

DOES GENDER AFFECT THE QUALITY OF SOIL AND VEGETABLE AMARANTH UNDER PERI-URBAN OF OSUN STATE, NIGERIA?

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ABSTRACT

Consumption of vegetables has been established to prevent cancer, hypertension and many other diseases. Cultivation of vegetables around cities is a lucrative venture and amaranth is fact becoming a leading leafy vegetable for commercial production under peri-urban in Nigeria. The system is a source of economic sustainability for many women and men. Fertilizer and water use efficiency for vegetable crops is greatly influenced by properties of the soil and knowledge of farmers. Amaranth plants samples were collected randomly from eight vegetable plots from Ile-Ife and Osogbo of Osun State, Nigeria. Soil samples were also collected directed from where plant samples were taken at 0-15 cm. Soil and plant samples were immediately transported to the Soil Testing Unit of the Obafemi Awolowo University, Ile-Ife. Farmers were interviewed on the types of fertilizers applied. Soil particle size distribution, pH, organic matter content and total nitrogen (N) were determined. Calcium, K, Na and P content of amaranth plants were also determined. Per cent sand was 63.10 and 50.00 % for soils from women and men plot, respectively. Per cent silt and clay, pH and organic matter content of soils were not significantly different. However, soil total nitrogen was 0.32% for men and 0.27% for women soils, which gave about 15.63% reduction in the value of total N for women. Amaranth vegetables from men plots contained significantly ($p < 0.1$) higher calcium content than that of women, whereas, phosphorus, potassium and sodium contents were not different. Potassium helps kidneys retain calcium, while a low K intake leads to increasing losses of Ca in urine. Increased vegetable consumption helps to preserve bones and fight the bone-thinning disease called osteoporosis. It was concluded that men have access to fertile soils than women. Nitrogen content of the soils was at high level. Men have better access to information and more financial resources to purchase mineral fertilizers than women. There is the need for research focusing on efficient nutrient and water use involving full participation of men and women vegetable growers for improved yield and quality of vegetable crops.

KEYWORDS: Soil properties, men, women, amaranth quality Gender.

INTRODUCTION

Leafy vegetables are valuable supplements to the diet for their protective agents containing protein, calcium, iron, carotene and ascorbic acid, and for their riboflavin, niacin, and thiamine contents, (Epenhuijsen, 1974, Onyango, *et al.* 2008). Leafy vegetables contain higher values of the components stated above than food grains. It could play a more important function in nutrition of little children and woman at reproductive stage. In Nigeria, vegetable amaranth (*Amaranthus* sp.) commonly named African spinach, bush green, *tete* varieties and Olorungbin (Epenhuijsen, 1974), is currently a leading leafy vegetable cultivated around cities of southwestern Nigeria.

After a long history of opposition, urban agriculture is gradually accepted as a solution to food shortages caused by adverse economic and climatic effects in West Africa. In the last two decades, vegetable production has become increasingly important in many West African capitals. It is the main source of income for an estimated 1000 to 3000 producers per capital, and benefits people all along the supply chain (Levasseur *et al.*, 2006). In Dakar, for example, urban production supplies 60% of all vegetables consumed in the city, and 15000 people are estimated to benefit indirectly from vegetable production. Due to the problem of land availability for vegetable production in the cities, available lands are intensively cultivated. The application of

fertilizers under this system to restore nutrients removed by vegetable crops is essential. It is widely reported that declining soil fertility, resulting from increasing soil nutrient depletion is the cause of falling food production per capita in Africa (Sanchez et al., 1997). Fertilizer use in Africa is less than 10% of the world average, fertilizers are either too expensive or not readily available, resulting in soil mining. In 1998, nutrient depletion in Nigeria (N + P + K) was 2.89 million tonnes, accounting for 35% of total depletion in Africa. Recently, Sheldrick and Lingard (2004) calculated the nutrient balance for Africa for the period of 1961-1998, it revealed nutrient depletion estimated at 17.4, 3.3 and 20.0 kg ha⁻¹ year⁻¹ for N, P and K, respectively.

Women play crucial roles in the food production chain in Nigeria. Women contribute about 70% of Agricultural labour force. They are close to nature, they harvest fire wood, fetch water and at the realm of water management and usage at household levels where water is used for cooking, washing, bathing and drinking. It was previously reported that men have better access to land with fertile soil, credit facilities, and information than women (Kunze *et al.*, 1998). There is limited information on gender perception to soil quality management and quality of vegetable cultivated under the system. It has also been observed that there is no substantial data to establish the arguments and lack of data could possibly be the reason why policy makers have not precisely come up with the best strategies to ball women out of these challenges. The aims of this paper are to (i) Compare some selected properties of vegetable amaranth grown soil of men with women; (2) Examine the interactive effects of gender and type of fertilizer use on soil properties and quality of vegetable amaranth.

MATERIALS AND METHODS

Plant and soil sampling

Based on farm surveys of eight women and ten men, given a total of 18 farmers, land management practices and the quality of the vegetable produced were investigated.

Vegetable amaranth (*Amaranthus hybridus*) samples were collected from vegetable plots cultivated for commercial purpose under wetland between October, 2007 and March, 2008. The farms were located in Ile-Ife and Osogbo, Osun State of Nigeria. Osun State lies between latitudes 5° 58'N and longitudes 4° 00'E, in the forest zone of southwestern Nigeria. The wet and dry seasons extend from April to October and November to March, respectively. The pattern of rainfall is bimodal, with the average annual rainfall estimated to be about 1400mm. The average monthly temperature ranges from 18.9 to 43.6°C and the mean monthly relative humidity is 61% and 83% for the early and late planting seasons, respectively.

Vegetable samples were uprooted randomly on each plot and labelled according to the fertilizer used and gender. Plant samples were immediately transplanted into the laboratory at the Department of Soil Sciences, Faculty of Agriculture, Obafemi Awolowo University, Ile-Ife, Nigeria.

The root of the plant samples were raised with distilled water and the plants were cut into 8cm long and oven dried at 65°C for 48h until a constant weight was obtained. The plant tissues consisting of roots, stems and leaves and kept in air tight polyethylene bags. Soil sample directly at the spot where vegetable plants were uprooted were also collected at 0-15cm depth. Soil samples were air dried, crushed and passed through 2mm sieve, the fractions that passed through the sieve was kept in polyethylene bag and stored for analysis.

Soil and plant analysis

Soil particle size distribution was determined using the modified hydrometer method (Bouyoucos, 1962) with 0.2M NaOH solution as the dispersing agent. Soil organic carbon was determined using the chromic acid digestion method of Walkley and Black (1934). The total nitrogen (N) concentration was determined using macro Kjeldahl method according to Bremner (1996).

Dried plant tissue was ground in a Wiley micro-hammer stainless mill to pass through a 1mm sieve (Piper, 1944; Aduayi, 1972). Before chemical analyses of the individual plant parts, a portion of each sample was re-dried at 105°C, placed in a desiccators and 0.5 g portion of ground plant tissue was ignited in a muffle furnace at 450°C for two hours (until ash was whitish/grayish white). The ash was dissolved in 5 ml of 4 N HCl solutions as described by Piper (1944). Phosphorus was determined by the vanadomolybdate method (IITA, 1979) using

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spectrophotometer (). Concentrations of Ca, K and Na were determined using flame photometer (Jenway PFP7, England). All soils and plant samples were treated in duplicate.

Data Analysis

All data collected were subjected to analysis of variance (ANOVA) to assess treatment effects and the significant differences between means were determined using Least Significant Difference (LSD) according to the methods of the SAS Institute (1990).

RESULTS AND DISCUSSION

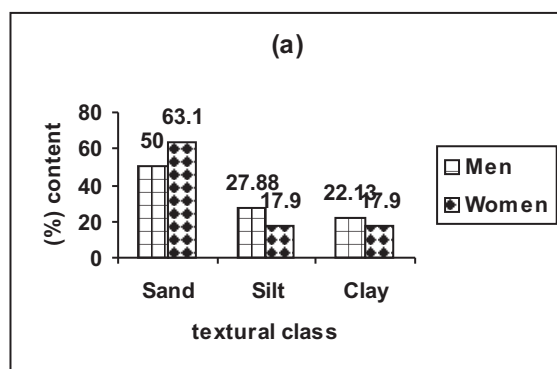
The traditional method of characterizing particle sizes in soils is to divide the array of possible particle sizes into three conveniently separable size ranges known as textural fractions or separates, namely sand, silt and clay. The sand is defined as particles ranging in diameter from 2000 μ m (2mm) down to 50 μ m (USDA classification) or to 20 μ m (IUSS Classification). Silt consists of particles intermediate in size between sand and clay, which, in turn, is the smallest sized fraction while clay fraction, with particle ranging from 2 μ m downwards, is the colloidal fraction clay particles, which have greater surface area per unit mass and its resulting physicochemical activity, clay is the decisive fraction which has the most influence on soil behaviours (Hillel, 1980). The results of this study indicated 12.90% high in sand which was significantly higher for vegetable land owned by women than men, while no significant effect was observed for silt and clay.

Soils of men are classified as loam while that of women are sandy loam. The class of soil called loam occupied a central location in the textural triangle. The term loam refers to a soil, which contain a balanced mixture of coarse and fine particles. Loam is often considered to be the optimal soil for plant growth and for agricultural production, as its capacity to retain water and nutrients is better than that of sand. Its drainage, aeration, and tillage properties are more favourable than those of clay. The suitability of the three sand, clay or loam could be determined by environment and plant species.

The soil pH and organic carbon content are not significantly affected by the farmer's gender. The average soil pH was 7.5 and organic carbon was 5.22, total nitrogen was 0.29. The results showed that the pH, organic carbon and total N are at adequate levels (Enwezor et al., 1988).

Interaction of Gender and Fertilizer type

The interaction of fertilizer type used and gender of farmers showed almost identical soil pH values for vegetable land owned by men and women with Urea, NPK and poultry manure treated. Organic carbon (OC) content was higher in the soil of men than women that used Urea. On the other hand, women soil with NPK contained higher organic carbon than the men own. The application of poultry manure gave similar values of OC



In this and other figures the bar represents LSD and OM = organic carbon TN = total nitrogen

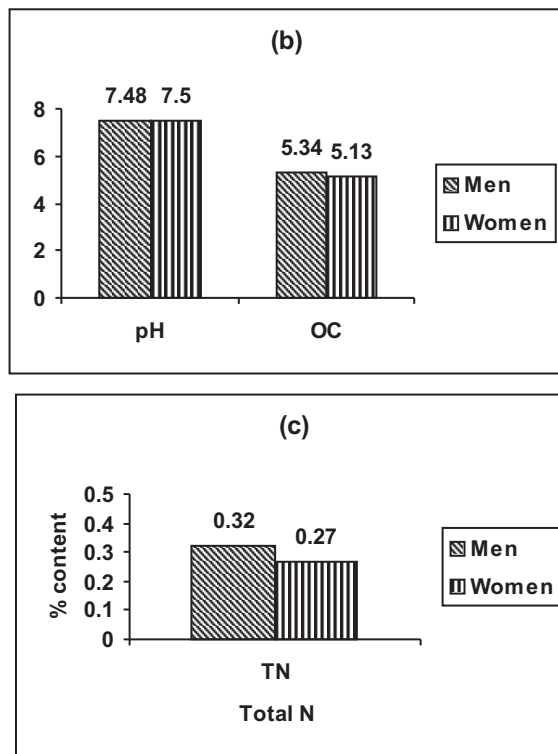


FIGURE 1: Effects of gender on (a) textural classes (b) pH and organic carbon content (%), and (c) total nitrogen of soils.

content for both men and women. Total nitrogen content was higher in men soils with urea and was identical with the soil that received poultry manure. About 55.10 and 30.23% reduction in OC and total N, respectively were obtained for urea treated lands. Only NPK application gave a higher value of 42.23% increase in total N for women's soils. These results are in line with the earlier study on organic carbon and total N for soil in the region. These results could be related to the amount of urea fertilizer used by the two farmers. The most widely use method of accessing nitrogen status of soils include the level of soil organic matter. Agboola and Corey (1973) related soil organic matter level to the nitrogen requirement of maize (*Zea mays*). It was indicated that nitrogen response was unlikely when soil organic matter was above 3.5% (organic carbon). Soil total nitrogen correlated with organic carbon, it is an acceptable indices of available N in southwestern Nigeria soil. It implies that N leaching and NH₃ volatilization could be higher from men farm land. The results also indicated that women farmer used more NPK fertilizer than men, and hence the higher soil organic carbon content. There is no difference in the soil (pH), organic carbon and total N among farmers on lands that received poultry manure (PM). This result could be due to equal access of farmers to PM, which they collect for free, except for the cost of transportation. This study assumed that the differences in soil properties are largely influenced by the amount of inorganic fertilizers applied.

Interaction of gender and fertilizer type on P, Ca, K and Na contents of plants

Figure 3 shows the effects of interaction of gender and fertilizer type on P, Ca, K and Na content of the

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amaranth plants (Fig 3 a-d). The interaction of gender and fertilizer type was significant on phosphorus ($p < 0.05$), calcium ($p < 0.01$) and sodium (0.05) content

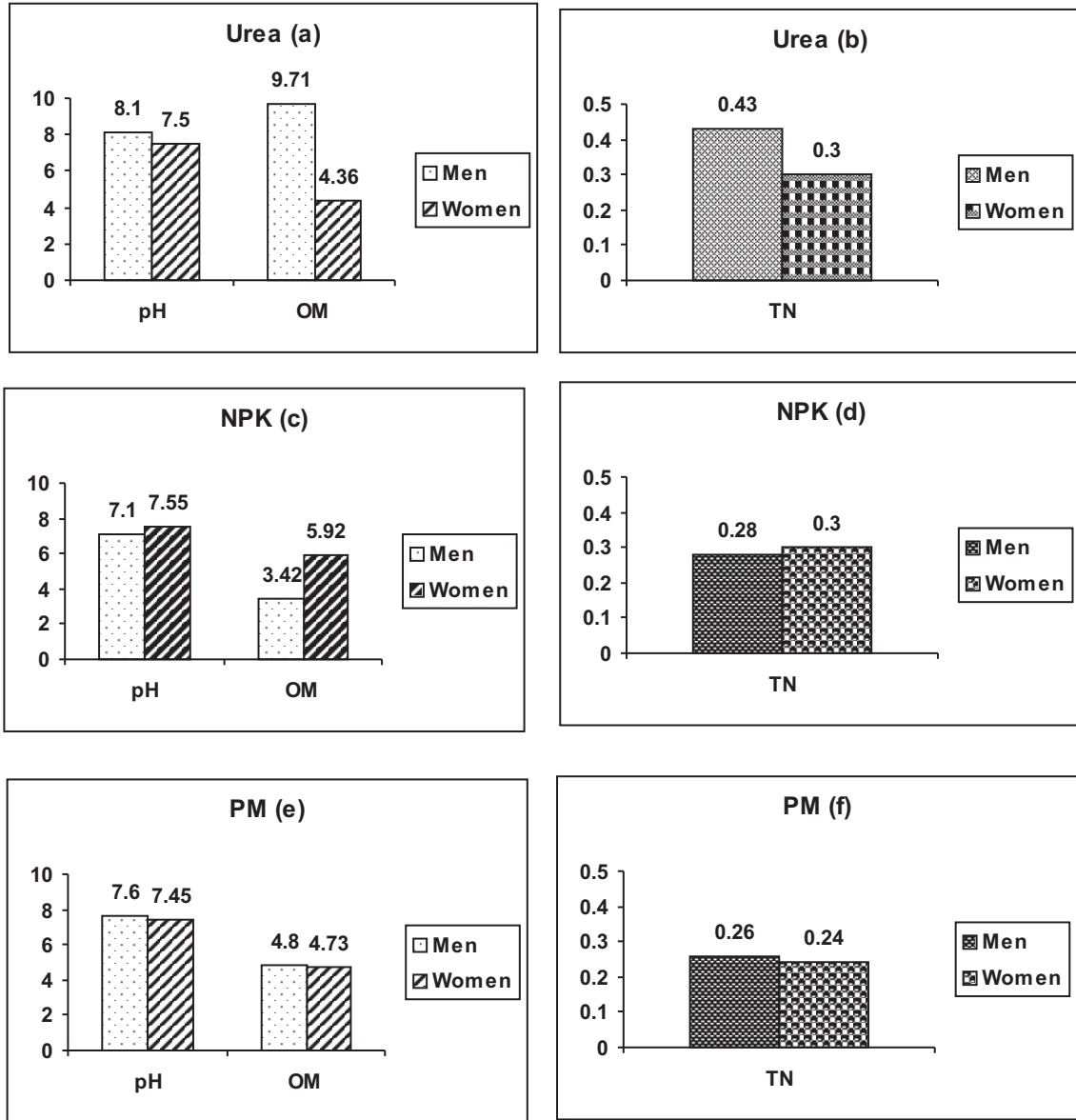


FIGURE 2: Effects of interaction between fertilizer types and gender on soil pH, organic matter content, total nitrogen of soils.

PM = poultry manure NPK = NPK (15-15-15)

but not significant on potassium content of the amaranth plants. Phosphorus content was significantly higher for men than women in Urea and NPK fertilizer treated vegetable, while values for poultry manure are almost identical. Calcium and sodium content of the plants have similar trends in plants that received urea. On the other hand, poultry manure has higher Ca content for men. The value of P, Ca, K, & Na obtained in the amaranth plant tissues are lower than the values reported by Akubugwo *et al.* (2008) for the leaves of the vegetable plants harvested from cultivated farm located in Ebonyi State of Nigeria. Who obtained 7.48, 54.01, 44.31 and 34.94 mg 100g⁻¹ for Na, K, Ca and P, respectively.

Sodium and potassium are important intracellular and extracellular cations. The Na/K ratios are important in determining the health status of an individual. A ratio of less than one has been recommended to prevent high blood pressure (FND, 2002). The values of Na/K ratio in the plant samples are less than one, indicating low risk of high Na content in the vegetables. Calcium/P ratio is another important component used to assess the quality of vegetable plants. Calcium and phosphorus are important in bone, teeth and muscle metabolism (Turan, 2003). Food is considered good if the Ca/P ratio is > 1 but poor if < 0.5 (Akubugwo *et al.*, 2008). The values obtained for Ca/P ratio in the study are high than 1, which implies that the Amaranthus plants are good.

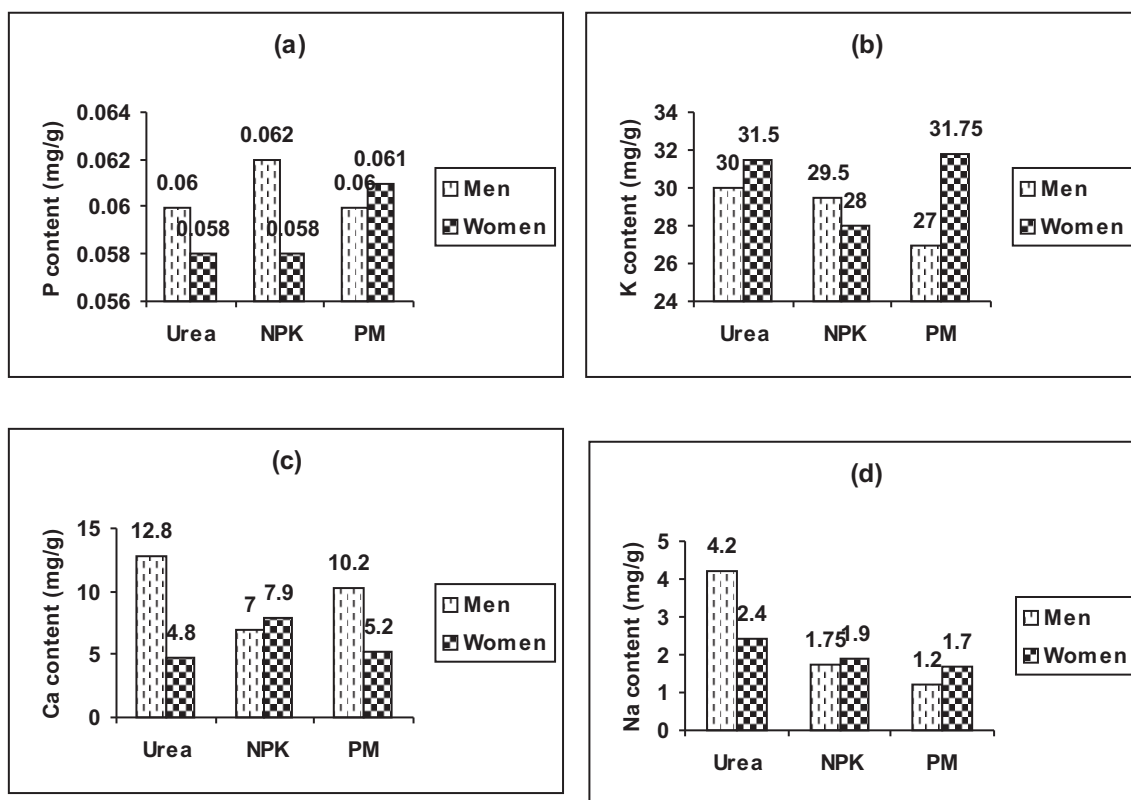


FIGURE 3: Effects of interaction between fertilizer types and gender on (a) P, (b) K, (c) Ca, and (d) Na contents of amaranth plant tissue.

CONCLUSION AND RECOMMENDATIONS

Many factors influence the contribution of women to soil conservation-soil conservation entails maintaining soil fertility and reducing soil losses (Omoro, 1998). This study showed that vegetable amaranth is a source of

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minerals such as calcium, potassium, sodium and phosphorus. The antioxidant properties of vegetables have been implicated in the prevention of aging related diseases such as cancer, arteriosclerosis, diabetes (Hertog *et al.*, 1992) and in the management of HIV/AIDS. Osteoporosis is a skeletal disorder characterized by compromised bone strength which puts many women at an increased risk of fracture. Potassium helps kidneys retain calcium, while a low K intake leads to increasing losses of Ca in urine. Increased vegetable consumption helps to preserve bones and fight the bone-thinning disease called osteoporosis. Maintaining fertilizer regimes that ensure a balance in K and Ca concentration in vegetable plants is very paramount.

It has been demonstrated that commercial production of traditionally leafy vegetables by small scale enterprises can be a viable business model (Besong *et al.*, 2001). Commercial production can serve as a useful tool for poverty reduction for women with little capital. The revenue generated from vegetable cultivation by women could contribute significantly to food security, access to family health care, and to attaining a degree of financial independence from their husbands. However, men have access to land with good fertility than women. It confirms the previous observation by Kunze *et al.* (1998) in Burkina Faso, that women receive land of lower quality than men. It is therefore, recommended that:

- i. Land ownership and tenure system should be reviewed to give men and women farmers equal access to fertile lands.
- ii. Incorporating teaching the techniques of soil fertilizer management for urban vegetable production into primary and secondary school students' agricultural curriculum could have positive effects on educating women, children will teach their mothers.
- iii. There is a growing demand for organically grown and good quality food crops worldwide. Furthermore, organic matter is a very important factor in maintaining the fertility of Nigeria soils, which are located at the tropical regions. Management of domestic solid wastes is a serious problem for Nigerian government. Indiscriminate disposal of the waste is a threat to human health due to, flies and offensive odour arising from dumping sites, and flood resulting from wastes dumped in runoff when rain is falling, which consequently block drainage channels. The organic fraction of domestic solid wastes, which is about 78%, is a good source of organic fertilizer. If the wastes are sorted from the kitchen, the organic fractions could be developed into high quality organic fertilizer. It is the organic fraction that makes the incineration of municipal wastes complicated. Sorting the wastes from the source does not place additional demand on women.
- iv. The access of women to credit facilities, extension information and farm input such as fertilizers needs to improve. Government needs to pay more attention to peri-urban vegetable production by influencing Banks to reduce the co-lateral securities and interest on loans for vegetable farmers. Farmers prefer to applied urea than NPK since, the price of mineral fertilizer is very high, and urea is cheaper than NPK. The application of high level of urea place more demands on potassium and water, it also makes the plant susceptible to diseases. It was observed that farmers apply pesticides unguardedly on vegetable plants for pest control. Both the consumers and vegetable growers have no enough knowledge of the negative impacts of unguarded application of fertilizers and pesticides on health and environment. There is the need for urgent local, regional and national research projects that will involve the participation of farmers and researchers on this subject.

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REFERENCES

- Aduayi, Emmanuel. (1972). Effect of copper sprays on the mineral nutrient content and growth of arabica coffee seedlings in Kenya. *Communications in Soil Science and Plant Analysis* 3 (4): 323-328.
- Agboola, A. A. and Corey, R. B. (1973). Soil testing calibration for NPK for maize in soils derived from metamorphic and igneous rocks of Western Nigeria. *Journal of West Africa Science Association*. 17: 93-100.
- Niger Agric. J. 40 No. 1 (2009): 312 - 320

- Akubugwo, I. E; Obasi, N. A; Chinyere, G. C. and Ugbogu, A. E. (2008). Mineral and Phytochemical contents in leaves of *Amaranthus hybridus* L. and *solanum nigrum* L. subjected to different processing methods. *African Journal of Biochemistry Research* 2(2); 40-44.
- Besong, M., P. Samalang, and C. Abia (2001). Commercialisation as an incentive and threat for *Gnetum* spp in Cameroon, Incentive measures for sustainable use and conservation of Agrobiodiversity, Lusaka-Zambia.
- Bouyoucus, G. H. (1962). Hydrometer method improved for making particle size analysis of soils. *Agronomy Journal*. 54: 464-465.
- Bremner, J. M. (1996). Total nitrogen. In: *Methods of Soil Analysis: Chemical Method*. ed. Sparks, D. L. Part 3. 1123-1184. Wisconsin, USA: SSSA, ASA, Madison.
- Enwezor, W. O., Udo, E. J., Ayotade, K. A., Adepetu, J. A. and Chude, V. O. (1990). A review of soil and fertilizer use research in Nigeria. Federal Ministry of Agriculture, Water resources and Rural Development. 109-200. Lagos.
- Epenhuijsen, C. W. van (1974). *Amaranthus* sp. In: *Growing native vegetables in Nigeria*. 30- 35. Rome: Food and Agriculture Organization of the United Nations.
- FND (2002). Food and Nutrition board; Dietary reference intake for Energy, Carbohydrate, Fibre, Fat, Fatty Acids, Cholesterol, Protein and Amino acid (micro-nutrient). Institute of medicine. *National Academy of Sciences*. The National Academies Press, Washington D. C. pp. 107-967
- Hertog, M. G. L., P. C. H. Hollman, and M. B. Katan (1992). Content of potentially anticarcinogenic flavonoids of 28 vegetables and 9 fruits commonly consumed in The Netherlands. *J Agric Food Chem* 40: 2379-2383.
- Hillel, Daniel. (1980). Texture, particle size distribution and specific surface. In: *Fundamentals of soil Physics*, 55-68. New York: Academic Press.
- Idowu, Mary. and Aduayi, Emmanuel. (2006). Effects of sodium and potassium application on water content and yield of tomato in southwestern Nigeria. *Journal of Plant Nutrition* 29 (12): 2131 - 2145.
- Kunze, D, Waibel, H. & Runge-Metzger, A. (1998). Sustainable land use by Women as Agricultural Producers? "In: *The case of northern Burkina Faso. Towards sustainable*.
- Land use*, ed. Blume, H. P; Eger, H; Fleischhauer, E. Hebel, A. Reiji, C and Steiner, K. G. (Eds.) II. Advances in Geoecology 31. Germany: 1469-1478. A cooperating series of the International Society of soil Science (ISSS). ISCO & CTA.
- Kuo, S. (1996). Phosphorus. In: *Methods of Soil Analysis. Part 3. Chemical Methods*. ed. Sparks, D. L. 869-920, Wisconsin: SSSA and ASA. Madison
- Levasseur, V; Pasquini, M. W; Kouame, C. and Temple, L. (2006). A review of urban and peri-urban vegetable production in West Africa. *ISHS Acts Horticulturae* 763:

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http://www.actahort.org/members/show_pdf?booknr&nr=762_23 (accessed June 29, 2009).

- Omoró, L. M. A. (1998). Women's Participation in soil conservation constraints and opportunities. The Kenyan Experience. In: *The case of northern Burkina Faso. Towards sustainable land use*, ed. Blume, H. P; Eger, H; Fleischhauer, E. Hebel, A. Reiji, C and Steiner, K. G. II. *Advances in Geocology* 31. 1463-1468. Germany: A cooperating series of the International Society of soil Science (ISSS). ISCO & CTA.
- Onyango, C. M, Shibairo, S. I, Imungi, J. K. and Harbinson, J. (2008). The physiochemical characteristics and some nutritional values of vegetable amaranth sold in Nairobi-Kenya. *Ecology of Food and Nutrition*. 47:382-398.
- Piper, C. S. (1944). Dry ashing. *Soil and Plant Analysis*. Interscience Publishers Inc., New York. 221-222.
- SAS Institute. (1990). SAS users' guide: Basics, 1990 ed. SAS Inst., Cary, N.C.
- Sheldrick, W. F. & Lingard, J. (2004). The use of nutrient audits to determine nutrient balances in Africa. *Food Policy*, 29:61-98.
- Tekalign, T., Haque, I. & Aduayi, E. A. (1991). Soil, plant, water, fertilizer, animal manure and compost analysis manual. *Working Document No. B13. International Livestock Centre for Africa*. Addis-Ababa, Ethiopia. 260.
- Thomas, G. W. (1996). Soil pH and soil acidity. In: *Methods of Soil Analysis Part 3*, ed. Sparks, D. L. 475-490. Wisconsin: SSSA and ASA. Madison
- Turan M, Kordali S, Zengin H, Dursun A, Sezen Y (2003). Macro and Micro-Mineral content of some wild edible leaves consumed in Eastern Anatolia. *Acta Agriculture Scandinavica, Section B, Plant Soil Science* 53: 129-137.
- Walkley, A. & Black I. A. (1934). An examination of the Degtareff method for determining soil organic matter and a proposed modification of the chromic acid titration method. *Soil Science*. 37:29-38.
- Sanchez, P. A; Shepherd, K. D. Soule. M. D; Place, FM, Buresh, R. J; Izac, A, - M. M; Mkwunye, AU; Kwasiga, FR, Ndirity, C. G; Wooners PL. (1997). In: *Soil fertility replenishment in Africa; an investment in national resource capital*. ed. Buresh, R. J. Sanchez, P. A; Calhoun, F., . 1-46. Special publication number 51, America: Soil Science Society of America.