Response of Okra (Abelmoschus esculentus L. Moench) to different Levels of Human Urine

This was a study about the possibility of using human urine as an organic fertilizer in growing okra. The results might serve as a guide in applying human urine as an organic fertilizer.

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Abstract

Human urine from dormitories of the Mindoro State College of Agriculture and Technology was used as organic liquid fertilizer. Its efficacy was tested in two varieties of okra (Abelmoschus esculentus). The experiment was conducted in Victoria, Oriental Mindoro, Philippines from September to December 2011 using a split-plot design with three replications. Results of the study showed varying responses of the two varieties to different urine levels. The optimum level necessary to significantly improve plant height of the Light Green is 25% urine + 75% water; the Smooth Green was not significantly affected. All urine-treated plants had significantly higher leaf area index than the untreated ones. Light Green had significantly heavier biomass than Smooth Green when applied with any level human urine. Smooth Green had significantly higher yield than Light Green when applied with 25% urine and 75% water. On the other hand, Light Green had significantly more enhanced vegetative growth than Smooth Green.

Introduction

Okra (*Abelmoschus esculentus L. Moench*) is a very nutritious vegetable and is popular in the Philippines due to its many uses. It is also resistant to drought and water logging and can be grown throughout the year as a stand-alone crop or in mixture with other staple crops (Odeleye, et al., 2005). Due to its popularity and the increasing demand for organically grown food products, the prospect of using organic fertilizer in growing this crop is very bright. One such organic fertilizer which is in abundance and at the same time, if not properly disposed, poses health hazard is human urine. Since most of the nutrients absorbed by our body from the food we eat is excreted via urine, it is rich in valuable nutrients in ionic form, e.g. 75-90% of nitrogen from urine is in the form of urea and most of the minerals especially potassium and sulphur which are present as free ions are directly available to plants without processing (Jönsson et al, 2004). As a fertilizer, it is fast-acting in nourishing plants (Kvarnström et al, 2006). Studies have also shown that the availability of plant nutrients from urine is comparable with those in chemical fertilizers (Mnkeni et al., 2005). Studies in different countries resulted to comparable yields in many different crops when equivalent amounts of chemical and urine fertilizer was used (Richert et al, 2010). In Sweden this was tested for barley (Johansson et al., 2001; Rodhe et al., 2004) and leeks (Båth, 2003); in the Philippines for sweet corn, eggplant and pechay (Gensch and Miso, 2011) and in India for maize (Sridevi, 2009) and Poovan banana (Jeyabaskaran, 2010). The use of urine as a fertilizer instead of the commercial fertilizer will thus reduce production cost (Germer et al, 2009). In addition, it also contains very few pathogens, hence it is easy and safe to use as organic fertilizer (Esrey et al, 2001).

Premises considered the response of two okra varieties to the application of different urine levels in terms of growth and yield components needs to be investigated.

Key findings:

- To ensure that human urine is not contaminated with pathogens a withholding period before application is needed to allow the pathogen to die-off. Urine should be stored undiluted in a sealed PVC container for several months.
- Human urine should be applied to Smooth Green okra variety at a mixing ratio of 25% urine to 75% water at the rate of 250 mL; the rate should be increased by 50 mL every week until it reach 500 mL; the initial application should be done three weeks after planting.
- The last application of urine should be at least one month prior to harvesting and urine should be applied into the ground if the edible parts of the plant grow above the soil surface.

Methodology

A Split Plot Design with three replications was used in this study. The level of urine was assigned as Factor A (A_1: no urine; A_2: 25% urine + 75% water; A_3: 50% urine + 50% water; A_4: 75% urine + 25% water; and A5: 100% urine) and the varieties of okra was assigned as Factor B (B_1 – Smooth Green; B_2 – Light Green).

A basal application of 6 kg of organic fertilizer per experimental unit was made. After the basal application of the fertilizer, each plot was covered with plastic mulch.

The human urine was collected every morning from the dormitories of the Mindoro State College of Agriculture and Technology, in Victoria, Oriental Mindoro, Philippines. It was prepared as a liquid fertilizer based on the mixing ratio proposed in the study. The liquid fertilizer was applied twice a week, around the base of the okra plants by drenching at the rate of 250 mL/plant. The amount of liquid fertilizer applied per plant was increased by 50 mL every week until it reached 500 mL. Urine application started three weeks after planting.

The data collected were analyzed using ANOVA for Split Plot Design tested at 5% and 1% levels of significance as described in Gomez and Gomez (1984). Mean comparison for significant differences was done using the Duncan's Multiple Range Test (DMRT) and was tested at 5% level of significance.

Findings

Height of the Plants

Highly significant variations in plant height were observed among plants treated with different urine levels. The specific test (Table 1) showed that in the Light Green variety, those treated with 25% urine and 75% water produced significantly taller plants, 88.7 cm, than the untreated plants and the others treated with higher levels as indicated by the letter notations that followed the data. The result implied that in using human urine as a fertilizer, the application of 25% urine and 75% water is the optimum level necessary to increase plant height of the okra Light Green variety. The effect of the different treatment combinations on the Smooth Green variety had no definite pattern i.e. the height of plants were comparable.

Leaf Area Index (LAI)

Variance analysis showed highly significant variations in LAI among plants treated with different urine levels, between varieties and the interaction between the two variables. Specific test (Table 2) showed that the plants in both varieties treated with 25% urine and 75% water had significantly higher LAI than the untreated ones and those treated with higher levels of urine. The significantly higher LAI of the Light Green plants in all treatments than their Smooth Green counterparts was an indication of differences in varietal characteristics.

Table 1: Specific test for plant height (cm)

Treatments (A)	Variety (B)		A-Mean	Difference
	Smooth[1]	Light[1]		
No Urine	78.7 a	73.7 c	76.7	5.0*
25U : 75W	75.3 b	88.7 a	82.0	-13.3*
50U : 50W	77.0 ab	84.0 b	80.5	-7.0*
75U : 25W	79.7 a	73.0 c	76.4	6.7*
100% Urine	77.7 ab	73.3 c	75.5	4.3*
B-Mean	**77.7**	**78.5**	**78.1**	**-0.9**

[1]Means followed by a common letter are not significant at 5% level by DMRT. *Significant difference.

Table 2: Specific test for leaf area index

Treatments (A)	Variety (B)		A-Mean	Difference
	Smooth[1]	Light[1]		
No Urine	0.73 c	0.85 d	0.79	-0.1*
25U : 75W	1.28 a	1.41 a	1.35	-0.1*
50U : 50W	0.76 c	1.20 b	0.98	-0.4*
75U : 25W	0.93 b	1.03 c	0.98	-0.1*
100% Urine	0.88 b	1.10 c	0.99	-0.2*
B-Mean	**0.92**	**1.12**	**1.02**	**-0.2***

[1]Means followed by a common letter are not significant at 5% level by DMRT. *Significant difference

Table 3: Specific test for biomass (g)

Treatments (A)	Variety (B)		A-Mean	Difference
	Smooth[1]	Light[1]		
No Urine	212.9 a	146.9 c	179.8	65.9*
25U : 75W	250.0 a	225.0 ab	237.5	25.0^{ns}
50U : 50W	203.1 a	168.8 bc	185.9	34.4^{ns}
75U : 25W	206.3 a	200.0 abc	203.1	6.3^{ns}
100% Urine	218.8 a	249.4 a	234.1	-30.6^{ns}
B-Mean	**218.2**	**198.0**	**108.1**	**20.2^{ns}**

[1]Means followed by a common letter are not significant at 5% level by DMRT. *Significant difference; ^{ns} insignificant difference.

Biomass

Variance analysis for biomass showed that the mean difference between varieties and the interaction between the urine level and variety was highly significant. Further test showed that in the Light Green variety, the plants applied with pure urine had significantly heavier biomass (249.4 g) than the untreated plants (146.9 g) (Table 3). This implied that human urine can significantly enhance the vegetative growth of Light Green variety of okra. For the Smooth Green variety, however, the application of different levels of urine did not have significant effect on biomass.

Number of Fruits (5 Harvests)

Variance analysis showed no significant difference among the treatments and between the two varieties. However, a significant interaction between the treatment and variety was observed. The Smooth Green variety responded to varying levels of urine, e.g. the application of 25% urine and 75% water significantly increased yield as compared to the application of pure urine; Light Green was not affected significantly.

Weight of Fruits (Five harvests)

No significant variation among the treatments and between the two varieties was noted. However, there was a significant interaction between the treatment and variety, i.e. the Smooth Green plants treated with 25% urine and 75% water produced significantly heavier fruits (516.7 grams) than the untreated ones (Figure 2). This finding shows a parallelism with the findings on the number of fruits.

Conclusions

The response to urine treatment of different varieties in terms of plant height varied significantly, i.e. the optimum level that could significantly increase plant height of Light Green variety is 25% urine and 75% water; the Smooth Green variety had no significant response to urine application. In terms of LAI, all plants in both varieties fertilized with urine had significantly higher LAI than the untreated ones. In terms of biomass, urine application did not affect the Smooth Green variety; the application of pure urine to the Light Green variety resulted to significantly heavier biomass, suggesting that its effect is variety specific. In terms of yield, the application of 25% urine and 75% water to Smooth Green variety of okra

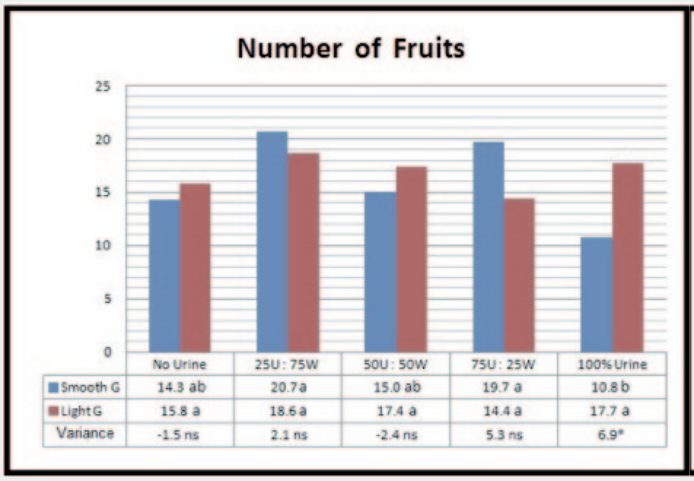

Figure 1:Number of fruits after 5 harvests and specific test

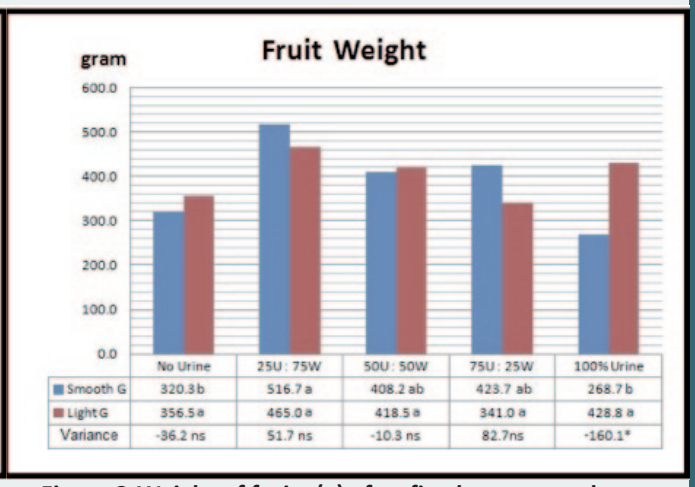

Figure 2 Weight of fruits (g) after five harvests and specific test

could significantly increase the number and weight of its fruits but not for the Light Green variety. The result indicates that application of varying levels of urine could enhance the vegetative growth of the Light Green variety. For the Smooth Green variety, however, the application level of 25% urine and 75% water could increase yield but beyond this point, the yield begun to decline.

Based on the results of this study, human urine could be used as an organic fertilizer for Smooth Green variety of okra and possibly other crops. Being organic in nature, the use of human urine as a crop fertilizer is economically viable, socially acceptable, technically and institutionally appropriate and environment-friendly.

Recommendations

1. Apply human urine as an organic fertilizer twice a week by drenching to Smooth Green okra variety at a mixing ratio of 25% urine to 75% water at the rate of 250 ml, gradually increasing the rate by 50 ml every week until it reach 500 ml. The initial application should be done three weeks after planting.
2. The collection of urine should be done by implementing appropriate urine separation techniques. The drain of urinals in male toilets should be designed to end in PVC containers and not in septic tank for ease in urine collection; toilet bowls that has a separate drain for liquid (urine) and solid (faeces) wastes, e.g. Chinese squat type urine-diverting toilet bowl should be installed in toilets.
3. On the perspective of health, to insure that the human urine intended for agricultural use is not contaminated with pathogens, there should be a withholding period before application to allow the pathogens to die-off. It should be stored undiluted in a sealed PVC container (prevents nitrogen loss) from 1-6 months at a temperature of 4-20 OC. This condition will provide a harsh environment for the pathogens. Moreover, the last application should be at least one month prior to harvesting and that it is applied into the ground if the edible parts of the plant grow above the soil surface.
4. Try varying levels of human urine as fertilizer for other crops.

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