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Effect of Oil Spillage on Sodium and Magnesium Content in the Soil

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ABSTRACT
The study looked at effect of oil spillage on sodium and magnesium content. Three research questions were used in the study. The work is limited to the examination of Sodium and magnesium content analysis of crude oil spillage on Immiringi community soil. The study was limited to analysis of depth 0.15cm, 15-30cm, 30-45cm and control line. Findings from research question 1 revealed that magnesium had 4.76 range at depth 0-15cm. Sodium had a range value of 13.76cm at a depth of 0-15cm. Also, magnesium had 5.67 range at depth 0-15cm. Sodium had a range value of 12.38cm at a depth of 15-30cm. Research question 2 revealed that magnesium had 4.56 range at depth 30-45cm. Sodium had a range value of 10.25cm at a depth of 30-45cm. Also, magnesium had 6.54 range at a control depth. Sodium had a range value of 11.94 at a control depth. Finally, it was recommended that multinationals operating in host communities should keep in check monitoring teams that will respond quickly to emergency oil spill in the communities to avoid wide spread of crude on land.
Keywords: Oil Spillage, Sodium and Magnesium

INTRODUCTION

The significance of crude oil as a fuel source and commodity of international importance are great. Observation shows that most countries in the world depends on the products of crude oil for its automobile and other energy associated demands. It is commonly used for generating heat for domestic purposes, power, transportation, electricity and for industries. The activities of man on this natural resource have always resulted in accidental and toxic discharges into the environment. This release of crude oil into the immediate and remote environments is what is generally known as oil spill or pollution. Oil spills have posed a major threat to the environment of the oil producing areas, which if not adequately handled may escalate to the total destruction of ecosystems (Adata, 2012). The ecological problems observed as a result of oil spillage includes brownish vegetation and soil erosion, diminishing resources of the natural ecosystem and adverse effect on the life, health and economy of the people (Abii & Nwosu, 2009).

The soil under the spill becomes oil-bathed , this means a total occupancy of the soil interstitial pores by oil in the absent of soil aeration reactions (organic and inorganic), proceeding requiring air are halted and the generation of organic nutrient required by the plant are ruled out ,the rate of peculation depends on the porosity and permeability of the soil , this renders the soil unproductive by destroying the soil fertility .Not only is the quality of soil affected , but also plant and living being that rely on these plants resulting from the direct release on land and through percolation and run-off into ground and surface water (Bariweni, 2014). The study also observe that as a result of oil spill in Immiringi community, hectares of land which otherwise could have been used for agriculture are rendered useless , it is well known that Bayelsa State has very scarce land area and the problem of oil spill is encroaching into an already scarce agricultural land. This situation is causing low crop yield and food scarcity. All these problems of pollution, fertility loss, rampant spread of diseases, loss of aquatic lives, killings, money loss, fire outbreaks, shut down in the oil production and community disturbances are traced to crude oil spillage.

With increasing soil infertility due to the destruction of soil micro-organisms, and dwindling agricultural productivity, farmers have been forced to abandon their land, to seek non-existent alternative means of livelihood. Aquatic lives have also been destroyed with the pollution of traditional fishing aqua sources, exacerbating hunger and poverty in fishing communities. In a study on the effect of oil spill on crop production in the Niger Delta, reported that oil spill causes great damage to plant community due to high retention time of oil occasioned by limited air flow. The oil hamper proper soil aeration as oil film on the soil surface acts as a physical barrier between air and the soil thus affecting the chemical properties of the soil such as temperature, structure, nutrient status and pH. Oiled shoots of crops like pepper and tomatoes may wilt and die off due to blockage of stomata thereby inhibiting photosynthesis, transpiration and respiration. Germination, growth performance and yield of these crops are stifled by oil spillage (Aghalino, 2000).

Heavy metals such as lead, cadmium etc. have been shown to accumulate in soil; affecting the fertility of the soil by clogging the soil nutrient, causing impeded growth of plants. Some of them may run into rivers and stream waters and get mixed up with surface water, which percolates into the soil, affecting groundwater tables, thus rendering it unfit for drinking.

Bariweni, (2014) stated that When oil is discharged into the environment, thin layers of the oil are formed over the surface of the environment which is a subjected to biological and chemical processes. These processes could tend to environmental degradation, which is a major cause for concern. The effect of any spill depends on the quality, mobility and environmental factors. Effect of oil spill on soil includes, reduced soil porosity due to clogging of soil particles. Other effects are decrease aeration, impaired soil biochemical process organic matter decomposition, symbiotic and non-symbiotic nitrogen fixation. Increase microbial activities, due to large quantity of oil present Creation of anaerobic soil due insufficient oxygen. There is therefore the need to analyze the effect of crude oil spillage on plants and micro-organisms in Immiringi Community in Bayelsa State.

LITERATURE REVIEW

Effect of Sodium on the Soil

Sodium stabilizes decayed soil organic matter (humus) and is one of several cations (positively charged ions or molecules) that may occupy sites on the soil CEC. Others include ammonium (NH_4^+) sodium (Na^+), potassium (K^+), magnesium (Mg^{2+}), and aluminum (Al^{3+}). These cations influence the tendency of soil colloids (clay particles) to separate (disperse) or aggregate (flocculate).

For proper growth and development, rhododendrons need acidic soils, with pH 4.0-5.5 (Czekalski 1991; Tiwari and Chauhan 2005). The presence of calcium carbonate ($CaCO_3$) in the substrate, via alkalization of the rhizosphere, markedly limits their growth. Excessive calcium uptake by a plant may lead to disturbances in ion balance, to the disadvantage of other nutrients (such as potassium and magnesium), or to changes in cytosol pH and a decrease in solubility of some ions, e.g. of iron (Chaanin and Preil 1992; Balakrishnan et al. 2000). It is very important in what form the calcium salts are supplied and if are soluble in the substrate. All changes in environmental factors deviating from optimum growth conditions are more or less stressful to plants. Plants can use the same or similar defence mechanisms in response to various stress factors.

Plant growth in extreme conditions (e.g. for rhododendrons: in substrates with a high calcium content and pH) causes changes in their morphology and in numerous metabolic processes. A majority of studies of the influence of calcium on rhododendrons are concerned with observations of external symptoms and changes, which are reflected mostly in leaf chlorosis and poor plant growth. A major aim of this study was to describe the changes that take place in rhododendrons under the influence of high concentrations of calcium carbonate or sulphate on selected metabolic processes.

In view of the important role played by phenolic compounds in plant protection, mostly against infection by pathogens and pests, they are stored in cells in some strategic sites, where they are involved in signalling or directly in defence responses to stress conditions (Beckman 2000).

Sugars are important metabolites, used by plants in defence responses under the influence of various stress factors. Environmental stresses induce changes in concentrations of soluble carbohydrates and starch, which is reflected in modified activity of the enzymes participating in carbohydrate metabolism (Szadel and Lorenc-Plucińska 2002).

Effect of Magnesium on the Soil

Magnesium (Mg) is an essential element for plant growth and development. The availability of Mg to plants depends on various factors: the distribution and chemical properties of the source rock material and its grade of weathering, site specific climatic and anthropogenic factors and, in agricultural systems, to a high degree on the agronomic management practices established at the specific production site including the cultivated crop species and crop rotation, cropping intensity and organic and mineral fertilization practice (Mikkelsen 2010; Scheffer and Schachtschabel 2002). The importance of Mg in crop production was underestimated in the last decades (Cakmak and Yazici 2010). Indeed, compared to other nutrients little attention has been paid on this mineral nutrient by agronomists and scientists in the last decades. Therefore, the term 'the forgotten element' was introduced and used (Cakmak and Yazici 2010). One decisive reason for this gap in research may be that Mg deficiency is often not recognized in agriculture, so that there is no concrete stimulus for enhanced (research) activity in this area. Indeed, acute Mg deficiency is typically correlated with visible interveinal chlorosis and growth reduction, whereas the more frequent latent deficiency is often not visible and hardly to diagnose but negatively affects yield of crops (Cakmak and Yazici 2010).

Latent and acute Mg deficiencies are common phenomenons in crop production (Römheld and Kirkby 2007). A typical Mg deficiency symptom is leaf interveinal chlorosis. Development of chlorosis requires preceding degradation of chlorophyll, since Mg acts as central atom in the chlorophyll molecule. As Mg is strongly bound to this molecule chlorosis appears to be a late response to Mg deficiency. In plants well supplied with Mg only about 20 % of the total Mg is bound to chlorophyll, whereas the remaining about 80 % are present in more mobile forms (Marschner 2012).

Magnesium is phloem mobile and readily translocated within the plant to actively growing plant parts acting as sink (White and Broadley 2008). Consequently, due to the high mobility under Mg starvation Mg deficiency symptoms typically appear on older leaves of the plant (Bergmann 1992). As chlorosis is a late visible response to Mg deficiency considerable decreases in yield formation can be expected. Therefore, the diagnosis of chlorosis is not a suitable tool for diagnosis of Mg deficiency as basis for fertilization recommendations. There is some evidence that Mg plays specific roles in dry matter formation and carbon partitioning to sink organs, as under Mg deficiency carbohydrates accumulates in source leaves (Cakmak et al. 1994a, b; Ding et al. 2006). Therefore, an earlier response of plants to Mg deficiency is carbohydrate accumulation in source leaves and reduced root growth due to restricted supply of the roots with carbohydrates (Cakmak et al. 1994a, b), even though some contrasting results exist for some plant species, for example sugar beet (Hermans et al. 2004, 2005). Hence, disturbed carbohydrate partitioning may be regarded as latent deficiency which per definition also impacts yield formation.

Purpose of the Study

The study looked at effect of oil spillage on calcium and magnesium content in the soil. Specifically the study sought to:

1. Examine the effect of oil spillage on Sodium calcium and magnesium along depth o-15cm and 15-30cm.
2. Examine the effect of oil spillage on Sodium and magnesium along depth 30-45cm and control line.

Research Questions

The following research guided the study:

1. What is the effect of oil spillage on Sodium and magnesium along depth o-15cm and 15-30cm?
2. What is the effect of oil spillage on Sodium and magnesium along depth 30-45cm and control line?

Scope of the Study

The work is limited to the examination of Sodium and magnesium content analysis of crude oil spillage on Immiringi community soil. The study was limited to analysis of depth 0.15cm, 15-30cm, 30-45cm and control line.

METHODS

The study adopted simple laboratory experimental test analysis method. Soil sample were drawn across various unit in the community. Different depth of soil sample were collected and tested in the laboratory. Small containers were collected and labelled Sodium calcium specimen A and magnesium specimen B. The laboratory testing exercise lasted for 2 weeks.

RESULTS

Research Question 1*: What is the effect of oil spillage on Sodium and magnesium along depth o-15cm and 15-30cm?*

Table 1: Effect of oil spillage on Sodium and magnesium along depth o-15cm and 15-30cm

Dept. cm	Mg	Na	TOC	CEC	PSA	Text	THC
0-15	4.76	13.76	14.85	37.87	193µ	M.S	4.87
15-30	5.67	12.38	6.54	33.38	175µ	M.S	5.38

Table 1 revealed that magnesium had 4.76 range at depth 0-15cm. Sodium had a range value of 13.76cm at a depth of 0-15cm. Also, magnesium had 5.67 range at depth 0-15cm. Sodium had a range value of 12.38cm at a depth of 15-30cm. TOC had a range value of 14.85 at a depth of 0-15cm. TOC had a range value of 6.54 at a depth of 15-30cm.

Research Question 2: *What is the effect of oil spillage on Sodium and magnesium along depth 30-45cm and control line?*

Table 2: Effect of oil spillage on Sodium and magnesium along depth 30-45cm and control line

Dept. cm	Mg	Na	TOC	CEC	PSA	Text	THC
30-45	4.56	10.25	6.00	34.03	165µ	F.S	5.86
Contl.	6.54	11.94	5.42	55.72	90µ	Silty	1.82

Table 2 revealed that magnesium had 4.56 range at depth 30-45cm. Sodium had a range value of 10.25cm at a depth of 30-45cm. Also, magnesium had 6.54 range at a control depth. Sodium had a range value of 11.94 at a control depth. TOC had a range value of 6.00 at a depth of 30-45cm. TOC had a range value of 5.54 at a control depth.

Summary of Findings

The findings of the study were summarized as follows:

1. Research question 1 revealed that magnesium had 4.76 range at depth 0-15cm. Sodium had a range value of 13.76cm at a depth of 0-15cm. Also, magnesium had 5.67 range at depth 0-15cm. Sodium had a range value of 12.38cm at a depth of 15-30cm.
2. Research question 2 revealed that magnesium had 4.56 range at depth 30-45cm. Sodium had a range value of 10.25cm at a depth of 30-45cm. Also, magnesium had 6.54 range at a control depth. Sodium had a range value of 11.94 at a control depth.

DISCUSSION OF FINDINGS

Damage Caused By Oil Spill to Plant at Different Locations

Sampling of the study areas shows that there is high level of contamination of total petroleum hydrocarbon (TPH). High hydrocarbon content causes deprivation and reduction in gaseous diffusion by the surface film of oil and this usually has high effect on the flora and fauna of the affected area, hence the soil fertility. Also high hydrocarbon content could also lead to loss or complete defoliation of the flora, as a result of either root or leaf exposure to oil, especially in severely impacted area Ekwezor shrieling, cupping up with leaves, arrested expansion of bubs and some degree of foliar necrosis have been identified as marked stress signs of a soil plagued with petroleum hydrocarbon (Odu, Bwoboshi, & Esuruoso, 1985).

CONCLUSION

In all, the study was able to state the extent of damage caused by crude oil spillage in Immiringi community in Bayelsa State. The study revealed that at different depth, the presence of magnesium and sodium are of limited quantity. These in turn would affect the fertility of the soil.

RECOMMENDATIONS

Finally, it was recommended that multinationals operating in host communities should keep in check monitoring teams that will respond quickly to emergency oil spill in the communities to avoid wide spread of crude on land.

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