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Roles of Micronutrients in Organic Rice Production

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ABSTRACT: The role of micronutrient in organic Rice production was investigated in Ihitte Uboma LGA using Lowa and Ikperejere Rice producing plots. Organic Rice producing paddies and non-organic Rice producing paddies in Lowa and ikperejere were sampled during and after rice harvest. The sources of organic enhancement used by the farmers were poultry droppings, cow dung and pig waste which were occasionally mixed with wood shavings. And these are sources of nutrients as well as organic matter. Two (2) rice paddies in Lowa and Ikperejere area in Ihitte Uboma L.G.A in Imo state were used. Fallow (control) soil were sampled also for comparism. Samples were randomly collected from depth of 0-30cm using spade. The micronutrient investigated were Zinc, Copper, Iron and Molybdenum. AAS was used to analyze Micronutrients and physicochemical was done routinely. Rice were harvested at maturity. The findings indicated that organic rice cultivation significantly increased the concentrations of the micronutrients (Zinc, Copper, Molybdenum and Iron(40 Zn, 36 Cu, 10 Mo and 23 Fe mgkg1) elements investigated compared with the control Zn 15, Cu 12, Mo 8 and Fe 10 $Mgkg^1$ and non-organic paddy (13 Zn, 8 Cu, 5 Mo and 8 Fe $mgkg^1$ respectively. In all case, the nutrient levels are not below critical micro nutrient levels at which deficiency may occur. Further findings on yield indicated that organic plots performed better with mean yield value of 740 kg per hectare compared with 639 kg yield per hectare from non-organic plot. The yield advantage could be attributed to addiction of organic matter which not only supplies nutrients in forms needed by plants but also helps in water and nutrient holding and release, create site for soil biota activities and formation of chelates for micronutrients availability to plants. The soil is of moderate fertility.

KEYWORDS: Micronutrients-Roles Organic-Rice –Farming

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1. INTRODUCTION

Micronutrients are just as essential as macronutrients but are required by plants in small quality or amount. There are eight essential micronutrients needed by plants which include; Iron (Fe), Zinc (Zn) Copper (Cu), Manganese (Mn), Boron (B), Chloride (Cl), Manganese (Mo) and Nickel (Ni). Soil vary widely in their micronutrients content and ability to supply micronutrients in quantities sufficient for optimal crop growth (Solberg*et al*., 1999). If any element is lacking in the soil or not adequately balanced with other nutrients, growth suppression and, or even death may result (Mangel *et al*., 2001).

Micronutrients often act as co-factors in enzyme system and participate in redox reactions, in addition to having several other vital functions in the key physiological processes of photosynthesis and respiration (Marschner, 1995; Mangel*et al*., 2001, and their deficiency can impede these vital physiological processes thus limiting yield grain. For example Boron (B) deficiency can substantially reduce yield in wheat With rice, Zinc deficiency is a major yield –limiting factor in several Asian countries (Westerman, 1990)). Many studies (Jacobsen and Jasper, 1991, Akirinde and Obigbesan, 2000) have revealed micronutrient deficiency in crops.

Researcher have also shown that the adverse effects of Micronutrients deficiencies include stress in plant, thereby resulting in low yield and quality, damage plant morphological structure (Benneth, 1993).

Therefore knowledge about the availability of micronutrients in the soil is paramount, as this will help to boast not only rice production, but other major crops.

Because Rice is one crop that is almost universally eaten, ways of improving production is critical.

2. MATERIALS AND METHOD

2.1 Study area

Rice producing areas in Lowa and Ikperejere in Ihitte Uboma LGA, Imo State were used. Organic rice production and non organic rice production fields were used.

The Micronutrients investigated includes Zinc (Zn), Copper (Cu), Molybdenum (Mo), Iron(Fe), Control (Fallow land).

2.2 Soil Sampling

Random collection of representative soil sample was done (Brown, 1987). Sampling was done with the aid of spade at a depth of 0-30cm since it is noted and showed that surface soils are better indicator of trace element concentration (Nyanagababo and Hamya, 1986).

Two(2) rice producing sites were sampled. Organic producing field and non-organic rice producing field. Fifteen samples were collected from each Site and 5 samples each were bucked for 2 composites replicates. Samples were emptied into a plastic envelop respectively. The control were sampled from 15 fallow lands, from each of the sites. The sample were bucked for composite samples.

2.3 Sample Preparation and Laboratory Analysis

Soil Sample Analysis: Soil samples were spread on clean and dry paper sheet for air drying, and crushed in clean ceramic mortar using a small ceramic piston. The samples was sieved with a 2-mm sieve to get a fine soil fraction. (Nelson and Sommers, 1982). The fine soil fraction was used to extract micronutrient using DTAP method (Lindsay and Novell, 1978). A 10g of soil sample was mixed with 20ml DTPA (0.05m-adjusted to pH 7.3) with TEA), then a mechanical shaker was used to shake the mixture for about 30-45minutes before filtering through whatman No.1 fitter.

The filtrates were analyzed for micronutrient (Cu, Zn, Mo, Fe) on Atomic Absorption spectrophotometer (AAS) (Adepetu, 1990).

Soil pH: Was determined in distill water (1.2.5 soil water using glass electrode pH meter

Organic Carbon: Was determined by multiplying organic Carbon by 1.724 (Van Bemellen's Factor)

Exchangeable Acidity: Was determined by the titration method (Mclean, 1982).

Cation exchange capacity (CEC): Was determine using summation method (Nelson and Sommers, 2005).

Particle Size Distribution: Was determined using hydrometer method of mechanical analysis

Base Saturation: Was calculated by dividing total exchangeable bases by effective cation exchange capacity value and multiplied by 100.

Total Nitrogen: Was determined using Kyeldahl method (Bremmer and Muvaney, 1982).

Available Phosphorus: Was determined using Bray 2 method

Effective Cation Exchange Capacity: Was determined using summation method that is exchangeable base plus exchangeable and Expressed in Cmolkg^{-1}.

2.4 Data Analysis

The data collected were summed and divided to produce means, respectively. Means were separated using the Least Significant Difference (LSD) according to Snedecor and Cochran (1980) and comparisms were made with results from the control and permissible limits.

3.0 RESULTS AND DISCUSSION

The chemical Property of the Soil.

Table 1 showed the concentrations of major fertility parameters. There is marked significant differences between sources and organic field seems higher in some parameters followed by fallow plots when compared with non-organic plot. Generally, the location is of moderate fertility.

Table 1: Chemical Properties of Soils of different field

Sites	pH $_{(H20)}$	pH$_{(KCl)}$	% OC	% OM	gkg-^{1} TEA	Cmolkg-^{1} AL	Cmolkg-^{1} H
Organic	6.43	5.53	2.09	3.61	1.20	0.80	0.40
Non Organic	6.26	5.61	1.55	1.55	1.60	1.10	0.50
fallow (control)	5.28	5.00	1.47	2.06	1.40	1.00	0.40

	gkg-^{1} TN	gkg-^{1} Ca	Cmolkg-^{1} Mg	Cmolkg-^{1} K	Cmolkg-^{1} Na	Cmolkg-^{1} CEC	% BS	P mgkg-^{1}
Organic	0.18	4.00	1.80	0.16	0.17	6.08	83.60	16.36
Non Organic	0.13	4.00	2.40	0.22	0.14	8.31	80.70	7.11
fallow (control)	0.10	3.20	2.40	0.24	0.10	7.34	80.90	5.63

3.1 Micronutrient Content

The result of micronutrients were shown in table 2.

Rice cultivation significantly reduced the elements studied except in organic rice paddy. This was supported by many researches that showed low levels of micronutrients in soils of tropical region (John *et al.*, 2005). This is evident when compared with control

Table 2. Micronutrient Content as influenced by Rice production

Sources	Zn	Cu	Mo	Fe
	……………………………………………………….Mgkg^{1}………………………………………………………….			
Organic	40	36	10	23
Non Organic	13	8	5	8
Control	15	12	8	10

Key Zn Zinc, Cu Copper, Mo Molybdenum, Fe Iron.

3.2 Rice Yield

The yield is significant different between plots. Organic rice plots have mean yield value greater than non-organic plot. The yield is significant different between plots involved. Organic plots performed better than non-organic plot except for plot ii. This is an indication that synthetic fertilizer when adequately applied is capable of given corresponding yield advantage all things been equal.

Table 3. Rice yield (kg per hectare)

Sources	Paddy i	Paddy ii	Paddy iii	Paddy iv	Mean
	Yield inKg				
Organic	857	562	697	846	**740**
Non Organic	599	792	538	627	**639**

It is known that long term cropping affect the availability of soil micronutrients (Ward, 1995).

However, poor management of plant nutrients can leads to decrease in yield production. It is found that the application of micronutrients such as zinc, copper, manganese and Boron is not a usual practice. A marked incidence of Micronutrient deficiencies is found in crop due to intensive cropping, loss of fertile topsoil and losses of nutrients through harvest are daringly widespread across the globe.

Intensive rice farming of two seasons a year further depletes the exhausted micronutrients pool in the soil. The deficiencies of micronutrients develop over time due to intensive farming systems and are likely due to large amounts of nitrogen, phosphorus, potassium fertilizers and lime application that promote nutrient imbalance, increasing micronutrients demand, altering micronutrients availability, and hastening the depletion of readily available soil micronutrients pool (White and Zaoski, 1999). Zinc has been identified as one of the most limiting factors in rice production (Yang *et al*., 2009).

4. CONCLUSION

There is better rice yield in organic rice production plots. This is as a result of organic inputs which consequently added organic matter and available nutrients to the soil. Organic matter can increase the nutrient content of soil and improves its physical and chemical properties (Bamka*et al*., 1999). It also enhances soil water and nutrient holding capacity and serves as chelates in micronutrient retention, release and availability. It also serves as sources of both macro and micronutrients to plants and therefore provides organic forms of these nutrients in utilizable forms. These contributed to greater yield in organic plots compared to non organic plots. Reduced yield occurs in paddies with water table exceeding 5cm during fertilizer application, and is more severe in tropical soils with low fertility index.

Deficiency of **zinc** results in light green, yellow or white areas between leaf veins, particularly in older leaves, premature foliage loss, malformation of fruits, often little or no yield, may occur. Zn in soil solution ranges from 2- 70 Mg/kg^{1}.with more than half complexed with organic matter. Deficiency of Zinc are usually associated with concentrations of less than 10- 20 Mg/kg^{1}. (Paterson, 2002). Depending on the crop, toxicity will occur when the leaf concentration of Zn exceeds 400 Mg/kg^{1}.

Copper deficiency and toxicity are not as common as other micronutrients deficiency. Copper deficiency include chlorosis in young leaves, and stunted. In advance stage, necrosis along leaf tips and edges appears. Stem melanosis, root rot and ergot infection can occur in small grains (Solberg *et al*., 1999). Cu toxicity include reduced shoot vigor, poorly developed and discolored root systems. Toxicity is uncommon, occurring where there are high deposits of waste such as municipal, sewage sludge etc. Concentration of Cu in soil ranges from 1- 40 Mg/kg[1].and averages about 9 Mg/kg[1].

Molybdenum deficiency is not common but is similar to interveinal chlorosis in Iron deficiency. Excessive amount of Molybdenum are toxic, especially to grazing cattle or sheep. Mo toxicity cause stunted growth and bone deformation in animal and can be corrected by oral feeding of Copper (Paterson, 2002). The soil concentration of Mo ranges from 0.2 to 5 Mg/kg[1]. (Benett, 2003).

Iron deficiency symptoms include interveinal chlorosis, which progresses rapidly over the entire leaf. In severe cases, leaves turn entirely white and necrotic (Van Dijk *et al*., 1993). Iron toxicity can occur under certain condition, for example in rice grown or poorly drained or submerged soils, leaf bronzing symptoms occur with 300 Mg/kg of Fe in rice leaves. Fe concentration is usually very low, 0.1- 0.50 Mg/kgand only the chelate dynamics make Fe more available (Van Dijk*et al*.,1993).

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