Research Journal of Environmental Sciences

ISSN 1819-3412

Academic
Journals Inc.

www.academicjournals.com

Research Journal of Environmental Sciences 1 (4): 166-172, 2007
ISSN 1819-3412

Effect of Cassava Processing Effluent on the Germination of Some Cereals

[1]Daniel Olorunfemi, [1]Hilda Obiaigwe and [2]Felix Okieimen
[1]Department of Botany,
[2]Department of Chemistry, University of Benin, Benin City, Nigeria

Abstract: The effect of cassava processing effluent on the germination of *Zea mays*, *Sorghum bicolor* and *Pennisetum americanum* were carried out using different effluent concentrations (25, 50, 75 and 100%). Percentage germination, radicle length and plumule length of the seedlings of the three varieties were noted. The effluent was observed to inhibit the germination of all seed types used. The percentage germination decreased significantly with increase in the effluent concentration. Length of radicle and plumule of the seedlings decreased with increase in effluent concentration. *Pennisetum americanum* was found to be least tolerant to the effluent while *Zea mays* was the most tolerant. Germination inhibition may be attributed primarily to the acidity of the effluent.

Key words: Cassava effluent, germination, radicle length, piumule length, seedlings

INTRODUCTION

In recent years, Nigeria has been consistently ranked as the world largest producer of cassava, *Manihot esculenta* Crantz. The Food and Agricultural Organisation of the United Nations in Rome estimated cassava production in Nigeria to be approximately thirty-four million metric tones (FAO, 2004).

Like most other members of the family Euphorbiaceae, the cassava plant produces latex. The processing of the cassava tuber, which contains two cyanogenic glucosides in significant amounts, is imperative in order to detoxify it before it becomes safe for human and animal consumption (Onwueme and Sinha, 1991). The highly toxic effluent so produced in the process inevitably gets disposed on land and water in an unplanned manner. Compounds that are generally toxic to living organisms will also at toxic concentrations prevent germination as well as inhibit growth. In the Southern part of Nigeria, cassava milling is one of the major industries and they are usually cited on locations where the effluents are capable of causing pollution on arable lands or fresh water near the mills.

In the past, a lot of attention was paid to the effects of pollution the on vegetation arising from oil spillage and hydrocarbons over the soil surface (Odu, 1972; Udo and Fayemi, 1975; Amakiri and Onofeghara, 1983, 1984). Although a lot of trade and commercial activities are closely associated with cassava cultivation resulting in increased grating engines in rural/urban areas of the tropics, literature is scanty on the effects of cassava effluent, which are usually discharged discriminately into the environment, particularly on farmland. (Ogboghodo *et al*., 2001, 2003, 2006).

Cereal crops of economic value such as *Zea mays*, *Sorghum bicolor* and *Pennisetum americanum* are extensively grown in various parts of Nigeria, where cassava is processed. This present study investigates the effect of cassava processing effluent on the germination and primary stages of growth of *Zea mays, Sorghum bicolor* and *Pennisetum americanum*.

MATERIALS AND METHODS

Zea mays, *Sorghum bicolor* and *Pennisetum americanum* seeds and fresh cassava processing effluent were collected from Uselu market in Benin City, situated between 6°15[1] N and 5°25[1] E. The

Corresponding Author: Daniel Olorunfemi, Department of Botany, University of Benin, Benin City, Nigeria

seeds were sorted, cleaned and tested for viability using the method of Idu and Olorunfeni (1988). The seeds were put in bowls of water and left for 5 minutes. Submerged seeds were collected and used while the seeds that remained afloat were discarded. The viable seeds were stored in polythene bags in the laboratory and used within a few days of collection.

The effluent was analysed for K, Na, Mg, Ca, Mn, Cd, Cu, Pb and Fe following the methods outlined by AOAC (1980).

Germination techniques follow that of Idu and Omoruyi (2003). Thirty seeds were placed in petri dishes and kept moist by a layer of cotton wool and coarse filter paper in triplicates. Twenty milliliter portion of each concentration (100, 75, 50, 45, 40, 35, 30 and 25%) of the effluent was added to each petri dish. (Serial dilutions of the stock solution were made to obtain the various test solutions at lower concentrations).

The Petri dishes were placed on a bench in the laboratory in light condition at room temperature and kept under plastic covers to reduce water loss by evaporation. Test solutions (i.e., effluent concentrations of 100, 75, 50, 45, 40, 35, 30 and 25%) were added when necessary to keep the filter papers moist. Filter papers were examined daily for fungal infection and seeds so affected were removed to avoid contamination of other seeds.

The Petri dishes were examined daily for germination. Radicle and plumule lengths were measured following the methods used by Idu and Omoruyi (2003).

RESULTS AND DISCUSSION

The physico-chemical characteristics of the effluent showed that it is slightly complex and highly acidic (pH 3.96) with a variety of dissolved cations and high conductivity (Table 1).

Total solids, Na, K, Ca, and Mg are fairly high. Fe, Cu, Mn and Cd concentration were low. The BOD of cassava effluent is within the permissible level of 30-100ppm for river discharge; however the effluent is highly acidic (Table 2).

It was observed that as the concentration of the effluent increased the inhibition on germination also increased (Fig. 1-4) for all the samples.

In particular, germination of *Zea mays* seeds treated with 25-100% effluent concentration was delayed (Fig. 1).

Table 1: Characteristics of the cassava effluent

Characteristics	Concentration (mg L^{-1})
Biological O_2	ND
Chemical O_2	ND
pH	3.96
Total solids	15,600.00
Conductivity (us/cm)	1,550.00
Sodium	112.10
Potassium	49.60
Calcium	54.51
Magnesium	23.35
Iron	1.82
Lead	8.33
Copper	1.03
Manganese	0.17
Cadmium	0.11

Table 2: pH of cassava effluent at different concentrations

Concentration of the cassava effluent (%)	pH
0	7.00
25	4.25
50	4.14
75	4.12
100	3.96

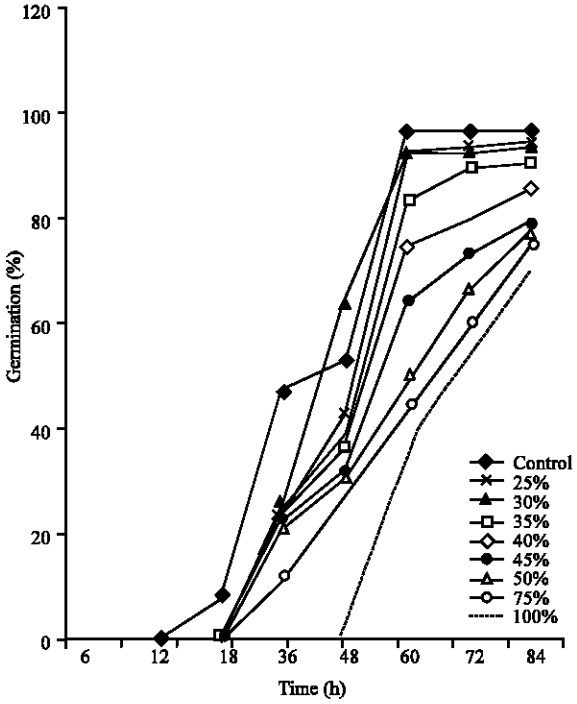

Fig. 1: Percentage germination of seeds of *Z. mays* at different time periods and effluent concentrations

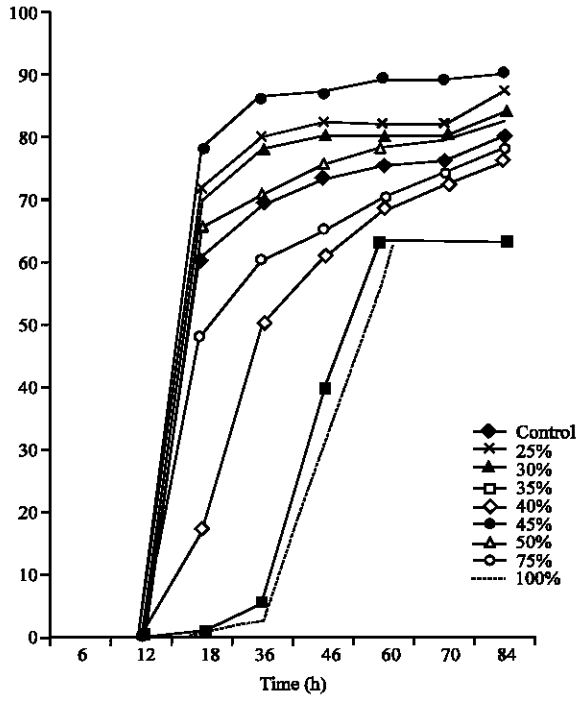

Fig. 2: Percentage germination of seeds of *S. bicolor* at different time periods and effluent concentrations

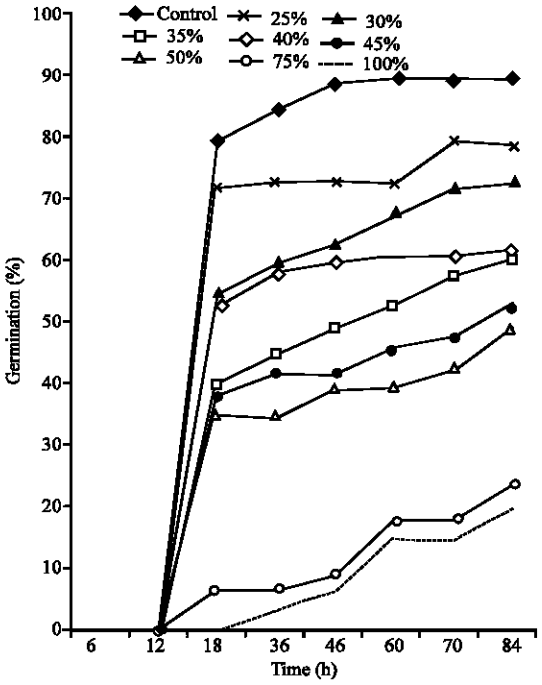

Fig. 3: Percentage germination of seeds of *P. americanum* at different time periods and effluent concentrations

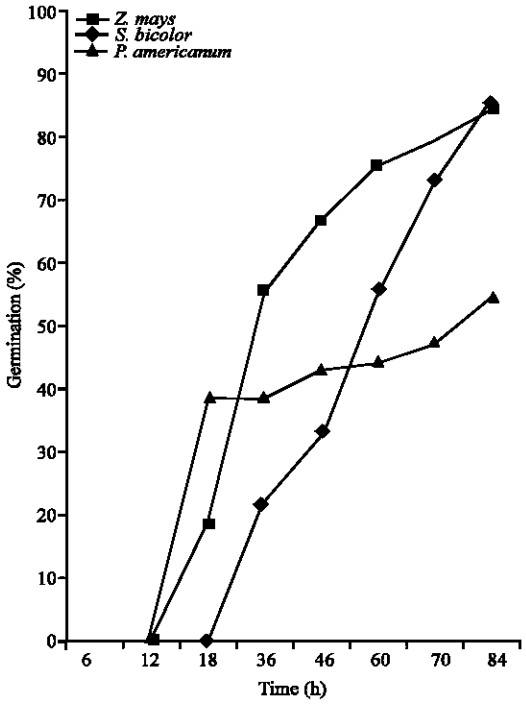

Fig. 4: Comparison of percentages of germinaton of seeds of *Z. mays*, *S. bicolor* and *P. americanum* in 50% effluent concentrations

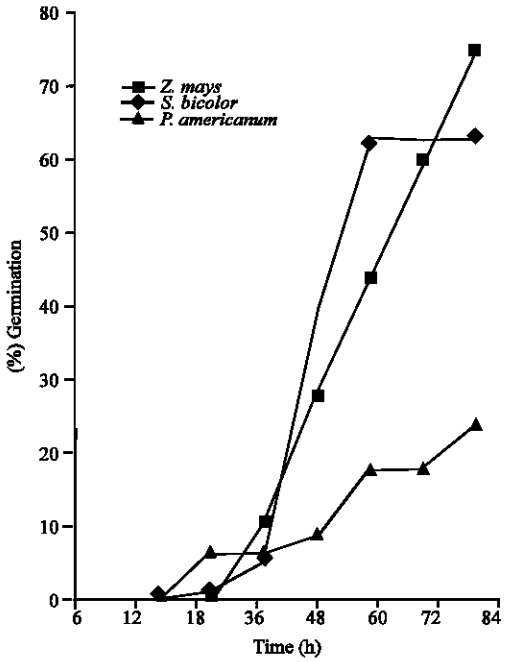

Fig. 5: Comparison of percentages of germinaton of seeds of *Z. mays*, *S. bicolor* and *P. americanum* in 75% effluent concentrations

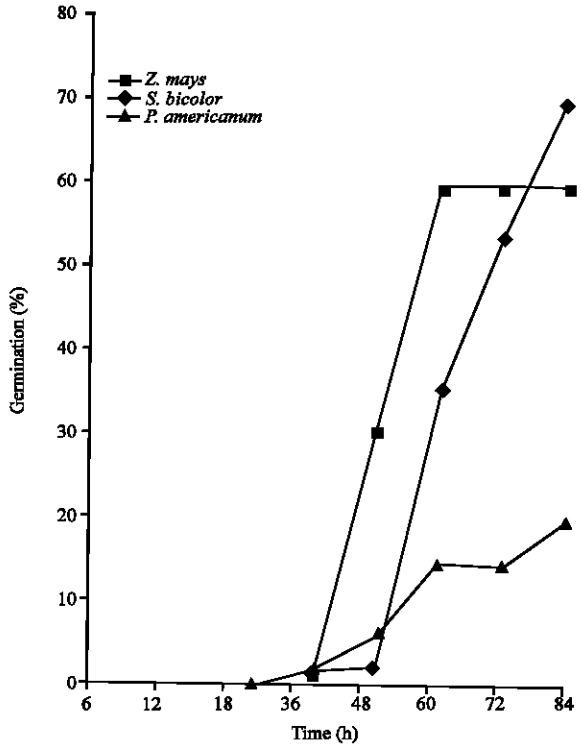

Fig. 6: Comparison of percentage of germination of seeds of *Z. mays*, *S. bicolor* and *P. Americanum* in 100% effluent concentration

Table 3: Effect of effluent on the radicle length of 4 day old seedlings

	Plumule length (cm)		
Concentration of the cassava effluent (%)	*Zea mays*	*Sorghum bicolor*	*Pennisetum americanum*
Control (water)	20.73±0.74	18.10±6.63	26.80±1.30
25	14.23±0.85	17.50±0.15	22.40±0.15
50	9.23±1.07	8.90±0.86	14.10±0.80
75	4.40±0.83	6.40±1.23	5.70±0.33
100	2.53±1.27	5.10±0.71	4.30±0.76

Values are means of triplicates, 4 days after addition of effluent

Table 4: Effect of effluent on the plumule length of 4 day old seedlings

	Radicle length (cm)		
Concentration of the cassava effluent (%)	*Zea mays*	*Sorghum bicolor*	*Pennisetum americanum*
Control (water)	22.10±1.63	28.90±0.35	36.70±3.51
25	12.70±1.04	21.20±1.40	26.80±3.80
50	11.70±0.15	15.60±1.12	11.40±1.50
75	8.67±0.63	10.40±1.11	0.50±0.05
100	3.73±1.86	6.60±0.52	0.50±0.21

In comparison with legumes, which have high percentage germination on scarification with acid (Idu and Olorunfemi, 1998), cereals have seeds that are single-coated; hence acidic treatment inhibited their germination because the integrity of the embryo is easily affected. According to Galinat (1998), *Zea mays* require an optimum pH of 6.0-7.0 for germination; therefore treatment with a highly acidic effluent may probably have been responsible for the delay of germination. Nevertheless, it was relatively the most tolerant to the effluent at high concentrations of pH 4.04 and pH 3.96 (Fig. 5 and 6) with a germination percentage of 75 and 70%, respectively. The seeds of *P. americanum* on the other hand gave the least% germination of 24 and 20% at effluent pH of 4.04 and 3.96, respectively.

In spite of the considerable reduction in the cyanide content of raw cassava during fermentation and processing as well as the availability of methods for eliminating cyanide from some cassava products, toxic levels of cyanide are still being reported in various cassava products (Nartey, 1981).

Radicle lengths were observed to decrease with increase in effluent concentration in the seedlings of all cereals (Table 3).

The response of the effluent-treated seedlings was the same with respect to the plumule length (Table 4).

According to Amakiri and Onofeghara (1984), any adverse effects on germination affects growth and, ultimately crop yield. Furthermore, it is observed that *Sorghum bicolor* seedlings were most tolerant to the effluent with respect to both radicle and plumule lengths while *Pennisetum americanum* seedlings were most drastically affected by the effluent.

Cassava mill effluent has been found to increase the number of organisms in the soil ecosystem which may have been associated with increases in the soil pH, organic carbon and total nitrogen (Ogboghodo *et al*., 2001, 2003, 2006)

Thus the present study highlights the effect of cassava effluent on germination of the seeds of *Z. mays*, *Sorghum bicolor* and *Pennisetum americanum*. It is also penitent to mention that flooding or irrigation can reduce the inhibitory effect of the effluent. The effect of cassava effluent on the later phases of growth is the subject of another investigation already in progress.

REFERENCES

Amakiri, J.O. and F.A. Onofeghara, 1983. Effect of crude oil pollution on the growth of *Zea mays*, *Abel esculentus* and *Capsicum frutenscens*. Oil Petrochem. Pollut., 1: 199-205.

Amakiri, J.O. and F.A. Onofeghara, 1984. Effects of crude oil pollution on the germination of *Zea mays*. Environ. Pollut., 35: 159-167.

AOAC., 1980. Official methods of analysis. 13th Edn., Washington DC: Association of Official Analytical Chemists.

FAO., 2004. Cassava industrial revolution in Nigeria. Codex Alimentarius Commission XII, Supplementary 4. Rome.

Galinat, W.C., 1988. The Origin of Corn. In: Corn and Corn Improvement. Agronomy Monogragh. Spraque, G.F. and J.W. Dudley (Eds.), American Soci. of Agronomy, Wisconsin, pp: 1-3.

Idu, M. and D.I. Olorunfemi, 1998. Germination of seeds of *Afromomum melegueta*. J. Applied Sci., 1: 111-118.

Idu, M. and O.M. Omoruyi, 2003. Effect of seed pre-treatments on germination of two surface types of *Dialium guineense*. Seed Technol., 25: 41-44.

Nartey, F., 1981. Cyanogenesis in Tropical Fields and Foods. In: Cyanide in Biology. Nennesland, B., E.E Conn, C.J. Knowles, J. Wesley and F. Wissing (Eds.), Academic Press, New York, pp: 115.

Odu, C.T.I., 1972. Microbiology of soil contaminated with petroleum hydrocarbons. 1. Extent of contamination and some soil and microbial properties after contamination. J. Inst. Petrol., 562: 201-208.

Ogboghodo, I.A., I.O. Osemwota, S.O. Eke and A.E. Iribhogbe, 2001. Effect of cassava (*Manihot esculenta crantz*) mill grating effluent on the textural, chemical and biological properties of surrounding soils. World J. Biotechnol., 2: 292-301

Ogboghodo, I.A., A.P. Oluwafemi and C.A. Unuigbe, 2003. Effect of polluting soil with cassava (*Manihot esculenta*) mill effluent on maize growth and some soil properties. Nig. J. Applied Sci., 21: 62-67.

Ogboghodo, I.A., A.P. Oluwafemi and S.M. Ekeh, 2006. Effect of polluting soil with cassava mill effluent on the bacteria and fungi populations of a soil cultivated with maize. Environ. Monit. Assess., 116: 419-425.

Onwueme, I.E. and T.D. Sinha, 1991. Field crop production in tropical Africa. Technical Centre for Agricultural and Rural Co-operation (CTA), pp: 159-237.

Udo, E.J. and A.A. Fayemi, 1975. The effects of oil pollution of soil on germination, growth and nutrient Uptake of corn. J. Environ. Qual., 4: 537-540.