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The Use of Urine as Free Fertilizer Increasing Plant Growth

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Abstract: *Human urine is freely available around the world and is composed of nitrogen (N), inorganic potassium (K), phosphorus (P), and other nutrients directly absorbable by plants. This resource was tested on several tropical horticultural species and showed rapid positive effect on plants growing. In the nursery: 3 trees and 1 vine species were treated with 50 mL urine (1/3) + water (2/3) and compared to control (50 mL of water). After 36 days of treatment, papaya tree, passion fruit vine, Serianthes myriadenia and Hibiscus tiliaceus treated with urine were significantly higher, greener and produced more leaves than control sister seedlings treated with water only. Human urine should be managed to keep valuable nutrients, benefiting for plants and food security and not treated as a waste product.*

Keywords: *Carica papaya, Hibiscus tiliaceus, horticulture, Passiflora edulis, organic, urine*

1. Introduction

The green revolution in agriculture led many people to forget about basic ecological rules in agriculture and most of them did not think that animal wastes are recycled / reused by plants. That is why today, human urine is thrown in drinkable water followed by costly treatment as public sanitation, and chemical fertilizers are bought and used for agriculture. However human urine is composed of nitrogen (N) (as urea (75-90%) and ammonium), inorganic potassium (K), phosphorus (P), Calcium (Ca), Sulphur (S) and Magnesium (Mg)[3] directly absorbable by plants, similarly to commercial fertilizers (Pradhan et al., 2007, Egigu et al., 2014, Nagy and Zseni, 2017). It was shown to be as efficient as commercial fertilizers without pathogen risk, low NH_3 emissions, no flavour effect, and has been tested positively on 6 different plant orders and families including tomatoes, cabbages, beans, corns, etc. (see table 1 with references). However, despite the importance of the subject, researches are recent, relatively rare and public still skeptical. Furthermore, I did not find scientific tests on horticultural species for food or wood production. This paper proposes to test human urine on tropical plant growth in horticultural nursery with tree and liana species. The target species are tropical plants used for fruit production (passion fruit, papaya) and tropical trees used for conservation purposes and reforestation programs (Beaune et al. 2018). The hypothesis is in accordance with general finding: trees and liana grow faster with human urine supplementation. The experimental design is simple in order to be easily reproducible by organic farmers and food security gardeners in developing tropical areas without chemist material.

2. Material and Methods

The tree nursery is located in Taravao, Tahiti, French Polynesia (Latitude**:** -17.752531 | Longitude**:** -149.318388) with tropical climate. The nursery is not covered, but shadowed by surrounding trees and receives natural rain plus artificial watering during days without rain. To limit genetic variation, the papaya (N=50 VS 50) are from the same fruit, and passiflora (50 VS 50), *Hibiscus* (20 VS 20) and *Serianthes* (30 VS 30) seeds are from the same parental tree. Two lots (marked, control with water VS. urine supplementation) of each species are spatially mixed and randomly remixed every week in order to confound µ-environmental factors (shadow, wind exposure, etc.). Seedlings planted at the same time in May 2017, are in black plastic pots (5x5x10cm high) filled with coconut coir; Weeds continuously removed. Plants were watered every three days with 50 mL of rain water (control) or 50 mL of urine treatment (1/3 of fresh human urine diluted in rain water). Human Urine compound varies

among adults. The source is a healthy vegetarian male without medication (composition should be close to N=3.07±1.15 g/L, K= 1.7±0.2, P=0.02±0.004 and S=1.17±0.12 g/L found in (Ranasinghe et al., 2016). Watering was done at the base of the seedling to avoid leaf damage due to the ions (Jönsson et al., 2004, Vinnerås et al., 2003). Seedling height and leaf number was measured after 36 days of treatment and compared. Growths and leaf number were compared and difference tested using *ad hoc* parametric t-test or W according to normality with R statistical software (R Development Core Team, 2011).

Table1: *Plant species showing positive results of growing with urine supplementation*

Order	Family	Plant Name	Species Name	Reference
Brassicales	Brassicaceae	cabbage	*Brassica oleracea*	(Pradhan et al., 2007)
Brassicales	Caricaceae	papaya	*Carica papaya*	this study
Caryophyllales	Amaranthaceae	beet	*Beta vulgaris*	(Egigu et al., 2014)
Cucurbitales	Cucurbitaceae	cucumber	*Cucumis sativus*	(Heinonen-Tanski et al.,2007)
Cucurbitales	Cucurbitaceae	pumpkin	*Cucurbita maxima*	(Pradhan et al., 2008)
Fabales	Fabaceae	beans	*Phaseolus vulgaris*	(Ranasinghe et al., 2016)
Fabales	Fabaceae	Faifai	*Serianthes myriadenia*	this study
Malpighiales	Passifloraceae	passion fruit	*Passiflora edulis*	this study
Malvales	Malvaceae	okra	*Abelmoschus esculentus*	(Akpan-Idiok et al. 2012)
Malvales	Malvaceae	Hibiscus	*Hibiscus tiliaceus*	this study
Poales	Poaceae	maize	*Zea mays*	(Guzha et al., 2005)
Poales	Poaceae	Barley	*Hordeum vulgare*	(Heinonen-Tanski et al., 2007)
Poales	Poaceae	wheat	*Triticum* sp	(Tidåker et al., 2007)
Solanales	Solanaceae	tomatoe	*Solanum lycopersicum*	(Egigu et al., 2014, Mnkeni et al., 2008, Pradhan et al., 2009)

3. RESULTS

Differences were clearly visible after only 36 days of treatment. For papaya, the seedlings that received urine were higher (156±SE.3cm VS. 92±2; p-value < 0.001), with more leaves (13.4±4 VS 6.8±2; p-value < 0.001). Passion fruit vines receiving urine were longer (119.1±3.5cm VS 79.6±3.0) and with more leaves (8.2±0.5 VS 5.9±0.3; p-value < 0.001). Hibiscus with urine were higher (146.9±12.6.1cm VS 76.2 ±17.1; p-value < 0.001) and with more leaves (8.6±0.7 VS 5.0 ±1.1; p-value < 0.001). Serianthes with urine were higher (241.2±6.3cm VS. 185.2±12.5; p-value < 0.001) with more leaves (7.6±0.2 VS 5.5 ±0.3; p-value < 0.001). See figures 1 and 2. All the plants for all the species presented greener leaves with urine treatment. See figure 3.

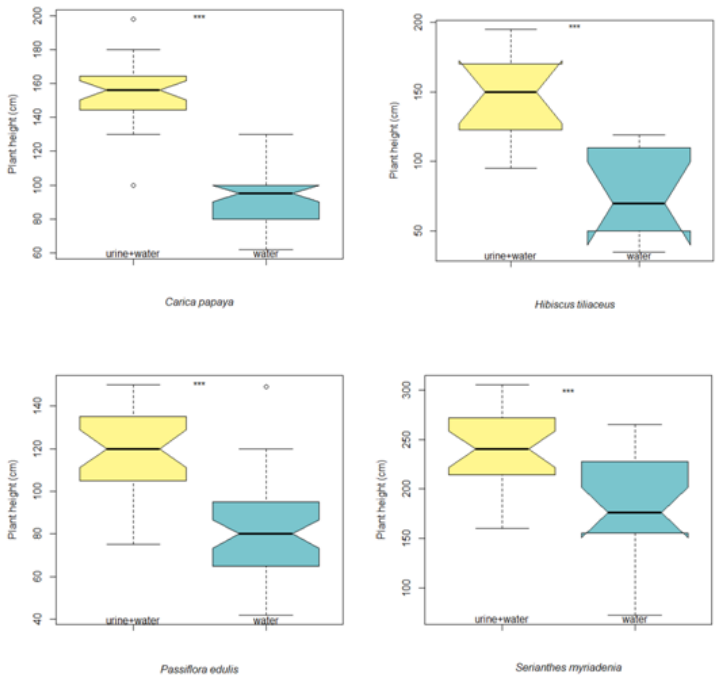

Figure1: *Differences in height for 4 tropical horticultural plants treated with 50 mL of human urine (1/3 diluted within+2/3 of rain water) (yellow boxes) and control treated with 50 mL of rain water (blue boxes). *** indicate significant difference with p-value < 0.001 (t or W tests) and Power analysis > 90%.*

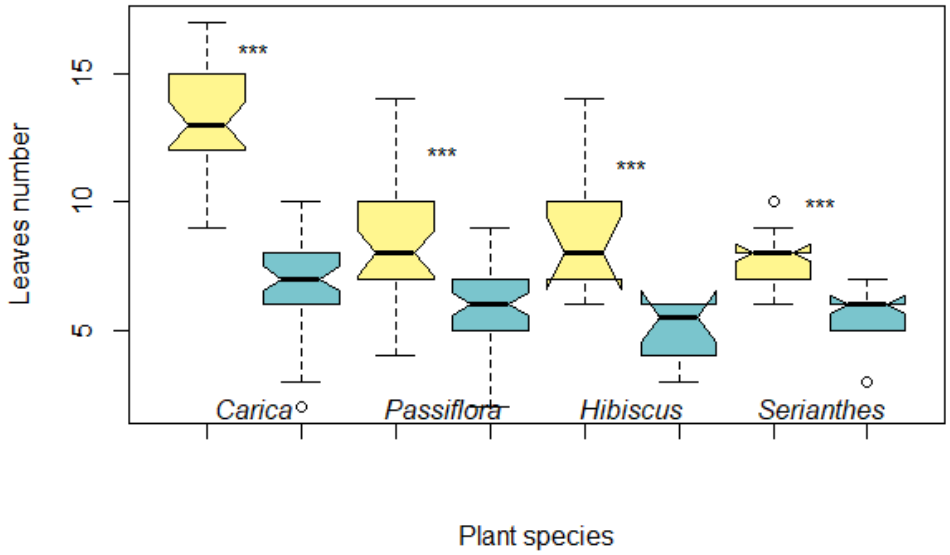

Figure2 : *Differences in leaves number produced for 4 tropical horticultural plants treated with 50 mL human urine (1/3 diluted within+2/3 of rain water) (yellow boxes) and control treated with 50 mL of rain water (blue boxes). *** indicate significant difference with p-value < 0.001 (t or W tests) and Power analysis > 90%.*

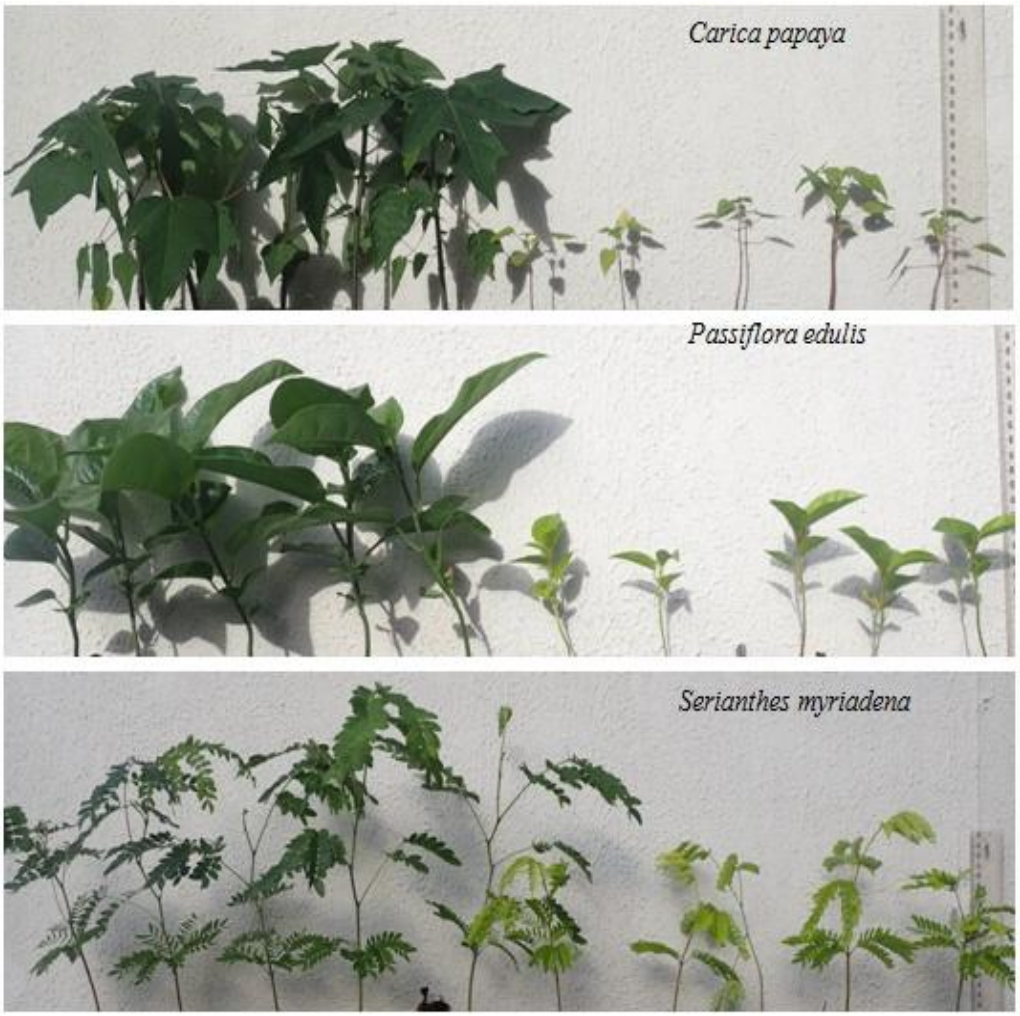

Figure3: *Random samples of the tropical horticultural plants treated with 50 mL of human urine (1/3diluted within 2/3 of rain water) (4plants at the right) and control treated with 50 mL of rain water (4 left).*

4. DISCUSSION

As for crops and vegetables, trees and liana seem to benefit human urine supplementation (50 mL of water with 1/3 urine every 3 days). In this tropical area, the treated seedlings grow faster and develop more leaves. Furthermore and not measured here, the treated plants have greener and larger leaves than sister plants receiving only water, while popular thoughts is that urine can kill plants or make them yellow. This difference in leaves color is probably due to a lack of nutrients for yellow leaves. While urine is still considered as a valuable waste and a water management and sanitation problem in the majority of poor and rich countries, it should be considered as a nutrient resource. Each adult human produces 1-1.5L of free urine per day (this study) with N, P and K. In spite of being a problem, urine could become the new golden fertilizer and cities would be considered as new mines for resources (in spite of exploiting mines that degrade ecosystems). With new urban and sanitation organization, human urine could be collected and separated from feces and be used for agriculture and horticulture (Heinonen-Tanski and van Wijk-Sijbesma, 2005, Nagy and Zseni, 2017). Dosage and other treatments as ash and compost adds is also considered for efficiency, soil structure and improved nutrient content (Pradhan et al., 2009, Jönsson et al., 2004, Rodhe et al., 2004, Vinnerås et al., 2003). This is cost and environmental effective, for ecology, economy, organic farming and food security in developing countries or in our case, for horticulture of endemic trees for a conservation program.

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