Human Urine Utilization: A Waste Management Strategy

1.0 Introduction

Waste management is the collection, transportation, processing, recycling or disposal of waste materials. The term usually relates to materials produced by human activity, and is generally undertaken to reduce their effect on health; the environment or aesthetics.Human urine can be well harnessed through proper waste management method. Waste management is also carried out on human urine to reduce the materials' effect on the environment and to recover resources from them. Human urine is liquid waste product of the body secreted by the kidneys by a process of filtration from blood and excreted through the urethra. This waste is eventually expelled from the body in a process known as urination. Most commonly the excretion of urine serves for flushing waste molecules collected from the blood by the kidneys, and for the homeostasis of the body fluids. This liquid waste product of the body is a potential source of fertilizer which is more environmental-friendly compared with chemical fertilizer if properly harnessed.

The use of human urine is particular interest in the field of organic farming where fast-acting fertilizers are in demand. A new project was demonstrated which showed the potentiality for developing urine-separation toilets, and that from agricultural point of view-separated urine is comparable to liquid manure. This is a unique way of managing human urine.

1.01 Urine

Urine used directly or after storage is of high quality and low cost, alternative to N-rich mineral fertilizer in plant production. The nutrients in urine are in ionic form and there plant – availability compares well with chemical fertilizer (Johansson et al., 2001; kirchmann and Pettersson, 1995; Kvarmo, 1998; Richert Stintzing et al., 2001). Urine is best utilized as direct fertilizer for N-demanding crops and leafy vegetables. If crop and region – specific recommendations are available for the use of N fertilizers (urea, ammonium or nitrate), a good starting point for how to use urine is to translate the recommendations to urine. The translation is simplified if the N concentration of the urine is known. If not then as a rule of thumb, a concentration of 3-7 grams of N per litre

of urine can be expected (vinneras, 2002; Jonsson & vinneras, 2004). Urine also contains large amounts of P and K, but due to its large content of N, its P/N and K/N ratios are lower than in many mineral fertilizers used for vegetable production.

The yield achieved when fertilizing with urine varies depending on many factors. One important aspect is the soil condition. The effect of urine, just as that of chemical fertilizers, is probably somewhat lower on a soil with a low content of organic substances than on a soil with a high organic content.

2.0 Broad Objectives

Testing the efficacy of the utilization of human urine as a fertilizer- a waste management strategy.

3.0Methods

This study was designed to determine the utilization of human urine in the context of waste management. The study was experimental in design and was conducted under the green house condition. Lemongrass was grown with three treatment media- inorganic fertilizer, urine, compost and ordinary soil as control. Each treatment was carried out by mixing 12.5g of organic manure with 5kg of soil, 0.25g of NPK with 5kg of soil, while 125mls of urine was mixed with 5kg of soil. The growth parameters which include number of leaves, number of stolons and height of the plant were monitored and determined for 18 weeks and compost made from city refuse. Lemongrass grown on ordinary soil was used as control. Each treatment was carried out by mixing 12.5g of organic manure (5tonnes/ha) with 5kg of soil. Furthermore, 0.25g of NPK (100kg/ha) was mixed with 5kg of soil while 125mls of urine was mixed with 5kg of soil which was applied at the rate of 4600l/ha.

The experiment was conducted in two sets and each treatment was carried out in triplicates. In the first set, urine was applied once while in the second set, the urine was repeatedly applied once every week for a period of 9-weeks at ratio 3:1 (water: urine). Meanwhile the whole of the experiment took 18-weeks after which it was terminated.

500ml of water was used for irrigation 3 – times in a week as this is the volume of water 5kg of the soil sample could take to avoid drainage. After the soil preparation, 17cm of lemongrass slips all of equal heights were planted at 5cm deep into the soil. The following parameters were taken weekly,

- The number of leaves - by counting
- The Height - using metric rule
- Number of stolon - By counting.

After 18 weeks, the leaves were harvested by cutting the plant at 15cm above ground level. One kilogram of fresh leaves from each treatment were milled and extracted for essential oil through hydro-distillation method. While some were oven dried at 65°C for 24hrs for laboratory analysis.

The soil samples were air-dried, sieved and packed for Nitrogen, Phosphorus and Potassium analysis both soil and plant samples were analyzed for NPK using standard laboratory method at International Institute for Tropical Agriculture Ibadan (IITA).

4.0 Results

The results showed that the mean number of leaves grown by the lemongrass treated with urine, inorganic fertilizer, compost and the control soil were 31.0, 30.7, 17.8, 14.6 respectively ($P<0.05$). The mean number of stolons of the lemongrass treated with urine, inorganic fertilizer, compost and the control soil were 4.9, 4.1, 2.7, 2.1 respectively ($P<0.05$). The mean height of the lemongrass in centimeter treated with urine, inorganic fertilizer, compost and the control were 71.6, 80.9, 93.3 and 63.9 respectively ($P<0.05$). The analysis showed that the growth of lemon grass were slightly higher with urine than with conventional fertilizer.

The total Nitrogen, Phosphorus and Potassium were determined from samples of lemongrass, including soil samples from each treatment. The results were analyzed using ANOVA and descriptive statistics. Table 1 to table 3 showed the significance difference

within the group, the number of leaves, number of stolon and height of lemon grass treated with NPK, Urine, Organic fertilizer and the Control respectively.

Table 1

One-way Analysis of variance for first set of Lemon grass

Number of leaves:

Number of leaves	**Mean**	**Standard Deviation**	**F. Value**	**P.Value**
N.P.K	30.70	19.103		
Urine	31.00	22.059	6.634	0.000
Organic Fertilizer	17.81	12.689		
Control	14.63	13.290		
Total	23.54	18.554		

Table 2

Number of stolon

Number of stolon	**Mean**	**Standard Deviation**	**F. Value**	**P.value**
N.P.K	4.0741	2.38466		
Urine	4.9259	3.80208	7.051	0.000
Organic fertilizer	2.6667	1.66410		
Control	2.0741	1.73041		
Total	3.4352	2.75231		

Table 3

Height(cm)

Height	**Mean**	**Standard Deviation**	**F value**	**P.value**
N.P.K	80.9259	23.81003		
Urine	71.6667	13.76171	10.948	0.000
Organic Fertilizer	93.3333	16.20779		
Control	638889	23.76865		
Total	77.4537	22.50416		

Table 4

Table 4 to Table 6 show a multiple comparison between the groups.

Multiple Comparisons

Number of Leaves

Urine	**Treatment**	**Mean Difference**	**Standard Error**	**Sig.**
	N.P.K	.296	4.693	.950
	Organic fertilizer	13.185	4.693	.006
	Control	16.370	4.693	.001

Table 5

Number of Stolons

Urine	**Treatment**	**Mean Difference**	**Standard Error**	**Sig.**
	N.P.K	.85185	.69263	.222
	Organic Fertilizer	2.25926	.69263	.001
	Control	2.85185	.69263	.000

Table 6

Plant Height(cm)

Urine	**Treatment**	**Mean Difference**	**Standard Error**	**Sig.**
	N.P.K	-9.25926	5.41593	.090
	Organic Fertilizer	-21.66667	5.41593	.000
	Control.	7.77778	5.41593	.154

The statistical analysis of the first set showed an increase of 52.8% in number of leaves, 10.9% in height and 57.9% in number of stolon of lemongrass treated with urine compare with control ($p<0.05$), while there was an increase of 42.6% in number of leave, 45% in number of stolon of lemongrass treated with urine compare with organic fertilizer at ($p<0.05$).

Table 7

Analysis of Variance of soil Samples.

Nitrogen.

Treatment	**Mean**	**Standard Deviation**	**F value**	**P value**
N.P.K	.11400	.002646		
Urine	.12633	.011372	4.462	.040
Organic Fertilizer	.11033	.005686		
Control	.10600	.006083		
Total	.11417	.009998		

Table 8

Phosphorus.

Treatments	**Mean**	**Standard Deviation**	**F. Value**	**P. Value**
N.P.K	39.4667	17.59324		
Urine	33.3567	14.07438	1.694	.245
Organic Fertilizer	25.7433	1.66962		
Control	18.9600	7.40452		
Total	29.3817	12.96330		

Table 9

Potassium

Treatments	**Mean**	**Standard Deviation**	**F Value**	**P Value**
N.P.K	.2333	.03786		
Urine	.1933	.02517	2.367	.147
Organic fertilizer	.2233	.02309		
Control	.2667	.04509		
Total	.2292	.03988		

Table 10

Multiple Comparisons for Nitrogen

Nitrogen	**Treatment**	**Mean Difference**	**Standard Error**	**Sig.**
Urine	N.P.K	.012333	.005855	.068
	Organic Fertilizer	.016000	.005855	.026
	Control	.020333	.005855	.008

The mean difference is significant at P 0.05 level

There was no significant difference in Physical and Chemical characteristics of the soil samples except in Nitrogen content ($P < 0.05$). Nitrogen in urine treated soil is higher than that of the control and organic fertilizer.

Table 11

Analysis of Variance of Plant samples

Nitrogen.

Treatment	Mean	Standard Deviation	F Value	Sig.
N.P.K	2.06933	.041525		
Urine	2.47700	.222032	2.618	.146
Organic Fertilizer	2.11250	.284964		
Control	1.66000	.499361		
Total	2.03670	.402878		

Table 12

Phosphorus

Treatment	**Mean**	**Standard Deviation**	**F Value**	**Sig.**
N.P.K	.17900	.004000		
Urine	.17050	.006364	.313	**.816**
Organic Fertilizer	.18700	.007071		
Control	.16233	.051394		
Total	.17390	.026354		

Table 13

Potassium.

Treatment	**Mean**	**Standard Deviation**	**F Value**	**Sig.**
N.P.K	.31000	.057236		
Urine	.40250	.006364	3.426	.093
Organic Fertilizer	.46150	.062933		
Control	.37067	.056889		
Total	.37700	.071643		

5.0 Conclusion

In conclusion, human urine could use as a fertilizer for lemongrass through proper waste management method and the quality of fertilizer it produces is better than the conventional ones. There is significant positive effect of urine on lemongrass if the urine is applied once for each harvesting period. The non-significant different in quality and quantity of lemongrass treated with NPK and urine could be attributed to the ionic form of nutrient in both fertilizers. Meanwhile, chemical fertilizer has environmental hazard and health risks. The use of urine will reduce the cost of fertilizer and instead of its being indiscriminately disposed which has negative impact on environmental safety; it could be harnessed for agricultural purpose thus serving a dual purpose of ecosanitaton and soil fertilization. This in itself is a waste management technique.