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Determinants of Native Selenium Mobility and Bioavailability

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Selenium as an element occurs on the earths crust as metalloid element on average 0.09 µg/g, in association with sulfide as metal selenide [1]. Selenium is thought to exist in many soils in inorganic species [2]. Due to different geological conditions, selenium status in crops, animals and humans vary markedly around the world [1]. Selenium is important for human health [3]. Diets are the most important source of selenium [1,3], understanding biogeochemical controls on distribution and mobility of environmental selenium is the key to assessment of selenium related health risks. Both total amount and speciation is important in determining whether the concentration is of selenium in food crops are sufficient to satisfy animal and plant requirements [3].

Selenite and selenates may exist under some conditions in the same agricultural soils [4]. Between pH 4 - 8 selenium solubility is governed by adsorption, the hydroxyl ions are more effective in governing selenium ions adsorption capacity . In the pH ranges 3 - 10, selenates are the most predominant in soils [2]. The adsorption is positively influenced by Calcium carbonate, cat-ion exchange capacity, (CEC), organic carbon, but negatively influenced by high salt, alkalinity, and pH [5].

The Oxidation status of the soil and pH determines selenium species available for plant uptake [2,6]. These have been generalized into three categories; in high redox (pe+pH > 15.0) selenates predominates, in moderate redox potentials (pe+pH = 7.5 - 15.0) either selenite or biselenite (HSeO3-) predominates but is firmly adsorbed to iron, aluminium and hydroxides hence not bioavailable to vegetation and water logged low redox (pe+pH < 7.5) where monohydrogen selenide (HSe1-) tends to predominates [6].

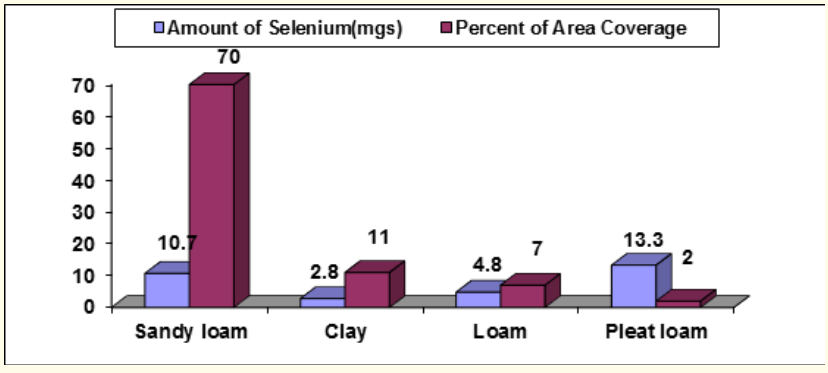

Figure: *Selenium levels in different soil types in Pala Bondo District, Kenya (source Otieno., et al. 2015).*

Selenates are weakly adsorbed by electrostatic forces in high redox conditions [2] and hence are highly bioavailable for uptake by plants and are also readily leached [7,8]. In acidic and neutral soils selenite is insoluble, while in neutral and alkaline soils selenates are highly bioavailable to crops [9,7,10] this is considered to be due to reduced capacity of clays and ferrous oxides caused by the increased pH [10] and exchange of hydroxyl ions for selenates (SeVI). At mV of +200 the selenites tend to be oxidized to selenates, and at mV of +450

solubility of selenates reaches maximum. Selenates constitute 95% of all dissolved selenium at pH 8.9 - 9.0 [2]. Selenides and selenium sulphides salts tend to exist in reducing, acidic and organic rich soils only, but due to low oxidation potential and solubility they are not bioavailable for uptake by crops [9].

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