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# EVALUATION OF SOURCE SEPARATED HUMAN URINE (ALW) AS A SOURCE OF NUTRIENTS FOR BANANA CULTIVATION AND IMPACT ON QUALITY PARAMETER

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## ABSTRACT

The recent approach is to go for productive sanitation technology to achieve food security. Ecosan systems that produce a safe human derived liquid fertilizer can potentially contribute to improvement in quality of life and life expectancy by enabling sustainable food production as well as proper waste water management. In this context, field experiments were conducted in farmers' fields at Nagasandra village, Doddaballapura Tq, Bangalore district for one year to study the source separated human urine as a source of nutrients for banana cultivation (*Musa paradisica*) to meet the nitrogen requirement of this crop. The treatments were absolute control, recommended dose of fertilizers, recommended dose of nitrogen through human urine with and without gypsum and fertilizer applied to soil and different combinations of human urine and fertilizers. The results of the field experiment revealed that the highest bunch yield (30.0 t $ha^{-1}$) of banana was recorded in the treatment which received RDN through human urine (After 30 days of planting) + Gypsum applied to soil when compared to control, and other treatment combinations. The available nutrients content of harvest soil viz., N, P and K had significant influence on it. Significant increase in the nitrogen, phosphorus and potassium content of plant samples was observed in the crop. The highest total soluble solids (25.85 percent), reducing sugars (20.93 percent) and total sugars (23.87 percent) were recorded in banana grown using human urine. The outcome of the present investigation revealed that ecosan system helps to provide better sanitation, help farmers to save the cost on fertilizers without affecting the crop yields and thus help to achieve food security.

**Keywords**: banana cultivation, human urine, ecosan, n, p and k fertilizer, gypsum, yield.

## INTRODUCTION

Source separating sanitation (Ecosan) systems that produce a safe human derived fertilizer can potentially contribute to great improvement in quality of life and life expectancy by enabling sustainable food production as well as proper waste management. Human urine is used for various purposes even references in ancient scripts has a medicinal value and used for wound therapy and also a source of nutrients. Recent studies showed that it is rich in plant nutrients which can be used as alternative to fertilizers. In this chapter relevant literatures are reviewed in an infallible manner on ecosan, collection and storage of human urine, fertilizer effect, crop response tohuman urine (ALW) and farmer's acceptance, etc.

Banana (*Musa paradisiaca* L.) is one of the most important nutritious fruit crops grown in India. It is the fourth important food crop in terms of gross value exceeded only by paddy, wheat and milk products. It is also a dessert fruit for million of peoples. In Karnataka, banana is being grown on an area of 61000 hectares with a production of 20.15 lakh tonnes (Selvaraj, 2003). Banana is one of the oldest fruits known to mankind. Elakki banana is one of the most popular varieties grown in Karnataka. The fruits of Elakki banana are attractive, small, and sweet with pleasant aroma and good keeping quality, although yields are low (25 to 30 tonnes $hectare^{-1}$). The agricultural scientists are convinced about use of human urine for agricultural purposes. But no information is available on the quantity and frequency of application of human urine as a nutrient source and the impact of its application on soil properties, growth, yield and quality of crops. Hence studies which find answers to various questions related to use of human urine for agricultural purposes is the need of the hour as it helps to solve the problems of water pollution and to use the nutrient elements present in human urine in a productive way which otherwise may go as a waste.

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In this context an attempt was made to study the evaluation of source separated human urine as a source of nutrients for banana cultivation and impact on quality parameter with the following objectives:

- To study the effect of application of human urine on growth and yield of banana and economics of cultivation; and
- To study the effect of application of human urine on quality parameters.

## MATERIALS AND METHODS

The field experiment was conducted in the farmer's field at Nagasandra village, Doddaballapura Taluk, Bangalore using banana (variety Elakki) as test crop with ten treatments and three replications in a randomized block design. The treatments tried were $T_1$- Control,$T_2$-Recommended Dose of Fertilizers (RDF), $T_3$- Recommended Dose of Nitrogen (RDN) through human urine (Basal),$T_4$- RDN through human urine (Basal) + gypsum, $T_5$- RDN through human urine (After 30 days of planting), $T_6$- RDN through human urine (After 30 days of planting) + gypsum, $T_7$- 40% RDN through human urine (Basal) + 60% RDN through Urea, $T_8$- 40% RDN through human urine (Basal) + 60% RDN through Urea + Gypsum, $T_9$- 40% RDN Urea (Basal) + 60% RDN through human urine in 6 splits and $T_{10}$- 40% RDN Urea (Basal) + 60% RDN through human urine + gypsum in 6 splits .

Banana suckers were planted at a spacing of 2 m x 2m (4 plants plot $^{-1}$) during summer to rainy seasons 2007-08 (April- 2007). Human urine at the calculated amount was applied in 6 equal splits at suitable interval to supply nitrogen and balanced phosphorus and potassium applied through chemical fertilizer as per the treatment. General crop recommendation for Elakki banana were followed (KAU, 1996).

Two plants in each plot were marked as observation plants and growth characters such as height, number of functional leaves were recorded at third months, six months after planting and at harvest stage. Yield and yield attributes viz., number of hands bunch $^{-1}$ and number of fingers were recorded at harvest. Quality analysis of the fully ripe fruits such as Non -reducing sugars (per cent), total soluble sugars and reducing sugars were done as per standard procedure. The data statistically analysed by applying techniques of analysis for RBD (Snedecor and Cochran (1967). Total cost of cultivation and gross returns were calculated from average input cost and average market price of the produce during the period of investigation and cost : benefit ratio was computed as follow Benefit cost ratio (BCR) = Gross returns /cost of cultivation.

## RESULTS AND DISCUSSIONS

### Effect of human urine on banana yield (t ha$^{-1}$) and quality

A significant difference in length of fruit, diameter of fruit, number of hands per bunch, number of fingers per hand, bunch height and bunch weight of banana was observed due to treatments (Table-1). The highest value was registered under $T_6$ treatment which received RDN through human urine (After 30 days of planting) + Gypsum when compared to RDF and control. This might be due to steady and increased availability of nutrients from human urine resulting in increased uptake by plants and rapid differentiation of the meristem into various floral primordial structures, that determine the future bunch size

The different treatments tried in this experiment significantly influenced the banana yield. The highest banana yield (30.0 t ha$^{-1}$) was recorded in $T_6$ treatment which received RDN through human urine (After 30 days of planting) + Gypsum. But all the other treatments receiving urine with or with out fertilizers were significantly superior over absolute control. This might be due to the improved soil fertility caused by the application of human urine and satisfactory availability of nutrients and more enzymes activity. Another possible reason might be due to the improved soil fertility caused by the application of anthropogenic liquid waste and satisfactory availability of nutrients and more enzymes activity (Hoguland, 2001). Other possible reason is the increased bunch weight is due to a corresponding increase in length of bunch, number of hands, number of fingers length and weight. This is in confirmation with the findings of Ray *et al*. (1993).

The other possible reason for the increased bunch weight is due to a corresponding increase in length of bunch, number of hands, number of fingers length and weight (Table-2).

### Quality parameters of banana as affected by human urine application

The highest total soluble sugars content (25.85 percent) was recorded in $T_6$ treatment received recommended dose of anthropogenic liquid waste (after 30 days planting) + gypsum).

Though slight difference was noticed in reducing content and non reducing sugar content among treatments. Significant difference was observed in total sugars. However the treatments were on par with each other. The reasons for these results are possibly the varietals characteristics controlling the content of biochemical quality parameters like non reducing sugars and total sugars

### Influence of anthropogenic liquid waste on economics of banana cultivation

Gross returns higher in human urine applied treatments. The highest gross returns (Rs. 525000.00 ha$^{-1}$) were recorded in $T_6$ treatment which received RDN through ALW (After 30 days of planting) + gypsum (Table-3). This might be due to increase in bunch yield.
Higher cost of cultivation was incurred on production per hectare with the in $T_2$ treatment which received recommended dose of fertilizer (Rs. 59790.25). This may be due to higher amount spent towards fertilizers. Indeed lower cost of cultivation was recorded in human urine applied treatments, as it is available for free of cost.

A relatively higher net returns and benefit cost ratio was obtained in $T_6$ treatment which received RDN through ALW (After 30 days of planting) + gypsum. This might be due to lower cost of cultivation and higher bunch yield of banana and higher marketable price at the time of selling and difference in cost of cultivation.

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**Table-1**.Effect of anthropogenic liquid waste on number of hands per bunch, number of fingers hand$^{-1}$, bunch weight (kg) and yield (t ha$^{-1}$) of banana.

| **Treatments** | **No. of hands per bunch** | **No. of fingers\ bunch $^{-1}$** | **Bunch weight** (kg) | **Yields** (t ha$^{-1}$) |
|---|---|---|---|---|
| $T_1$-Control | 9.0 | 11.0 | 8.0 | 19.93 |
| $T_2$- RDF | 11.0 | 12. | 11.0 | 28.41 |
| $T_3$-RDN through human urine (Basal) | 10.0 | 14 | 10.0 | 24.92 |
| $T_4$- RDN through human urine (Basal) + Gypsum | 11.0 | 12 | 10.5 | 27.41 |
| $T_5$- RDN through human urine (After 30 days of planting) | 11.0 | 14 | 11.5 | 28.65 |
| $T_6$- RDN through human urine (After 30 days of planting) + Gypsum | 12.0 | 16. | 12.5 | 30.00 |
| $T_7$-40% RDN through human urine (Basal) + 60% RDN through Urea | 9.0 | 12 | 9.5 | 23.67 |
| $T_8$-40% RDN through human urine (Basal) + 60% RDN through Urea + Gypsum | 9.0 | 14 | 10.0 | 24.92 |
| $T_9$-40% RDN Urea (Basal) + 60% RDN through human urine in 6 splits | 10.0 | 13 | 11.0 | 24.92 |
| $T_{10}$-40% RDN Urea (Basal) + 60% RDN through human urine + Gypsum in 6 splits | 11.0 | 13 | 11.5 | 27.45 |
| Mean | 10.27 | 13 | 10.55 | |
| SEd | 0.05 | 0.30 | 0.07 | 1.02 |
| CD (P = 0.05) | 0.10 | 0.62 | 0.14 | 2.04 |

**Table-2**.Effect of anthropogenic liquid waste on fruit quality of banana.

| **Treatments** | **TSS** | **Reducing sugars** | **Non-reducing sugars** | **Total sugars** |
|---|---|---|---|---|
| | (%) | | | |
| $T_1$-Control | 22.21 | 18.06 | 2.43 | 20.49 |
| $T_2$- RDF | 25.67 | 21.03 | 2.74 | 23.76 |
| $T_3$-RDN through human urine (Basal) | 23.46 | 18.99 | 2.65 | 21.64 |
| $T_4$- RDN through human urine (Basal) + Gypsum | 23.60 | 18.99 | 2.65 | 21.64 |
| $T_5$- RDN through human urine (After 30 days of planting) | 25.80 | 21.90 | 2.91 | 23.83 |
| $T_6$- RDN through human urine (After 30 days of planting) + Gypsum | 25.85 | 20.93 | 2.98 | 23.87 |
| $T_7$-40% RDN through human urine (Basal) + 60% RDN through Urea | 23.05 | 19.17 | 2.94 | 22.06 |
| $T_8$-40% RDN through human urine (Basal) + 60% RDN through Urea+ Gypsum | 23.26 | 19.32 | 2.73 | 22.05 |
| $T_9$-40% RDN Urea (Basal) + 60% RDN through human urine in 6 splits | 25.45 | 21.05 | 2.75 | 23.76 |
| $T_{10}$-40% RDN Urea (Basal) + 60% RDN through human urine + Gypsum in 6 splits | 25.67 | 21.03 | 2.74 | 23.80 |
| SEd | 0.99 | 0.60 | 0.12 | 0.61 |
| CD (P = 0.05) | 0.28 | 1.20 | NS | 1.22 |

**Table-3**. Economics of cultivation of banana crop as influenced by application of anthropogenic liquid waste.

| **Treatments** | **Banana yield** ($t\ ha^{-1}$) | **Gross returns** (Rs) | **Cost of cultivation** (Rs) | **Net returns** (Rs) | **C : B ratio** |
|---|---|---|---|---|---|
| $T_1$-Control | 19.93 | 348775 | 45640.00 | 303135.00 | 1:6.64 |
| $T_2$- RDF | 28.41 | 497175 | 59790.25 | 437384.75 | 1:7.32 |
| $T_3$-RDN through human urine (Basal) | 26.92 | 471100 | 52490.60 | 418609.40 | 1:7.97 |
| $T_4$- RDN through human urine (Basal) + Gypsum | 27.42 | 479675 | 52805.60 | 426869.40 | 1:8.08 |
| $T_5$- RDN through human urine (After 30 days of planting) | 28.65 | 501375 | 52490.60 | 448884.40 | 1:8.55 |
| $T_6$- RDN through human urine (After 30 days of planting) + Gypsum | 30.00 | 525000 | 52805.60 | 472194.40 | 1:8.94 |
| $T_7$-40% RDN through human urine (Basal) + 60% RDN through Urea | 24.67 | 431725 | 59155.15 | 372569.85 | 1:7.70 |
| $T_8$-40% RDN through human urine (Basal) + 60% RDN through Urea+ Gypsum | 28.92 | 506100 | 59280.15 | 446819.85 | 1:7.54 |
| $T_9$-40% RDN Urea (Basal) + 60% RDN through human urine in 6 splits | 28.92 | 506100 | 56985.00 | 449114.90 | 1:7.88 |
| $T_{10}$-40% RDN Urea (Basal) + 60% RDN through human urine + Gypsum in 6 splits | 27.45 | 480375 | 57165.10 | 423209.90 | 1:7.40 |

Note:
Urea- Rs. 5.50 /kg, Single super phosphate- Rs.3.50
Mop- Rs. 4.75, 1 kg Banana- Rs.17