## 1. What is urine?

Urine is the fluid excreted by the kidneys. It consists of water, carrying in solution the body's waste products and excess substances. Most of the nutrients absorbed by the human body from the food we eat is excreted via urine. Therefore, urine is rich in valuable plant nutrients and can be considered a liquid fertilizer.

| | Per litre | Per person & year |
|---|---|---|
| Nitrogen | 7 g | 3.5 kg |
| Phosphorus | 1 g | 0.5 kg |
| Potassium | 2 g | 1.0 kg |
| Sulphur | 1 g | 0.5 kg |
| Magnesium | 80 mg | 40 g |
| Calcium | 200 mg | 100 g |

*Tab 1: Approximate plant nutrient content of human urine*

Within a period of one year, an average person excretes almost 6 kg of pure plant nutrients via urine. This is almost equivalent to the amount of nutrients contained in 15 kg of compound NPK+ fertilizer.

*Fig. 1: Selection of sanitary installations for urine collection. Flush-less sitting toilet (Ghana), squatting pan (China) and home urinal (Germany)*

## 2. Why fertilize with human urine?

Just like the nutrients in chemical fertilizers, those in urine are easily taken up by plants. The well-nourished plant will grow faster, develop more leaves and produce greater yield. When urine is applied to crops instead of fertilizers, we save the expenditure on the latter while achieving the same yield increase.

## 3. How to fertilize with urine?

Application of urine can be scheduled as usually done with nitrogen fertilizers. Any planning of urine fertilization must take the transport into account. In comparison with common fertilizers, the nutrient density of urine is low. For example, to provide 1 kg of nitrogen, we only need about 2 kg of urea, but almost 150 litres of urine. Consequently, it is convenient either for crop land to be close to the urine collection facility or to have an appropriate transport system available.

| | Low | Medium | High |
|---|---|---|---|
| Crops | Herbs, beans, peas, lettuce | Onions, peppers, potatoes | Tomato, cucumbers, cabbage |
| N-demand kg per ha | 45 | 100 | 160 |
| Urine litre per ha | 6,500 | 14,000 | 23,000 |
| Urine litre per $m^3$ | 0.6 | 1.4 | 2.3 |

*Tab 2: Urine application rates in relation to the crop nutrient demand*

Depending on what crops are grown, the urine of one person is enough to keep 300 to 1,000 $m^2$ well-fertilized.

## 4. The nutshell guideline

- *Collect urine.* Urine is collected separately from faeces to allow its use as a liquid fertilizer. In waterless toilet systems the separate collection also reduces odour nuisance and enhances pathogen die off in the faecal matter. Depending on the scale a variety of plastic containers, urinals with local or centralised collection and separating toilets can be used. Generally waterless toilet systems are preferable as the dilution of urine with water multiplies the storage and transport requirements.

*Fig. 2:Urine storage tanks close to agricultural fields (Ghana)*

- *Storage.* Storage of urine allows its use when the nutrients are most needed. Further, during the storage period, chemical processes kill pathogens. In tropical climates, urine should be stored for about three months before application. If storage is not possible, then the fresh urine should only be applied to tall standing crops. Examples of such crops are: banana, plantain, papaya, oranges, avocado and mango.

- *Stirring*. During storage urine tends to develop crystallisation and precipitation of salts while it is standing at ambient temperature. These salts may trap a significant proportion of the

total nutrients, especially phosphorus. Therefore, the stored urine should occasionally be stirred before field application.

*Fig. 3: Fertigation of a cashew seedling with urine-water mixture*

- *Timing*. Avoid application during elevated day time temperatures. A large amount of nitrogen will evaporate when the urine comes in contact with hot soil. Fertilization with urine, as with all other nitrogen fertilizers, should be preformed at cool temperatures, either in the early morning or late in the afternoon.

Urine is ideally applied before light rainfall. This will ensure that the nutrients are washed into the soil. On very dry soils, more nitrogen evaporates, and in the case of heavy rains, nutrients are washed away from the crops.

- *Application*. Fertilization with urine is most commonly preformed with watering cans. When large quantities of urine are to be applied on extensive areas, application devices as used for other liquid fertilizers are preferable. To reduce nitrogen losses, the urine can be worked into the soil, or the treated area is covered with leaves or compost.

Dilution of urine is not necessary if the urine is applied directly onto the soil. For leaf application, e.g., seedlings and vegetables, dilution of one part urine with 5 or more parts of water will avoid burning of leaf tissue.

## 5. Troubleshooting

- *Plants are yellowish.* Insufficient nitrogen supply, or inability of the plants to absorb nutrients. Increase urine dosage or improve growing conditions, e.g., irrigation or drainage.
- *Plants are dark green and susceptible to aphid attack*. Likely nitrogen over-fertilization, suspend urine application.
- *Plants are stunted and bluish green.* Soil is becoming saline. Leach salts from soil by excess irrigation or suspend urine fertilization.
- *Leaves have an unusual red to purple tinge.* Plants may be phosphorus deficient. Apply compost, manure or phosphorus fertilizers.

## 6. Hygiene considerations

Human urine is generally free of pathogens (germs) when excreted by a healthy person. However, post-excretion cross-contamination, e.g., from separating toilets, may occur. Therefore, urine should never be applied directly onto the part of the plant to be harvested and crops should not be fertilized within a month before harvest. Naturally, as with all other manures, hand washing after working with urine is strongly recommended.



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# Fertilization with human urine...


# ...in a nutshell