Enhancing agricultural productivity of chickpeasusing Low-grade rock phosphate enriched human urine

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**Abstract**

To maintain agricultural production in a resource-constrained environment, it is essential that current reserves be maximised while also encouraging their recycling. Furthermore, considerable value may be generated from methods of using previously thought waste products. This study proposes a distinctive fertiliser blend of two waste materials: low-grade Rock and human urine, to investigate alternative replenishing ways. The use of this combination has been proved to be a viable alternative to produced inorganic fertilisers. Cicer arietinum crop tests were carried out on a red loamy soil utilising RP enriched urine at diverse application rates (pH of 8.11). Plant growth response testing revealed that using this fertiliser combination in the same ratio produced results equivalent to using the mineral fertiliser Di-Ammonium Phosphate. As a result, the usage of RP enriched urine provides a great deal of prospects for waste reduction, waste utilisation, and enhanced resource performance all at the same time.

Introduction

Cropping arable land for human use has an influence on the inherent availability and distribution of nutrients found in the soil. Cultivated fields need the addition of soil-enhancing fertilisers on a regular basis to preserve long-term soil fertility and a quality yield. In commercial agricultural production, this has been done via the use of synthetic chemical fertilizer. In past few years, urea and ammonium nitrate have proved to be the most used nitrogen (N) sources for soil additions in agricultural fertilisation. In many locations, phosphorus (P) is the predominant growth limiting soil nutrient; phosphate fertilisers have contributed an important part in raising agricultural productivity and bringing global food supply to present levels. Soil health has suffered because of poor soil nutrient management and the continued use of artificial fertilizers (Sarkar et al., 1997). Innovative strategies and procedures for increasing agricultural productivity must be envisioned and implemented to guarantee the most effective use of available resources and the long-term sustainability of food supply. In this context, human urine has been proposed as a sustainable, high-quality, low-cost alternative fertiliser capable of supplying a rich reservoir of minerals to increase agricultural output (Wohlsager et al., 2010). This research suggests a novel method for enhancing soil fertility by combining the application of low-grade RP and human urine on the plant development response properties of Chickpea (Cicer arietinum).

Material and Methods

Human urine was obtained from twenty healthy young male volunteers. Fresh samples of urine were collected in plastic sealed canisters and refrigerated at -20°C to reduce ammonia volatilization. Jordan Phosphate Mines Company Limited's Eshidiya mines produced RP tailings with 43.8% tricalcium

phosphate (20.05% P2O5). Plant growth studies were conducted at the VIT University Research Farm in Vellore, India. The soil used was red loam soil with 4.33% gravel, 92.84% sand, and 2.83% fines. Air-dried soil was placed in trays (0.44 0.32 0.14 m) and 8 replications were carried out. Trays were arranged in six different arrays. On a grid of four rows by twelve columns, each array comprised eight copies of the six soil treatments. It was determined that the plant growth data had a normal distribution with uniform variances. The data was statistically analysed in Microsoft Excel using ANOVA followed by Tukey- HSD as a post-hoc test at a level of significance of P 0.05.

Results and Discussion

The crop experiment findings presented here imply that waste products like as low-grade RP and human urine might be employed to restore nutrients to impoverished lands. A proportional agronomic accuracy of 1.2 computed using experimental results from 8 simulations confirms the viability of employing these waste products as recycled crop fertilisers (Table 1). Rodhe et al., (2004) observed that utilising human urine may achieve crop yields comparable to 90% of those of similar ammonium nitrate fertiliser in their investigation on the N impact of fertilisers on barley in a Swedish environment. The pH of the soil rose substantially following the treatment, from 8.11 to 8.32, owing mostly to urea hydrolysis. Because of increased K and Na availability, the treated soils' Cation Exchange Capacity (CEC) increased dramatically. The high nitrogen concentration of urine, together with *Cicer arietinum's* nitrogen-fixing activities, increased the overall nitrogen content of the soils.

Conclusions

The current research developed a technique for fertilising crops by combining low-grade RP and human urine. Numerous plant growth indices indicate that such fertilisers have a significant potential to function as substitutes to chemical fertilizer currently in demand. The application of human urine in agriculture via urine diversion and eventual use as a N source for improving yield offers two major benefits: it minimizes health hazards to persons by diverting urine from polluted water networks while rapidly recovering nutrients back into agricultural systems. Additionally, the usage of low-grade RP offers a long-term solution for feeding P to plants, particularly in regions where high-grade RP deposits are scarce. It ensures the use of both low-grade RP and human urine while also serving like a low-cost alternative to inorganic fertilizer including DAP. According to the study's conclusions, waste materials may deliver considerable social and environmental benefits.

References

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**Figures and Tables**

**Table 1** Response of plant parameters (Cicer arietinum) and effectiveness of different treatments

