Urine Drip Fertigation of Tomatoes; a Solution to Chemical Fertilizer

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Abstract
The prices for chemical fertilizers are increasing in Zambia and the challenges posed by chemical fertilizers to marginalised small holder famers especially female headed households, agriculture ecological zones and the soil fertility cannot be over emphasised. Madimba is one of the peri urban communities of Lusaka with more than 200 small holder urban farmers with rented farm land with sizes ranging from 0.2 to 0.5 Lima. The crop yield is substantively below to sustain household food security for peri urban poor.

The paper discusses a twenty six (26) weeks comparative study of humanurine drip fertigation and the liquid chemical fertilizers (poly-feed and Muilt –K) in a greenhouse technology demonstration. The project collects human excreta (urine and faecal matter) from 100 urine diversion dry toilets constructed in Madmba community (2008 -2013) by Network for Environmental Concerns and Solutions (NECOS) with the financial support from its International partner Global Dry Toilets Association of Finland (GDTAF), while the Greenhouse technology was supported by the Student Union of Helsinki University. A 1,200 litres polythene urine tank with retention time of three months at the temperature between 20C° ∞ 30 C°. Land of 20m x 8m = 160m^2 under a green house was prepared for the planting of 325seedling of tomatoes. Lime application based on 100g/ m^2 *160* ≤ m^2 =? 100 = 1, x = 160, » 16000g ÷ 1000 = 16kg of Lime.+

Urine drip fertigation application ratio of urine & water mixture of (1 part urine per 3 parts of water). The seedlings transplanting took place on 7th July, 2014 and the application started one (1 week) after seedling transplanting of Tomatoes in the Greenhouse until the harvest period. As a general rule of thumb, use 0.7 L/m^2 of urine at every fertigation. Based on the given total surface area in the Green house of 160m^2 x 0.7L= 112litres of urine and capacity of drip fertigation tank of 500 liters and the mix ration of 1 part urine to 3 parts tap water applied as follows 112 liters (L) + (112x3)=336 liters of Water =448litres with tank allowance of 500L- 448L= 52L.

Urine fertilization by the use of urine drip system constructed in a Green house technology is a concept demonstrated in Madimba community for the period of 24 weeks. The Tomatoes seedlings as a crop received a balanced nutrient supplied which includes but not limited to nitrogen, phosphorus, potassium, and sulfur. The urine reaches the root zone directly and there was no leave contact, which might have damaged the plants.

Harvesting started on 12th September, 2014 to 31st December, 2014 of barely 8 weeks shows a total of 46 Boxes of Tomatoes translating into 10,243 actual fruits excluding wastage. It is evident, that instance Urine Drip Fertigation of Tomatoes introduced in a green house technology is the best Solution to Chemical Fertilizer such as Poly feed and Muilt-K which are also used in a liquid form.

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The high prices for chemical fertilizrs is viewed as an exploitation to small hold famers in Zambia and is identified as one of the three (3) major problem areas of great concern in the agriculture sector. Unfortunately, over dependence on chemical fertilizers as the main source of soil nutrients, has been identified as one main contributing factor to food insecurity especially among the women small holder farmers in Zambia.

In most cases, small scale famers have not realised the impact of chamical farfilizers not only to the environment but also as an agriculture imput exploitation model, hence, the need to a twenty six (26) weeks comparative study of humanurine drip fertigation and liquid chemical fertilizers (poly-feed and Muilt –K) in a greenhouse technology demonstration (Obed C. Kawanga 2014). The study cites high price of chemical fertilizer as a contibuting factor to household food insecurity among the small holder pesant famers especially women urban famers. It is acknowledged that, if such a situation continues, many small holder famers will continue to be food insecure, unless alternative steps are taken to reverse the trend.

The Zambian Governments have identified the agriculture sector as one of the key driver of the economy and has been the largest contributor of foreign exchange earnings and national revenue. The country has enormous potential to expand agricultural production due to vast resource endowment in terms of land, water, climate and labour. Zambia's total land area is 75 Million hectares (752,000 Km2), 58 percent (42 Million hectares) is classified as medium to high potential for agricultural production, with rainfall ranging between 800 mm to 1,400 mm annually. (Isimwa 2013)

Zambia is divided into three major agro-ecological regions, namely Regions I, II and III. Rainfall performance as well as the quality of soils differs across these regions. Maize, Zambia's staple food is grown by over 2.7 million agricultural households. The crop is not only used as source of food but is a source of income for many of the rural households. The income obtained from maize sales are hadly enables the small scale famers meet other basic necessities for livelihood and provid the resource needed to purchase inputs for the upcoming agricultural season. (Zambia Agriculture policy 2013).

Looking at the price for chemical fertilizers which are increasing in Zambia and the challenges posed by chemical fertilizers to marginalised small holder famers especially female headed households, agriculture ecological zones and the soil fertility cannot be over emphasised. (Obed Kawanga 2015)

The environmental pollution is a significant problem and a major source of environmental devastation which is caused by modern food production. Far from being life sustaining, our modern chemical-dependent farming methods strip soil of its nutrients and destroy critical soil microbes and Saturate farmlands with toxic pesticides herbicides and fertilizers that then migrate into ground water, rivers, lakes and oceans (Dr. Damaus 2014, organicconsumers.org).
https://www.organicconsumers.org/news/how-chemical-fertilizers-are-destroying-our-soil-and-water

In Madimba a peri urban communities of Lusaka with more than 200 small holder urban women farmers with rented farm land, sizes ranging from 0.2 to 0.5 Lima which translate into 0.06 and 0.12 Hectares of land respectively, have felt the impact of high cost of chemical fertilizers. Thier crop yield is drastically reduced and substantively below sustainance household food security for peri urban poor.

Women share the workload on smallholder farms, but tend to have less say in their operation and receive little of the income. But when women are included as equals, productivity almost always goes up. Women are more likely than men to invest their increased income in the long term interests of their

families and communities. There are three initial areas that will make a real difference. First, ensure that women get equal access to agricultural training. Second, make microcredit widely available to female farmers. Third, help women set up cooperatives and Small and Medium Enterprises which NECOS has embarked. Figure 1 Training women in Urban Agriculture.

Fig. 1: Practical training session for women Small and Medium Enterprises in Urban Agriculture

Statement of the Problem

The study aims to compare the effectiveness of human urine drip fertigation and the liquid chemical fertilizers (poly-feed and Muilt –K) in a greenhouse technology demonstration. The study revealed the effectiveness haman urine drip fertigation as alternative source of soil nutrients to sustain Tomatoes growth in the green house technology. It is common knowledge that unless alternative steps are taken to reverse the trend, there is likelihood that this drastic application of chemical fertilizers will adversely affect the small holder famers, communities, the environment and other socio-economic aspects of the people.

1.3 Objectives and Scope of the Study

The main and general objective of the study is to explore data on the effectiveness of human urine drip fertigation of Tomatoes in a green house and set strategies, which will: -

Directly or indirectly provide diverse opportunities for chemical fertilizers among the target study groups and promote community participation in soil conservation.

The study specific objectives:

- Collect information on human urine drip fertigation of tomatoes and their success rate
- Determine the growth rate and production of Tometoes under urine drip fertigation
- To identify and determine factors that has led to non-exploitation urine as fertilizesr

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Solutions (NECOS) with the financial support from its International partner Global Dry Toilets Association of Finland (GDTAF), while the Greenhouse technology was supported by the Student Union of Helsinki University in 2013. A 1,200 litres polythene urine tank with retention time of three months at the temperature between 20°C, ∞ 45 °C at ambient tempreture. Land of 20m x 8m = 160m^2 under a green house was prepared for the planting of 325seedling of tomatoes with spacing of 150cm in the width and the sedling spacing of 30cm apart. Lime application based on 100g/ m^2 *160* ≤ m^2 =? 100 = 1, x = 160, » 16000g ÷ 1000 = 16kg of Lime.

Urine drip fertigation application ratio of urine & water mixture of (1 part urine per 3 parts of water), were applied as indicated in the table below revealing intervals. The 325 seedlings transplanting took place on 7th July, 2014 and the urine drip fertigation or application started one (1 week) after all the seedling transplanting of Tomatoes in the Greenhouse until the harvest period. As a general rule of thumb, use 0.7 L/m^2 of urine at every fertigation. Based on the given total surface area in the Green house of 160m^2 x 0.7L= 112litres of urine and capacity of drip fertigation tank of 500 liters and the mix ration of 1 part urine to 3 parts tap water applied as follows 112 liters (L) + (112x3)=336 liters of Water =448litres with tank allowance of 500L- 448L= 52L.

Table 1.Time Line and Quantities of Dripfertigation of HUre -Fertilizers

	JULY 29th ,2014		**1st December, 2014**	
Quantities (Hure & HO_2 **)**	***6 wks***	***6 wks***	***6wks***	***6wks***
HUre160m^2 x 0.7L= 112litres	1	2	3	4
HO_2 of 112 liters (L) + (112x3)=336	3	6	9	12
HURE-FERTIGATION	3^3	6^3	9^3	12^3
Total Hure-Fertigation	$1+3^3$	$2+6^3$	$3+9^3$	$4+12^3$

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Key Lessons Learned

- Human acceptance of HUre as fertilizers will greatly influenced by the local environmental and social-economic situations, in a case of Madimba, a peri-urban settlement in Lusaka, Zambia. It is learnt that the social-economic, cultural beliefs are influencing factor for the acceptability of human urine as fertilizers. The cultural beliefs and local conditions commonly found in the particular peri urban settlements, residents face challenges in changing their mind set to implementing the full utilization of human urine.
- It is likely to make further experiment on food crop initiatives such as tree planting,
- Legalising HUre as fertilizers to use in backyard gardens in communities and settlements will usually reduce the challenges in the utilization of HUre fertilizers.
- This is because they are not legally recognised and hence are not fully utilised by must small scale famers. For instance, Madimba peri urban settlement, the use of urine fertilizer is not legally recognised; hence this makes it difficult for the residents to use it openly.

AUTOBIOGRAPHY

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Twenty three (23) years work experience in research, surveys, data processing, analysis, interpretation and dissemination of reports to diffent stakeholders. Studed at Kings College, Cabridge University UK in 2014 and manjure in Ecosystem and Biodiversity Valuations, Darmstadt University 2007-2008 and majre in Msc in International Cooperation and Urban Development Studies

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