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## **Recycling of Agricultural, Municipal and Industrial Residues in Agriculture**

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## **HUMAN URINE AS A FERTILISER - PLANT NUTRIENTS, APPLICATION TECHNIQUE AND ENVIRONMENTAL EFFECTS**

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A large proportion of the plant nutrients that human beings excrete is found in the urine, which makes it interesting to sort and recycle the urine as fertiliser in agriculture. Urine is collected in source separating toilet systems.

A field trial was carried out by JTI during 1997-1999 with the purpose of investigating human urine as a fertiliser in agriculture and the effects on a crop of barley, soil and environment. Treatments were organised into a randomised block design with three replicates. In the trials, two different spreading seasons (spring or early summer in growing crop), two techniques (band spreading followed by incorporation four hours after spreading by harrowing or band spreading with trailing shoes) were used for different application rates. The studies concerned yield, ammonia losses, and risk for nutrient leakage. The experimental site was situated south of Stockholm. Also, balances on field level were made concerning plant nutrients in order to compare human urine and mineral fertilisers.

The results from the trials showed that human urine is a quick acting fertiliser that can replace mineral fertiliser in production of cereals. The part of ammonia nitrogen in the urine was as high as 80-100% of the total nitrogen content. The calculated effect of human urine showed that an application of 100 kg nitrogen per hectare with human urine gave a yield that was 70-100% of the yield produced with 100 kg nitrogen in mineral fertiliser per hectare.

Nitrogen losses in the form of ammonia were in average over a period of three years, 5% of applied nitrogen after spring application. The largest losses amounted to 10% of applied nitrogen, which was measured after an application of 60 tonnes of urine per hectare in spring. The losses were very low, close to 1% of applied nitrogen, when the urine was incorporated directly into the soil by band spreading with trailing shoes. Hardly any emissions could be detected when the urine was applied in growing crop.

No negative effects could be noticed when the urine was spread in growing crop. This means that the time for application can be extended from sowing until the crop is 20-30 cm high. The result showed that late application during the growing season should be combined with a starter of mineral nitrogen in the spring.

The levels of residual mineral nitrogen in the soil after harvest were on the same level in plots fertilised with human urine as in plots fertilised with mineral fertiliser. However, plant nutrient balances showed that there were larger amounts of nitrogen left in the soil after fertilisation with human urine than after mineral fertiliser. This nitrogen may be

stored in the organic soil pool of nitrogen, or may be lost through leakage or denitrification.

The studies were carried out by JTI and financed by Stockholm Water Company (Stockholm Vatten AB).