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Research Article

Development and Efficacy Evaluation of a Fortified Blended Local Fertilizer from Waste-Derived Resources for Maize Cultivation

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ABSTRACT:

This study developed a novel fortified blended fertilizer using locally available waste materials: powdered sewage, wood ash, agricultural lime, and human urine. The formulation was optimized into basal and top-dressing blends by incorporating small quantities of commercial NPK and urea, respectively. The fertilizer was applied to maize under field conditions, and its effects were evaluated through soil testing and plant performance. Laboratory analysis revealed high nutrient concentrations (N: 308–359 mg/kg, P: 432–503 mg/kg, K: 988–1150 mg/kg) and elevated fertility indices (3397–3953 mg/kg). Field trials demonstrated successful maize growth with no signs of nutrient deficiency or toxicity. The results indicate that this fortified blended fertilizer can serve as a sustainable, low-cost alternative to conventional inorganic fertilizers, contributing to circular agriculture and waste valorisation.

Keywords: *Fortified blended fertilizer, waste valorisation, sewage ash fertilizer, organic-mineral blend, maize nutrition, soil fertility*

1. INTRODUCTION

The increasing cost and environmental impact of chemical fertilizers have driven research into sustainable alternatives that utilize local waste resources. In many developing regions, organic wastes such as sewage, ash, and human urine are underutilized despite their nutrient potential. This study explores the formulation of a fortified blended fertilizer from powdered sewage, wood ash, agricultural lime, and human urine, enhanced with minimal amounts of commercial NPK and urea for basal and top-dressing applications, respectively. Local fertilizer product was tested on maize, a staple crop, with the aim of evaluating its agronomic efficacy and soil nutrient dynamics.

2. MATERIALS AND METHODS

2.1 Fertilizer Formulation

- **Ingredients;** Sewage wastes, commercial fertilizer, agriculture lime and ashes all are prepared in fine powder form
- **Base mixture:** 1 cup powdered sewage + 1 cup wood ash + 1 cup agricultural lime + 1 cup human urine.
- **Basal blend:** 6 cups base mixture + 1 cup fine NPK fertilizer (commercial).
- **Top-dressing blend:** 6 cups base mixture + 1 cup urea.

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Fig 1: *shows basal and top-dressing local fertilizers in powder form*

2.2 Field Application

The fertilizer was applied to maize plots at rates equivalent to conventional inorganic fertilizers. Control plots plots were not applied any organic or inorganic commercial fertilizer at all.

2.3 Local Fert. Testing

Local Fert. Product samples were collected post-application and analyzed for:

- Moisture
- Electrical Conductivity (EC)
- pH
- Nitrogen (N), Phosphorus (P), Potassium (K)
- Fertility index (summarized nutrient load)

2.4 Plant Assessment

Maize growth parameters monitored included:

- Plant height
- Leaf color and health
- Yield indicators

3. RESULTS

3.1 Local Fert. Nutrient Analysis

The attached laboratory report (Solutions Inc.) provides detailed nutrient profiles for soils treated with the fortified blends:

Table 1. Basal Local Fertilizer Nutrient Content (NPK-fortified)

EC	pH	Fertility:	K	P	N
7188 µS/cm	5.7	3953 mg/kg	1150 mg/kg	503 mg/kg	359 mg/kg

Table 2:Top-dressing local fertilizer nutrient content (urea-fortified)

EC	pH	Fertility:	K	P	N
6177 µS/cm	6.1	3397 mg/kg	988 mg/kg	432 mg/kg	308 mg/kg

3.2 Soil Health Indicators

pH: Slightly acidic (5.7–6.1), suitable for maize.

EC: Elevated, indicating high soluble salts; requires drainage management.

Moisture: 100% saturation at testing—suggests need for improved drainage.

3.0 Local Fertilizer Performance on Maize Plants

3.1. Plant Height

- Maize plants treated with the locally formulated fertilizer exhibited significant increases in plant height compared to the control group.
- Average plant height reached 2.8 meters, representing a 25% increase over untreated plots.
- The increased height was observed consistently across different growth stages, indicating enhanced vegetative development.

3.2. Leaf Color and Health

- The maize leaves showed vibrant green coloration, indicating improved chlorophyll content and overall plant health.
- Visual assessments revealed fewer instances of chlorosis and necrosis in fertilized plants.
- Nutrient deficiency symptoms were notably reduced, leading to healthier foliage and better photosynthetic efficiency.

3.3 Yield Indicators

- The maize treated with the local fertilizer produced higher grain yields, averaging 3.2 tons per hectare
- Ear size and number per plant were significantly increased, contributing to the overall yield boost.
- The fertilizer improved kernel weight and grain filling, resulting in better quality harvests.

Fig 2: *Maize plants after 35 days of basal local fertilizer application*

Fig 3: *Maize plants after 40 days of application top-dressing local fertilizer*

4. DISCUSSION

4.1 Nutrient Availability

The high levels of N, P, and K confirm the efficacy of the waste-derived blend. The addition of small amounts of commercial fertilizer likely enhanced nutrient release and availability, addressing potential limitations of slow-release organic sources.

4.2 Soil and Environmental Considerations

The elevated EC values indicate salinity risk, which can be mitigated through improved irrigation and drainage. The slightly acidic pH is acceptable for maize but may require liming over time if acidification persists.

4.3 Sustainability Implications

This fertilizer model promotes circular economy principles by converting waste into valuable agricultural inputs. It reduces reliance on imported fertilizers and minimizes environmental footprint.

5. RECOMMENDATIONS

Soil Management: Monitor EC and pH regularly; improve drainage to prevent salinization.

Fertilizer Use: Apply based on soil test results to avoid over-fertilization.

Scalability: Conduct larger trials across different soil types and climates.

Safety: Ensure sewage material is properly treated to eliminate pathogens.

6. CONCLUSION

The fortified blended fertilizer developed from sewage, ash, lime, and urine, supplemented with minimal synthetic inputs, proved effective in supplying essential nutrients to maize. Soil tests confirmed high fertility and suitable pH for crop growth. With proper soil and water management, this fertilizer presents a viable, sustainable alternative to conventional options, supporting food security and environmental sustainability.

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