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Cytogenotoxic characterization of Porto – Novo lagoon waters in Benin

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Abstract

Toxic waste constitutes today a real problem of public health because they are rejected into our rivers without a preliminary treatment. The genetic inheritance of the species halieutics is affected by this pollution what can generate a contamination of the trophic chain. The agricultural and industrial activities produce worn water and several chemical pollutants which are poured in our rivers constituting sources of chemical pollution thus. This pollution is a danger to the development of the local fisheries. Rain water and the urban rejections can also be potential sources of chronic pollution of the rivers. Once the cytogenotoxicity of water and fish of the Porto-Novo lagoon determined, that will make it possible to know the cytogenotoxic map of the lagoon so that a project of depollution of this lagoon is achieved. This study has as principal objectives, the chemical depollution of the lagoon, its valorization in order to booster rocket the productivity of the resources halieutics. This will allow the increase in the local consumption of the products halieutics then the reduction of the importation of fish and other products of fishing frozen in Benin, in order to allowing the development of the local fisheries. The results obtained made it possible to determine the cytogenotoxicity of water and fish fished in the lagoon what revealed a toxicity which varies according to the fish species studied and the sites considered. The reproduction of the various species halieutics is prevented by this toxic pollution which makes the products of fishing unsuitable for consumption. The productivity of the species halieutics will increase when the lagoon is cleansed what will booster the marketing and the local consumption of the local products of fishing. The destruction of the watery ecosystems will be slowed down by this depollution and the conservation of the biodiversity of fauna and the flora of Porto-Novo lagoon would be a reality.

Keywords: Depollution, cytogenotoxicity, species halieutics, contamination, lagoon of Porto-Novo.

Introduction

The problems of public health and environmental pollution then the impoverishment of biological diversity are caused by toxic pollutants which were discharged in rivers and the littoral lagoons. This pollution can have irreversible effects on the aquatic ecosystems such as disappearance of animal and vegetable species, the contamination of the trophic chain with very important economic consequences[1]. The hydrocarbons derived from oil, domestic and industrial wastes are generally the cause of toxic pollution in the aquatic environments. The pollutants involved were accumulated gradually to reach toxic thresholds which exceed those tolerable by the organisms. Thus they cause harmful consequences on the health[2].

The rejections of domestic worn water and the pollutants resulting from the agricultural and industrial activities in our rivers[3] constitute the sources of chemical pollution[4].

This pollution proves to be a danger with the production on a large scale of the products halieutics and cause the dramatic consequences on the floristic and faunistic biodiversity[5].

Material and methods

Material: Water samples of seven (7) sites of the lagoon of Porto - Novo were treated. A pH/Oxymeter equipped with a probe WTW 340i was used to measure the pH and dissolved oxygen. The temperature, salinity, conductivity and TDS were obtained by conductimetry with a probe WTW 340i,

One also used a colorimeter HACH DR890, a disc of Secchi, plastic bottles to take water and a microscope LEICA DMLB with camera Tk-1280 E. The onions used for the test of cytogenotoxicity were bought in the ``OUANDO" market and were dried in laboratory.

Methods: For the test of cytogenotoxicity[6-10], the culture of onions was made in the water samples with various concentrations which are 0%, 25%, 50%, 75% and 100%. The measurement lengths of the onions roots is made after 96 hours of culture (4 days) for the cytotoxicity[11] and the cut of the ends of the roots after 48 hours of culture (2 days) for the genotoxicity[12-15].

Results and discussion

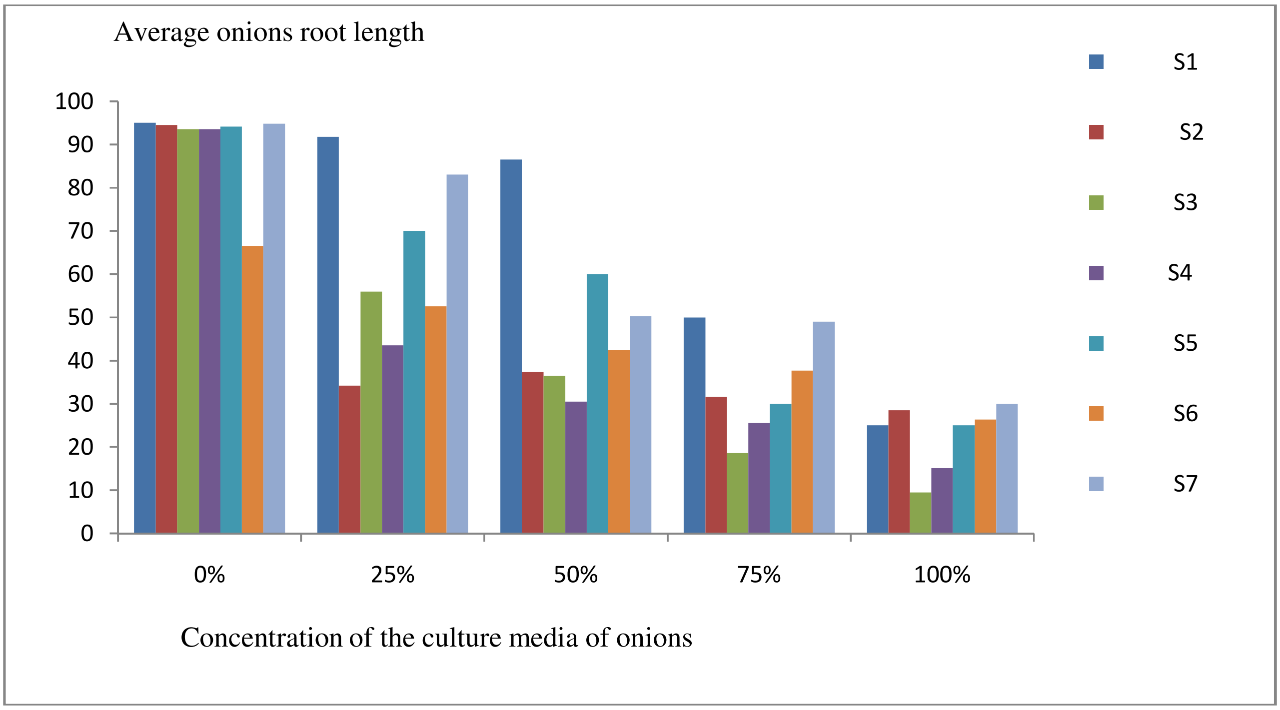


Figure-1: Average of onions roots length sex posed in water of the seven sites during the first campaign.

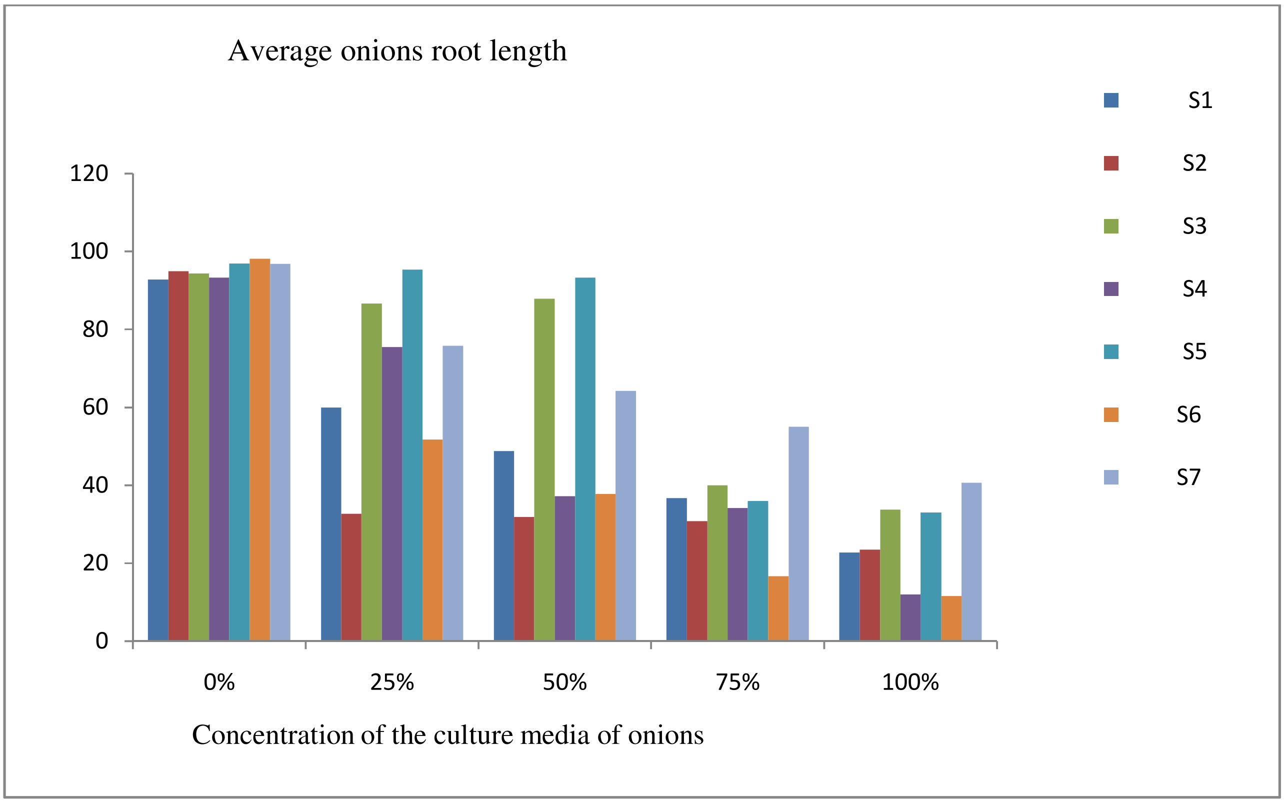


Figure-2: Average of onions roots lengths exposed in water of the seven sites during the second campaign.

Parameters based on inhibitions of the growth of the onions roots: During the first campaign, the averages lengths of the roots relating to the seven studied sites varied from 66.6% to 95% in the witness. For waters concentrated with 25%, the weakest average of 34.2% is obtained on site 2 whereas highest is 91.8% and was obtained on site 1. With a concentration of 50% of water tested, the weakest average lengths of the roots was obtained on site 4 and is 30.5% while highest was recorded on site 1 and is equal to 86.5%. With regard to waters concentrated with 75% and 100%, the weakest averages were recorded on site 3 and are respectively equal to 18.6% and 9.5%. The highest average of waters concentrated with 75% was obtained on site 1 and is 50% whereas highest from waters concentrated at 100% of 30% is obtained on site 7 (Figure-1).

The averages of roots lengths in witness waters varied from 92.8% to 98.2% during the second campaign. On the graph of Figure-2, the waters concentrated with 25% have the weakest average which of 32.7% is obtained on site 2 whereas the highest average is 95.4% and was obtained on site 5. The weakest average lengths of the roots relating to waters concentrated with 50% was recorded on site 2 and is equal to 31.9% while the highest average is 93.3% and was recorded on site 5. The waters concentrated with 75% and 100%, have the weakest averages evaluated respectively with 16.6% and 11.6%; both obtained on site 6. The averages lengths of the highest roots of waters concentrated with 75% and 100% respectively equal to 55% and 40.6% are recorded on site 7.

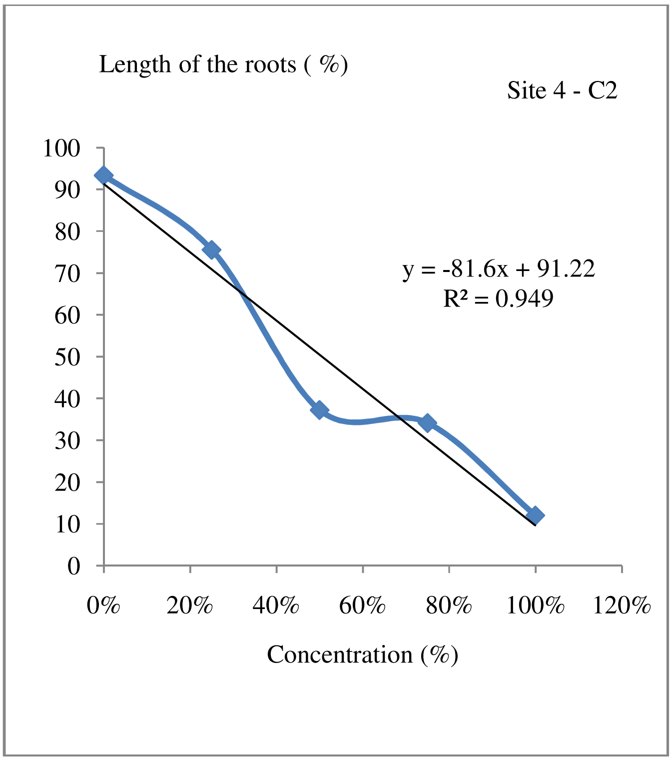


Figure-3: Inhibition of the onions roots growth exposed in water of site 1 for the first campaign.

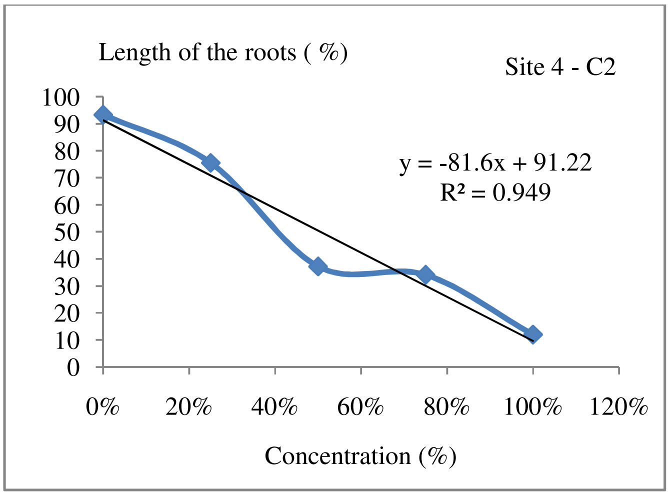


Figure-4: Inhibition of the onions roots growth exposed in water of site 2 for the first campaign.

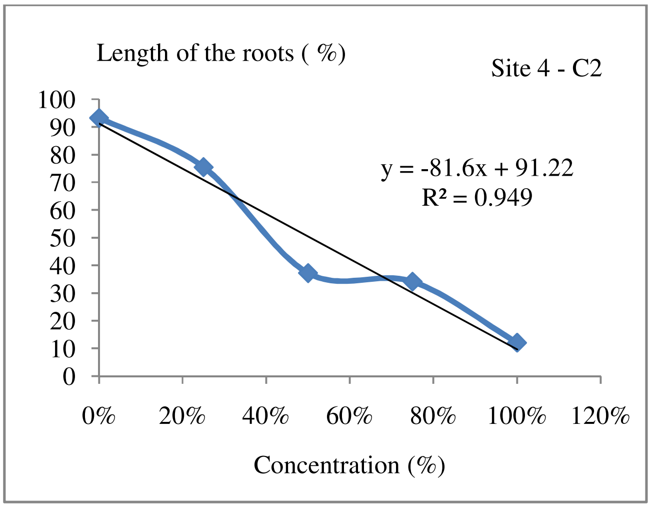


Figure-5: Inhibition of the onions roots growth exposed in water of site 3 for the first campaign.

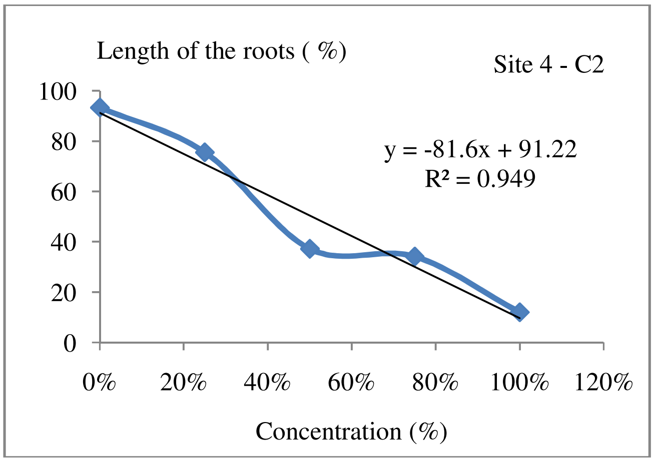


Figure-6: Inhibition of the onions roots growth exposed in water of site 4 for the first campaign.

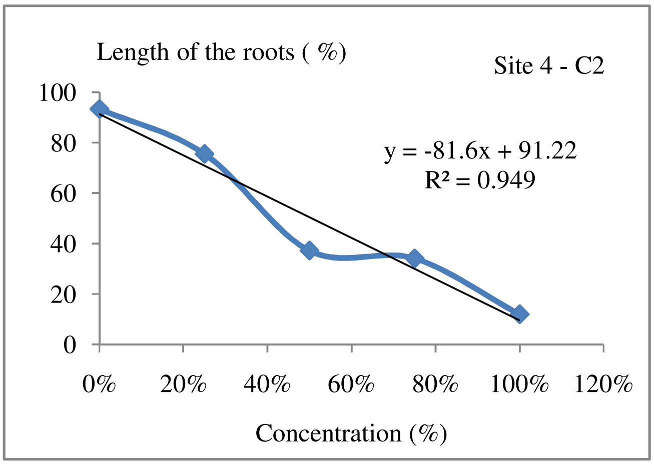


Figure-7: Inhibition of the onions roots growth exposed in water of site 5 for the first campaign.

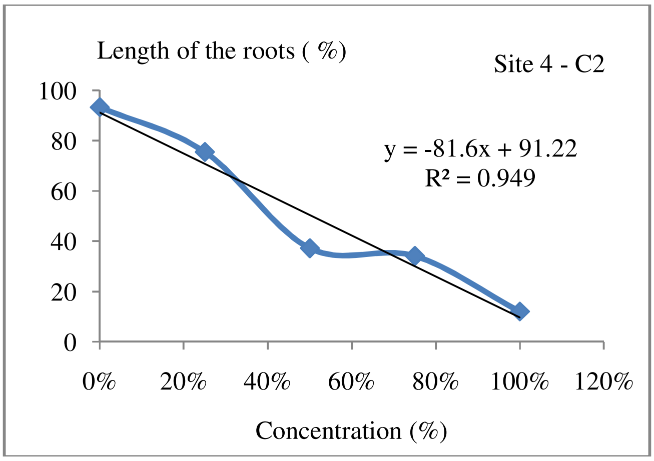


Figure-8: Inhibition of the onions roots growth exposed in water of site 6 for the first campaign.

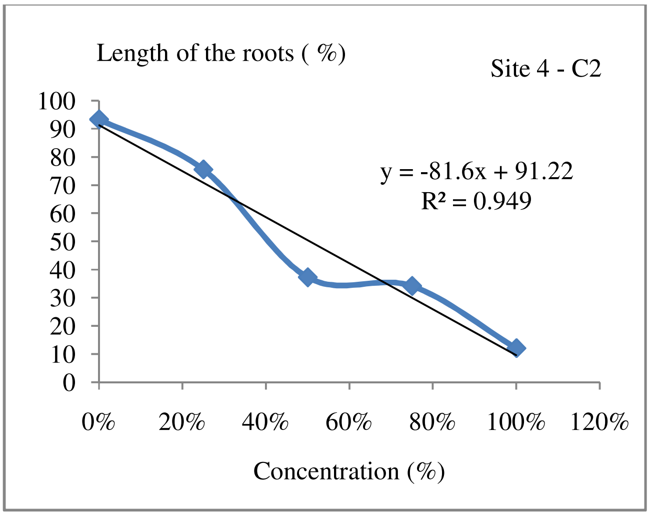


Figure-9: Inhibition of the onions roots growth exposed in water of site 7 for the first campaign.

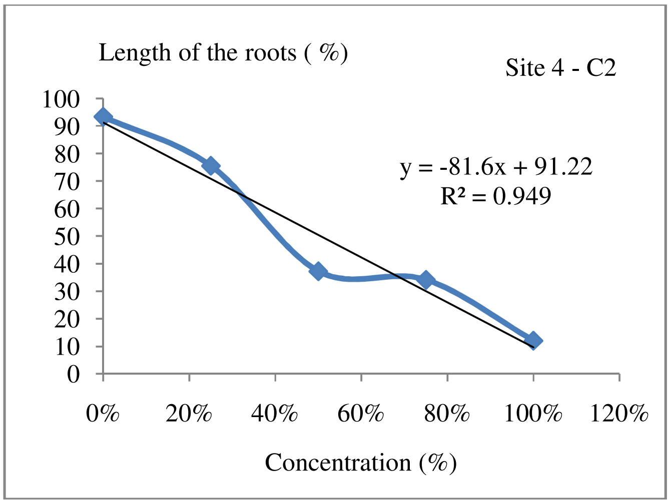


Figure-10: Inhibition of the onions roots growth exposed in water of site 1 for the second campaign.

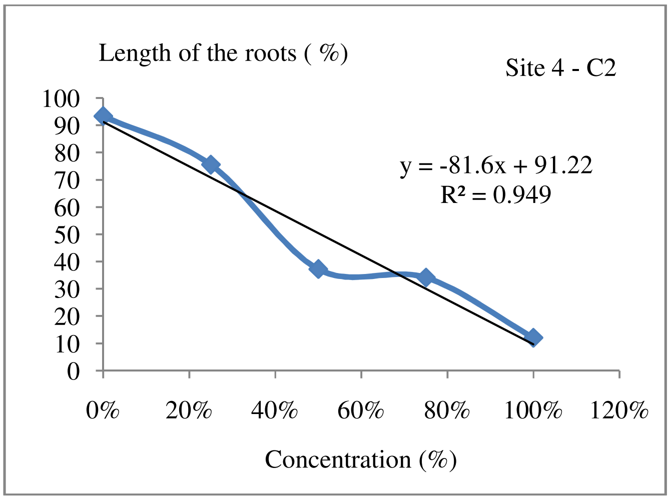


Figure-11: Inhibition of the onions roots growth exposed in water of site 2 for the second campaign.

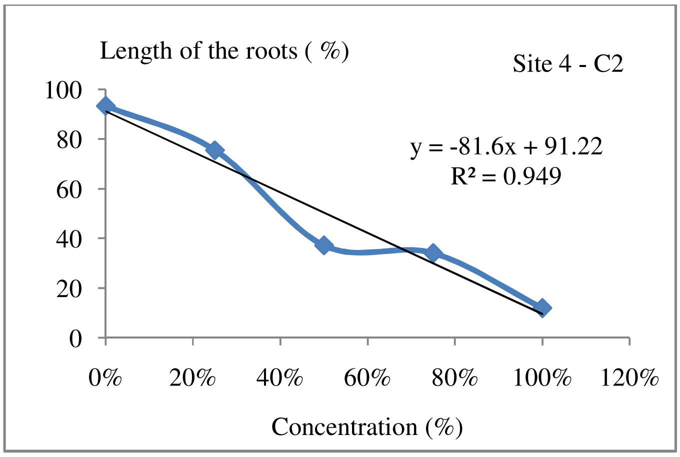


Figure-12: Inhibition of the onions roots growth exposed in water of site 3 for the second campaign.

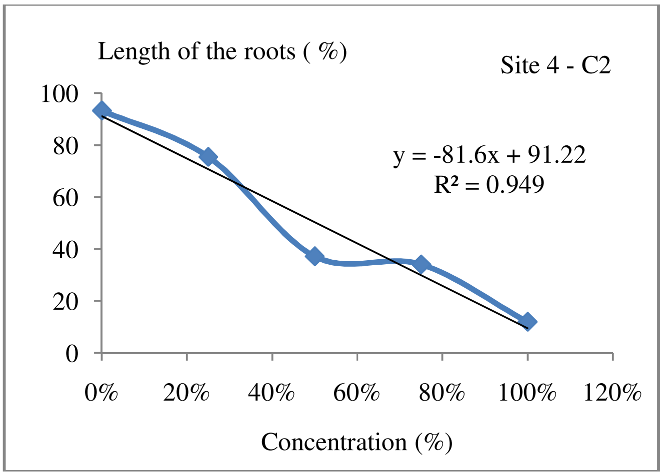
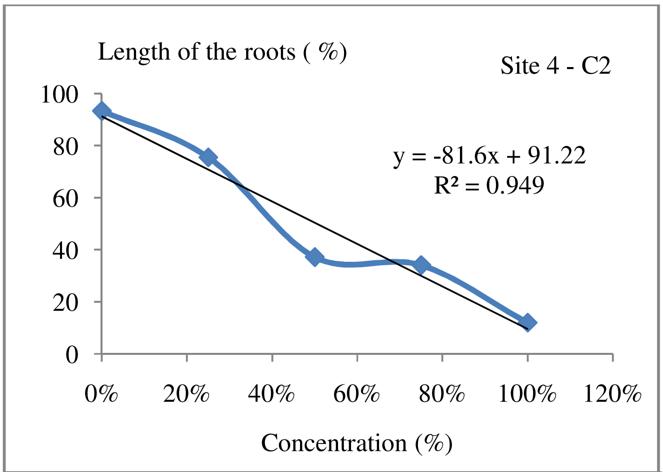


Figure-13: Inhibition of the onions roots growth exposed in water of site 4 for the second campaign.



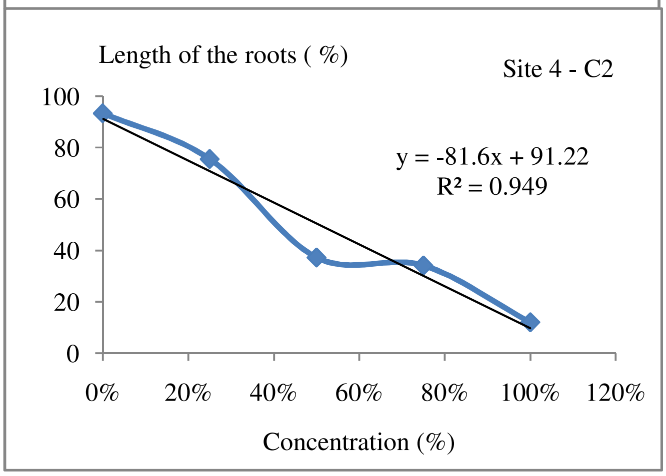


Figure-14: Inhibition of the onions roots growth exposed in water of site 5 for the second campaign

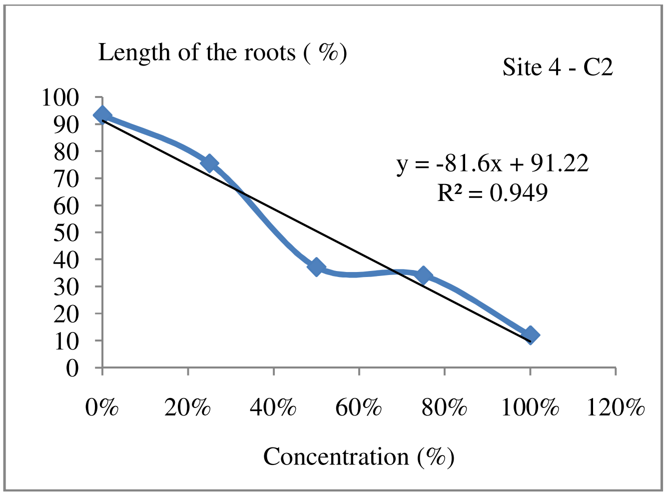


Figure-15: Inhibition of the onions roots growth exposed in water of site 6 for the second campaign.

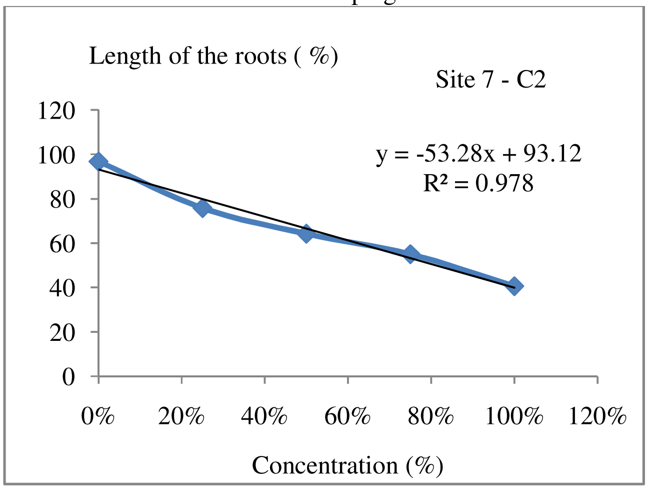


Figure-16: Inhibition of the onions roots growth exposed in water of site 7 for the second campaign.

Table-1: EC_{50} of seven sites for first and second campaign.

Site	EC_{50} (campaign 1)	EC_{50} (campaign 2)
Site 1	80	56
Site 2	40	40
Site 3	43	85
Site 4	38	53
Site 5	58	80
Site 6	36	45
Site 7	66	81

Site 2 has a weak concentration EC_{50} = 40% during the first and second campaign thus it is more toxic during the great dry season and the beginning of the great rain season. Sites 3, 4 and 6 respectively have their weaker effective concentrations EC_{50} equal to 43%, 38% and 36% during the first campaign (Figures 3-9).One thus concludes from it that they are more toxic during the great dry season. This same toxicity was evaluated in worn water and the industrial waste[6,16-18].

When we compared the acute toxicity of the seven sites during the first campaign, we noted that site 6 is most toxic during the dry season because it has the weakest effective concentration EC_{50} = 36% (Table-1). Acute toxicity could especially prove to be dangerous even mortal for certain species halieutics for the fish[19,20]. During the second campaign (Figures 10-16), it is the site 2 which presents the weakest effective concentration EC_{50} = 40% (Table-1); it is then most toxic at the beginning of the great rainy season.

Table-2: Average Mitotic index and Average of aberration for first and second campaign.

Site	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7
Average Mitotic index	8.75	9.19	9.35	8.64	9.44	9.21	9.01
Average of aberration (%)	1.77	0.91	0.88	1.46	0.48	0.51	1.62

Cytogenotoxicity of waters: The average mitotics index and the average percentages of aberrations[4,21-24] obtained on the seven sites were gathered in Table-2. The weakest average mitotic index was obtained on site 4 and is 8.64 while highest was recorded on site 5 and is equal to 9.44. The percentage of chromosomal aberrations[25-27] average highest is 1.77. It was obtained on site 1 whereas weakest was recorded on site 5 and is equal to 0.48. These various values permit us to classify in the table 3 the sites of pollution according to the cytogenotoxic parameters by decreasing order.

Table-3: Decreasing ranking of the sites according to the mitotic index and aberration.

Decreasing ranking of the sites according to the mitotic index	R Decreasing ranking of the sites according to aberration
Site 4	Site 1
Site 1	Site 7
Site 7	Site 4
Site 2	Site 2
Site 6	Site 3
Site 3	Site 6
Site 5	Site 5

Conclusion

This work showed that the seven sites objects of this study reveal a total toxicity and an acute toxicity which vary according to sampling sites and to the various seasons.

The deformations such as the unfolding of the ends, the swelling of the roots, malformations and the reversals of the roots to the top obtained of the cytotoxic study were precursory signs heralding a genotoxicity of water of the sites of the studied lagoon. This observation allowed us to make a genotoxic study of water of these seven sites. This study showed that water of the seven studied sites is indeed genotoxic.

The values of effective concentrations EC_{50} obtained starting from the analyses of toxicity based on the Inhibition of the onions roots growth made it possible to compare the toxicity of the seven sites of taking away during two campaigns carried out during the four seasons of the year. The results obtained showed that site 6 is most toxic during the dry season and that site 2 is most toxic at the beginning of the great rainy season. Site 1 is most toxic for the small rain season and the period of high waters.

The values of the mitotic index (MI) obtained starting from the analyses of genotoxicity based on the number of cellular division of the mitosis and the various chromosomal aberrations such as viscosity, chromosomes wandering or in bridge, binucleate chromosomes, multipolar anaphases then the percentages of aberrations showed that water of the seven studied sites is genotoxic with varied degrees. We deduced that all the sampling sites present a genotoxicity which varies according to concentrations of water tested. The cytogenotoxic character of water of the Porto-Novo lagoon was confirmed by the microscopic test on fish fished in the lagoon.

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