. Eynon. J. Soc. Chem. Ind. 42, 32T (1923).

Oswueme, I.C. *The Tropical Tuber Crops. Yams, Cassava, Sweet Potato and Cocoyams*. pp. 110-111. John Wiley and Sons. Chichester, New York, Brisbane and Toronto (1978).

Oswueme, I.C. and A.O. Lawanson. Effect of heat stress on subsequent chlorophyll accumulation in seedlings of *Colocynthis citrullus*. Planta (Berl.) 110, 91-94 (1973).

Plummer, D.T. *An Introduction to Practical Biochemistry*. p. 363. McGraw Hill. London and New York. (1971).