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Research Application Summary

Effects of innovative farmer practices in soil fertility and water management on soil productivity and maizeand leafy vegetable production in Harare, Zimbabwe

Nyamasoka, B.[1], Nyamugafata, P.[1], Madyiwa, S.[1] & Nyamangara, J.[2]
[1]Department of Soil Science and Agricultural Engineering, University of Zimbabwe,
P. O. Box MP167, Mt Pleasant, Harare, Zimbabwe
[2]International Crops Research Institute for the Semi-Arid Tropics, Matopos Research Station,
P. O. Box 776, Bulawayo, Zimbabwe
Corresponding author: bnyamasoka@agric.uz.ac.zw

Abstract

Poor soil fertility and increased frequency of mid-season droughts due to climate change have made it difficult for urban farmers to get sustainable crop yields especially on sandy soils. Higher yields can be attained by urban farmers if proper fertilizer types and rates are applied with sufficient soil moisture. The use of animal manures and organic municipal wastes as fertilizers is on the increase in urban agriculture (UA). However, nutrient dynamics of these organic materials need to be known so as to help farmers manage them in a manner that optimises nutrient uptake and ultimately crop productivity. In this study, field and greenhouse trials will be conducted where maize and leafy vegetables will be the test crops fertilized using sewage sludge, animal (cattle, poultry, pig) manure and mineral fertilizer under conventional and minimum tillage systems. Nitrogen (N), phosphorus (P), heavy metals uptake and biomass production will be determined at 4 weeks after germination (WAE) and physiological maturity for greenhouse and field trials, respectively. An incubation experiment will be conducted to study N and P mineralization from the organic amendments. This study also seeks to determine gendered labour responsibilities and control over means of production as well as socio-economic issues in UA and their influence on crop productivity by conducting a baseline survey. The goal of the project is to enhance food security (nutritive value and quantity) of the urban farmers and better prepare them to face the impacts of climate change.

Key words: Fertilizers, gender, manure, urban agriculture, Zimbabwe

Résumé

La pauvre fertilité du sol et la plus grande fréquence des sécheresses en pleine saison dues au changement climatique ont rendu la vie difficile des agriculteurs urbains pour obtenir des rendements de récolte durables particulièrement sur les

sols sablonneux. De plus grands rendements peuvent être atteints par les agriculteurs urbains si les types et les taux appropriés d'engrais sont appliqués avec l'humidité du sol suffisante. L'utilisation des engrais animaux et des déchets municipaux organiques comme engrais est à la base de l'amélioration de l'agriculture urbaine (UA). Cependant, la dynamique nutritive de ces matériaux organiques doit être connue afin d'aider des agriculteurs à les contrôler dans une manière qui optimise l'absorption des nutriments et finalement la productivité agricole. Dans cette étude, des essais dans le champ et dans la serre seront conduits où le maïs et les légumes seront les récoltes d'essai fertilisées en utilisant la boue d'épuration, l'engrais animal (le bétail, la volaille, le porc) et l'engrais minéral sous les systèmes conventionnels et minima de labourage. L'absorption d'azote (N), du phosphore (P), des métaux lourds et la production de biomasse seront déterminées dans 4 semaines après la germination (WAE) et aussi la maturité physiologique respectivement pour les essais dans la serre et dans le champ. Une expérience d'incubation sera entreprise pour étudier la minéralisation de N et de P des amendements organiques. Cette étude cherche également à déterminer les responsabilités liées au genre et la surveillance du travail au-dessus des moyens de production aussi bien que les questions socio-économiques dans l'agriculture urbaine et leur influence sur la productivité agricole en conduisant une étude initiale. Le but du projet est d'augmenter la sécurité alimentaire (en valeur nutritive et en quantité) des agriculteurs urbains et mieux les préparer pour faire face aux impacts du changement climatique.

Mots clés: Engrais, genre, fumier, agriculture urbaine, Zimbabwe

Background

Urban Agriculture (UA) is the production of crops or livestock on land which is zoned for urban areas (Mbiba, 1995). Studies by Drescher (1994) reported that close to 40% of households in Lusaka, Zambia and 29% in Nairobi, Kenya relied on the urban environment to grow food for consumption and sale. In Harare, 60% of the food consumed by low-income groups is self-produced through UA and 40% of farmers produce enough food to cover half a year's consumption while less than 10% sell maize to the market (Toriro, 2007). When practiced effectively, UA can contribute significantly to the socio-economic environment by providing income and improving food security and nutrition of households. However, soils in Harare are inherently deficient in N, P and other nutrients, thereby contributing to poor soil fertility and ultimately to poor crop

yields. Crop production is largely rain-fed and it suffers from unpredictable rainfall regimes which are intensifying as climate change impacts become more severe. Harare experienced more severe midseason droughts in the past two seasons (2007/ 2008 and 2008/2009) resulting in crop failure and low yield especially on sandy soils. Limited access to irrigation (except for plots along streams where wastewater is used for vegetable production) has also increased crop failure. These harsh conditions have prompted urban farmers in Harare to use organic amendments such as farmyard manure, woodland litter, sewage sludge and termitaria to fertilize their crops, since mineral fertilizers are not affordable. Water management technologies have also been used to increase soil moisture available for crop growth. It is therefore important to assess and optimise selected innovative farmer practices in soil fertility and water management commonly sued by urban farmers, and to determine socio-economic factors that affect their adoption.

Literature Summary

Urban agriculture has been propelled by population pressure due to rural-urban migration. In Harare, the rate of urbanization was at 4.5% per year in 2005 (Mawoneke and King, 2005) raising levels of unemployment and prompting urban dwellers to turn to UA for food security and to augment family incomes. Crop production is practiced with maize grown during the rainy season and vegetables grown in large quantities during the dry season (May – September). However, almost 33.3% of crop production fields are in environmentally sensitive areas like slopping land which is prone to soil erosion and along stream banks where agro-chemicals are easily washed into water bodies causing eutrophication (ENDA-Zimbabwe, 1996). Farmers have been using technologies such as direct seeding, mulching with hay grass and stover from the previous season, and inter crops. Various organic amendments such as animal manure, leaf litter, compost and bio-solids have also been commonly applied on agricultural land to increase crop yield. In sub-Saharan Africa, research on these organic manures has mainly focused on their role in supplying N required by crops (Nyamangara *et al*., 2000) with little attention given to P. Nitrogen is the single most limiting nutrient to both crops and microbes in Zimbabwean soils and P is ranked second.

Study Description

The study sites are located in North-Western Harare (Dzivarasekwa) (17º46’08.79"S and 30º54’52.83"E) and Chitungwiza (18º00’00.89"S and 31º00’18.38"E). The soils in Chitungwiza are granitic sands classified as Fersiallitic (5G)

(Zimbabwe soil classification system) or ferrallitiic cambisol (FAO) while those from Dzivarasekwa are clay soils derived from dolerite and classified as Fersilliatic (5E) (Zimbabwe) or chromic luvisols (FAO) (Nyamapfene, 1991). The clay soils are moderately leached and contain free sesquioxides whilst the sands are coarse- grained sandy loams with low organic carbon (less than 1%). The research will be conducted in three phases. Firstly, a baseline survey (structured questionnaire and key informant interviews) will be carried out after which field trials will be conducted using maize as the test crop. Greenhouse experiments will be carried out during the dry season using maize, rape *(Brassica napus)* and tsunga *(Brassica juncea)* as test crops. Incubation experiments will be carried out parallel to the greenhouse experiment. A completely randomised block design will be used for field agronomic trials and greenhouse experiments, and a completely randomised design will be used for incubation experiments .

Research Application

Since more and more people are relying on urban farming for food security, this study is expected to contribute towards enhancing food security (nutritive value and amount) of the urban farmers and better prepare them to face climate change by identifying practices that are promising and availing research findings on sustainable and affordable means of crop production that promote high crop yields. Preliminary results from the baseline survey indicate that combined use of organic amendments and inorganic fertilizers has attained higher maize yields as compared to the use of inorganic fertilizers alone on both soils (Fig. 1) although higher maize yields can be attained

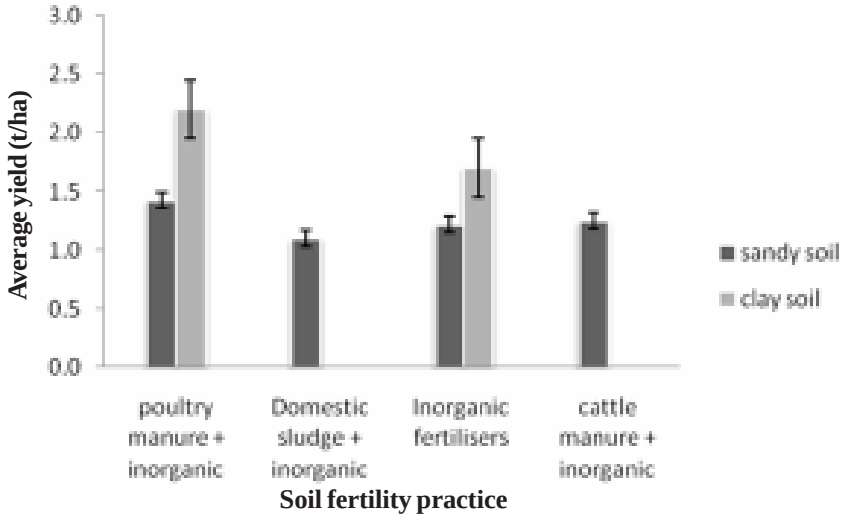

Figure 1. Soil fertility practices and their average.

if the correct rates of manure and fertilizer are applied since the farmers apply N (from inorganic and organic sources) at rates well below the recommended 120kgN/ha for maize(Fig. 2).

Studying gender labour responsibilities and control over means of production as well as socio-economic factors influencing urban agriculture will enable a more focussed provision of extension services to allow for efficient production. For example women dominate in most activities done in urban farming (Table 1), hence there is need to focus on enhancing women's ability to effectively participate in UA by providing financial support and training.

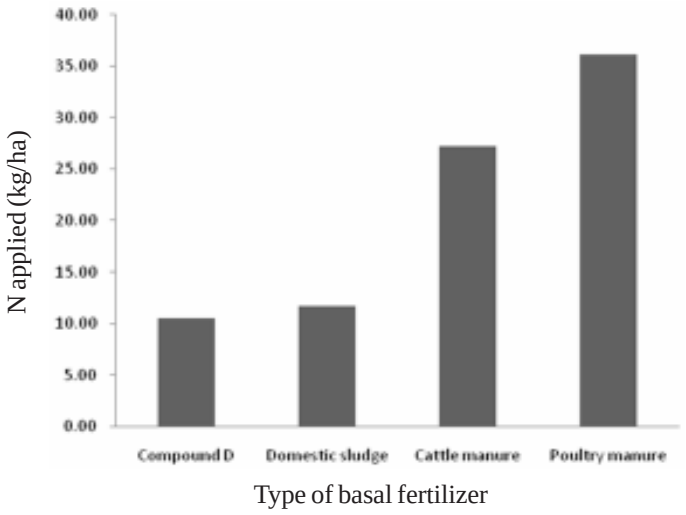

Figure 2. N applied from different sources of basal fertilizers.

Table 1. Gendered labour responsibilities in Harare urban agriculture.

% responsible	Agronomic activity							
	Land preparation	Planting	Fertiliser application	Weeding	Irrigating	Pest control	Guarding	Harvesting
Men	33.7	16.1	12.7	11.8	6.8	16.6	22.9	10
Women	43.4	46.3	47.8	45.6	6.3	5.9	3.9	40
Both	22	37.1	39	39.7	3.9	4.4	5.4	46
Neither	1	0.5	0.5	2.9	82.9	73.2	67.8	2.9

Studying the impacts of the soil fertility practices on crop and soil productivity will enable promotion of those activities that promote high yields and good soil fertility ultimately encouraging food security in the area.

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