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**Pelletised biomass ash (5:1 ash to gypsum, 12% water) applied at 3–7 t/ha significantly increased soil potassium, calcium concentrations and boosted ryegrass biomass yield by up to 38%, proving its effectiveness for urban soil remediation.**

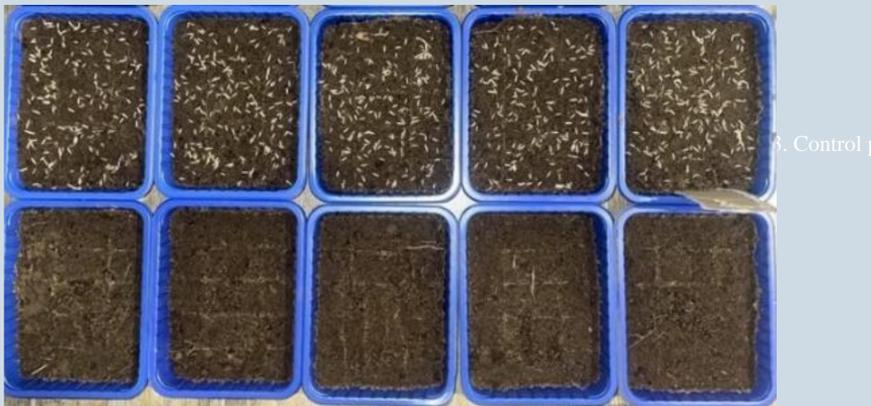


Fig. 1. Control pots (bottom) and Ryegrass pots (top)



Fig. 2. Biomass ash and gypsum pellets ratio of 5:1 and ratio of 15:1

## Introduction

Biomass ash, a byproduct of energy production from biomass (170 million tonnes annually), is rich in essential nutrients like Ca, K, Mg, and P, making it a promising soil amendment for degraded urban soils by enhancing its fertility, structure, water retention, and microbial activity. However, concerns over heavy metal content (Pb, Cd, Zn, Cu) remain, and this study aims to evaluate the effectiveness of ash-gypsum pellets in improving nutrient-depleted urban soils while evaluating environmental risks.

## pH changes

Biomass ash pellets application had a significant influence on soil pH. While 1 t/ha and 3 t/ha rates had minimal effect (negating natural acidification), 5 t/ha and 7 t/ha significantly increased pH. The highest fertilisation rate (7 t/ha) increased pH by 0.28 within 28 days, confirming biomass ashes and gypsum pellets potential as a liming agent in acidic soils.

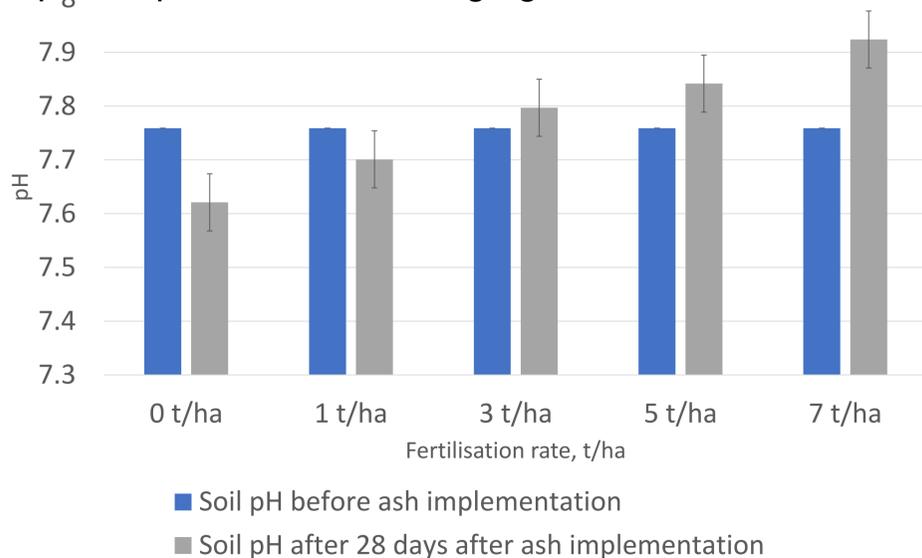


Fig. 3. Soil pH levels changes before and after fertilization

## Methodology

XRF analysis was used to determine initial elemental composition of ash and soil and soil elemental composition changes, while ash-gypsum pellets were produced in varying ratios and applied at rates from 0 to 7 t/ha to pots sown with ryegrass, simulating field conditions. Over four weeks, soil nutrients, pH, and ryegrass biomass yield were monitored, revealing the influence of pelletised ash fertilisation on urban soil remediation.

## Biomass yield

Fertiliser rates of 5 t/ha and 7 t/ha enhanced ryegrass biomass by 30.9% and 38.0%, respectively, after 21 days, while lower rates showed no significant effect. Reduced biomass ash pellets effect on biomass yield when compared to 3 t/ha to 5 t/ha and 5 t/ha to 7 t/ha fertilisation rates suggests that there might be a threshold application level for optimal growth response, beyond which yield gains may plateau.

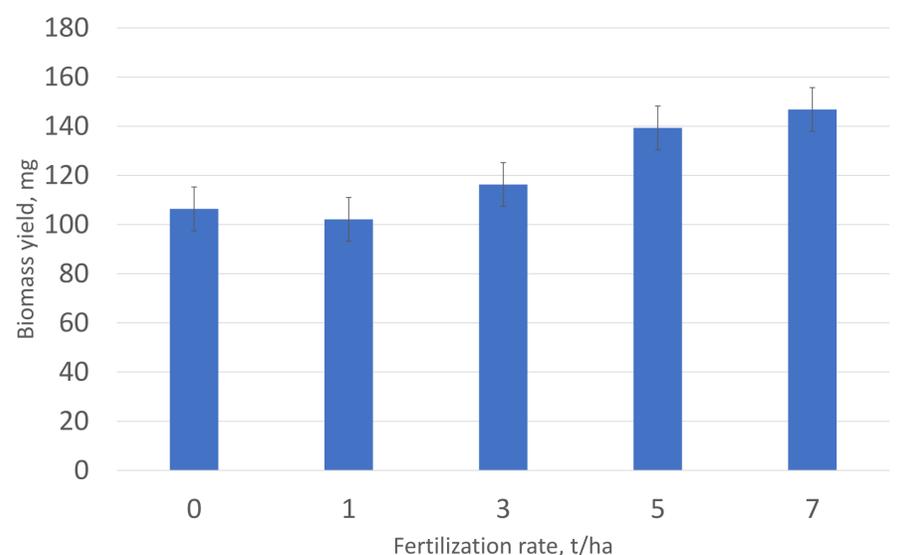


Fig. 4. Ryegrass biomass yield after 21 days since germination