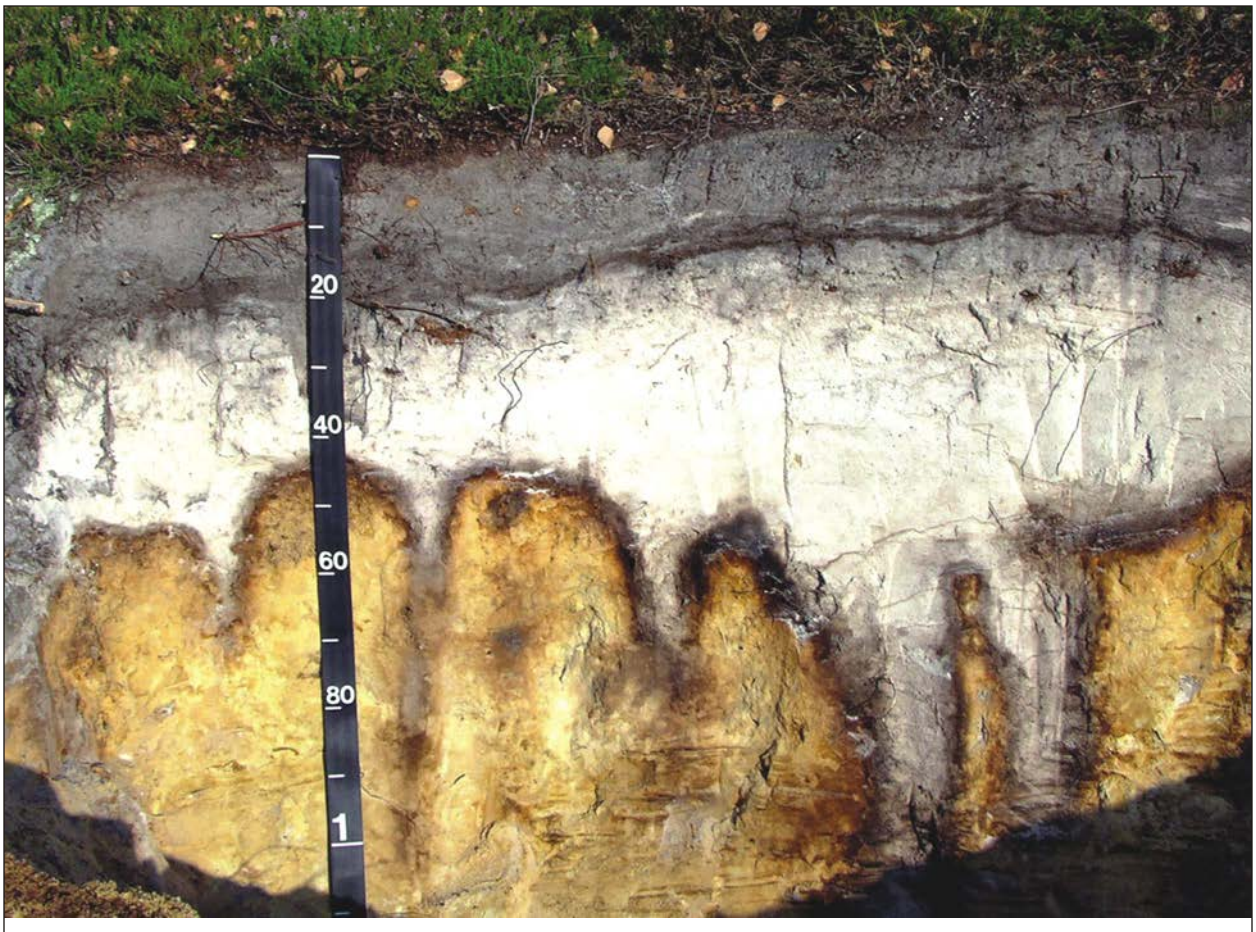

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Integrated Plant Nutrition Management: A Panacea for Sustainable Crop Production in Nigeria

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ABSTRACT

This study reviews the need for Integrated Plant Nutrition Management (IPNM) around the efficient use of combining locally available and environmentally feasible agro-wastes with low level of mineral fertilizers for soil fertility maintenance and crop production in Nigeria. Integrated application of combined agro-wastes and mineral fertilizers complement each other in term of nutrients release. Research findings indicate that little has been done to transfer the technology to the peasant farmers who produce the bulk of the food in the country. Efforts should be made towards IPMN in order to increase food production that can feed the teaming population. Adequate soil map should be generated to reduce fertilizer abuse.

Key words: Agro-wastes, soil, fertility, mineral fertilizers

INTRODUCTION

A nation that cannot feed its citizens is not only a weak nation but has no justification for continued existence. Virtually, in every part of Nigeria, food availability has played and continues to play a key role in overall socio-economic development (Adeleye, 2002). It is the goal of many farmers in Nigeria to produce sustainable high yield of crops. However, decrease in soil fertility after few years of cropping is a major limitation. The soils mainly Alfisols and Ultisols are composed of low activity clays characterized by low nutrient content, low pH, low organic matter content and high susceptibility to erosion (USDA, 1975). Application of chemical fertilizers constitutes a practice by farmers in attempt to correct the deficiencies of nutrient elements. The case of significant increase in fertilizer consumption and increase in crop production in Nigeria is obvious from all the researches carried out so far. The main problem is that, though, demonstrated yield increases from chemical fertilizer is not deniable, fertilizer costs remain high. At the farm level, inefficient distribution systems often prevent fertilizer being available. The result is often higher price and low yield that does not commensurate with the purchased price. Potential profitability is, however, often affected by other fundamental problems such as high rates of their application without soil test where available. This adversely affects the soil chemical and physical properties causing nutrient imbalance, increase in soil bulk density and low infiltration rate (Nottidge *et al*., 2005a). These factors hinder the uptake of nutrients by plants.

Apart from the fact that the soils are acidic as a result of their parent materials, weathering and leaching (Obi and Ekperigin, 2001), the continuous use of acid-forming fertilizers like sulphate of ammonia, urea and ammonium nitrate also contributes significantly to soil acidity. Thus, the need to focus on alternative sources of nutrients that will be less damaging to the soil becomes imperative. Many workers have suggested the use of organic manures. Farm wastes are been recycled and combined with chemical fertilizers by researchers but has not been appreciated by

both the peasant farmers and Nigerian governments. In Southwestern Nigeria, many organic types of manure such as pig manure, goat dung, cattle dung and poultry manure are in abundant but poultry manure has been used more than any of these manures by researchers. These manures especially poultry manure are rich in organic matter. Their use as organic fertilizers enhances soil productivity but they have their own limitations that hinder optimum production of food that can guarantee the teaming population. The increase in the cost of animal feeds, transportation problems and for the fact that majority of the farmers are not interested in animal keeping especially poultry production as a result of the risks involved, limit their use as fertilizers. However, the huge amount of these organic wastes required for field crop production and handling problem also make them not suitable as substitute to mineral fertilizers. Organic manure vary in nutrient composition depending on the source and handling procedure, supply mainly N, P, K, Zn, Fe, Cu, Mn and B although, large quantities of animal manures would be required to produce large nutrient inputs to the soils. In Ghana, Jackson (1999) found that to correct Zn deficiencies of soils near Wench, about 20 t ha^{-1} of poultry manure were required. The amount of sheep or cattle manure required was estimated to be between 40-60 t ha^{-1}. In farmer surveys in the villages of Akrobi, Bepyease, Manso and Dawomo in Ghana, Kiff *et al.* (1997) noted that farmers knew of the availability of manure, but often felt that they were regressive, that supply was unreliable and that it was too much effort to collect. These combined factors made the use of manure generally unattractive to farmers. Though, recently there has been boost in poultry business in urban areas in Nigeria and huge poultry waste dumps are found lying waste (Adediran *et al.*, 2003) yet they are not still enough and many farmers are not ready to make use of them.

There is also increase interest in the use of plant residues from plant as sources of plant nutrients especially phosphate and potash fertilizers (Ojeniyi, 1995). These materials are often considered less likely to have detrimental effect on soil physico-chemical properties compared with mineral fertilizers but their uses are also limited by the large quantity required to meet crop nutritional needs due to their low nutrient content and time lag to mineralize. Examples of such plant residues are cocoa pod, kola husk; *Azadracta* leaves (neem), glriccidia, oil palm bunch, sunflower etc. For example, cocoa farmers in Nigeria are handicapped as to the best way of disposal of the huge amount of cocoa pod husks that serve as inhabitant for some destructive pathogens such as *Phytophtora palmivora* in their cocoa farms. About 800, 000 tonnes of cocoa pod husk are annually generated in Nigeria and often wasted (Egunjobi, 1975). It is advised the husk be burnt into ash as a method of sanitation and for the control of black pod disease of cocoa. Oil palm bunch is also a problem to the farmers as their presence harbours venomous animals e.g., snakes.

Hence, neither mineral fertilizer nor organic manure is a panacea to soil fertility management (Agboola and Unamena, 1989). Both mineral fertilizers and organic manures have their own roles to play in soil fertility management but none can solely supply all the nutrients and other conditions of growth for producing crops that can feed the teeming population (Uyobisere and Elemo, 2000).

In Nigeria, some attempts were made to investigate the combined effect of cow dung, poultry manure and swine manure with mineral fertilizers (Ayeni *et al.*, 2008; Ayeni and Adetunji, 2010; Adeleye and Ayeni, 2010; Ayeni, 2010) on soil chemical properties and maize yield as well as tomato and found more positive responses than when not combined in Southern Nigeria. Uyobisere and Elemo (2000) combined locust bean (*Perkia bigobosa*), neem (*Azadirachta indica*) and three rates of NPK fertilizer at 0, 1/2 and 1/4 of the optimum recommendation of 120-60-60 in an experiment conducted to show the effect of foliage of locust bean and neem on soil fertility and productivity of

early maize in savanna Alfisol of Northern Nigeria. Different organic wastes have also been combined with positive results. For example, Ayeni *et al.* (2008), Ayeni (2010) and Adeleye and Ayeni (2010) combined cocoa pod husk ash and poultry manure and got positive response on maize yield and increase in soil fertility when low level of cocoa pod ash was combined with poultry manure. Also worked on integrated application of organominer fertilizer and kola pod husk on growth, quality and yield of *Amaranthus cruentus* L. and got more positive result than when they were singly applied in Southwestern Nigeria.

BRIEF DESCRIPTION OF NIGERIAN SOILS

The USDA soil map of the world (Arkceson *et al.*, 1968; USDA, 1975) classified most of Nigerian soils on basement complex Alfisols and on sand stones as Ultisols. This generalized grouping tends to suggest basic similarities in the soil reaction processes with reaction intensities only modified by climatic and vegetative differences. According to Ojeniyi (1995) and Agboola *et al.* (1992), soils in Nigeria suffer deficiencies common to tropical soils. These include low organic matter content, shallow depth and high acidity. About 63% of the agricultural soils in Nigeria are low in productivity and over 90% are Alfisols and Ultisols that are low in organic matter and have low activity clays. He also maintained that about 35% of soils in Eastern Nigeria are made up of acid sands that have more than 60% sand in surface horizon and cations such as Ca, Mg and K that are easily leached causing Al and Mn toxicity. Most of Nigerian soils are acidic due to the nature of their parent materials, leaching and weathering (Ano, 1990). Kang and Osiname (1972) reported that micronutrients such as Zn, B and Cu are lacking in soils of several parts of Nigeria. Nitrogen, sulphur, zinc and boron are the main nutrients limiting soil fertility for maize in Southwestern Nigeria soils. The level of these elements is inadequate for good growth and yield of maize, even in a newly opened land (Adetunji, 1991).

Agboola and Sobulo (1981) and Sobulo and Osiname (1987) reported that well drained soil profiles near the forest-savanna fringe in Southwestern Nigeria tended to have higher values (means 1.6%) of organic carbon in their surface horizons than the savanna region with about 0.8% on the average. They observed as one moves from the South to the North, the amount of organic matter declines. This is because as amount of rainfall decreases, the amount of organic matter decreases. Generally, savanna soils have lower N status and wider C/N ratio than forest soils that greatly affect N availability (FPDD, 1990). In Nigerian soils, N and P are the most limiting nutrient. Soils under savanna vegetation have higher K contents than soils in forest region (Akinrinde and Obigbesan, 2005). Nigerian soils vary widely in their content of total S as reported by various workers cited by FPDD (1990). The recommendations were 45-180 and 170 ppm for Southwestern Nigeria. Reported 44-134, 101-295 and 117-489 ppm for guinea savanna in the North, derived savanna and forest soils of the South, respectively. Continuous cultivation of land using mechanized methods in Nigeria and other tropical regions, soils deteriorate very fast with the loss of organic matter and soil structure. Once the vegetation is removed (Zake, 1993), the soils are subjected to increased intensive rate of weathering and excessive leaching of nutrients and degradation in soil structure and nutrient status to decline in soil organic matter. Appropriate management methods must be adopted to sustain the productivity of soils without degrading the soil physical, chemical and biological quality for high crop productivity. Among the management methods will include integrated plant nutrition measures centers on local available materials.

Effects of organic and mineral fertilizer combinations on soil fertility and yield of crops: Studies carried out in Southwest Nigeria recommended combinations of farmyard manure and NPK

fertilizer intercropped in Nigeria. Organomineral fertilizer is an organic fertilizer currently under investigations. Results have indicated that it promotes high crop yields when used in combination with inorganic fertilizer (Chude, 1999).

Research findings have convincingly shown that, it is the use of inorganic fertilizer in combination with organic materials that gives higher and sustainable crop yields than using either inorganic fertilizer or animal manure alone (Agbim and Adeoye, 1991). Nottidge *et al.* (2005b) conducted an experiment on comparative effect of plant residues and NPK on nutrient status and yield of maize in a humid Ultisols. There result showed that wood ash, pea nut residues and NPK combinations gave higher dry matter yields and leaf N, K, Ca and Mg contents compared with each treatment applied alone. In another experiment (Nottidge *et al.*, 2005b) showed that ash and peanut combined reduced soil bulk density and increased aggregate stability and porosity.

The application of 300 kg ha^{-1} NPK, 7 t ha^{-1} poultry manure and six combinations of reduced level of NPK showed that maize performed better when organic and mineral fertilizers were combined at a reduced quantity (Adeniyan and Ojeniyi, 2005). Application of combined use of Organic Based Fertilizer (OBF) and urea at 2 t ha^{-1} OBF and 90 kg ha^{-1} urea was more superior to application of either of the fertilizer alone.

It is shown that 20 t ha^{-1} organic manure in addition with 2.4 t ha^{-1} crushed rock waste material significantly increased maize yield in an Ultisol. Combined application of reduced quantities of poultry manure and NPK fertilizer tended to give better residual effect on soil and leaf nutrient content and maize yield than fertilizer alone. The effectiveness of cow dung, poultry dropping, oil palm sludge, Calcium Ammonium Nitrate (CAN) and urea with their combinations on soil chemical properties and maize yield have been reported (Nnadi *et al.*, 2004). The organic wastes combined (i.e., combination of poultry manure, oil palm sludge and urea) increase the soil pH, organic matter, total N, Bray-1- P and exchangeable Mg and K values while the mineral fertilizer reduced the values of these soil properties.

The common problems associated with both chemical fertilizer and organic manure when singly applied could be eliminated by integrating the good qualities in each material in order to achieve a better interaction effects (Kulkarne and Kulkarne, 1982). There is no justification in wasting scarce resources on chemical fertilizer, which does not justify the ends. The cost of procuring chemical fertilizers in Nigeria has gone beyond the reach of the peasant farmers. Cost reduction is ensured under the integrated fertility management approach because only small quantity of chemical fertilizers is required with animal manure.

A lot of money is being spent on liming acid soil without significant improvement. Therefore, the complementary use of these fertilizers would maintain a stable pH level in the soil. However combining residue incorporation with judicious fertilizer use is more likely to provide the most effective and efficient means of maintaining soil productivity and sustained crop yields in the humid tropical environment (Adetunji, 1997).

CONCLUSION AND RECOMMENDATION

Food is the basic necessity of human being which he must not be denied. A country that could not feed herself serves as dumping ground for other better nations. The population of Nigeria is increasing daily while the death rate is decreasing as a result of better health care delivery system than ever before. The oil boom of 1970s in the country is fading away as many countries are now refining oil and other substitutes that could reduce the use of petroleum to the barest minimum. The groundnut peak in Northern Nigeria that used to serve as export crop which generate revenues to the country has become an old story as a result of poor soil fertility which leads to poor

yield of groundnut. Cocoa farms are left with moribund trees with little or no effort to resuscitate them. Nigeria is still using a generalized soil map which could not state specifically which particular place or region is suitable for a specific crop. This has resulted in indiscriminate application of mineral fertilizers which poses more risk on the fragile soil. Awareness has not been adequately created by individual or government agencies as to the use of integrated plant nutrition management for soil fertility and optimum crop production.

It is expedient to go back and make amendment to the soil by making use of available local resources to improve its fertility before the situation gets out of control.

Government at all levels, are advised to make scientific findings released by researchers as one of their priorities in their program.

Farmers need technical education on how to make use of the available land for crop production through judicious use of combined fertilizers through on farm adaptive research so as to preserve the soils.

Comprehensive soil map is required indicating soil types and nutrient requirements of each crop suitable for each locality or region.

There is need to stop wasting organic materials that could be used to increase soil nutrients.

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