Seed Ball Technology Development for Application in Pearl Millet Production Systems in Semi-Arid Senegal

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Summary

In Sahelian cereal production the seed ball technology could be one option to reduce cropping risks and improve grain yields for subsistence-oriented farmers. However, there is a profound lack of knowledge about the potentials and principles of seed ball application. In three subsequent development stages experiments with pearl millet (*Pennisetum glaucum* L.) were conducted in semi-arid Senegal to evaluate and improve the seed ball technology. The first development stage was aimed at creating seed balls from different materials at low or no cost that could mitigated nutrient deficiency for plants (mainly N and P) during early growing stages. Sandy loam ('clay'), charcoal, compost, manure, wood ash, NPK-fertiliser, termite soil and gum arabic were selected for seed ball creation. Seed balls were created using a mixed volumetric-gravimetric ratio scheme.

With regard to chemical properties seed balls of sufficient precision could be created. It was further possible to control the average number of seeds per ball. In the petri dish experiments seed balls with charcoal addition and seed balls without an organic compartment showed the most reliable germination rates. All seed ball types showed a high germination activity of 95% (±11). Gum arabic addition inhibited water suction in seed balls and led to unreliable and poor germination activities of 36% (±33).

Sub-surface seed ball application (SSA) of 3 cm resulted in total emergence inhibition for all seed ball types, irrespective of the simulated rain amount. This included gum treated seed balls. With 15 mm rain and at-surface application (ASA), all seed ball types of 1 cm diameter showed highest plant emergences rates of >80%. However, with increasing seed ball

diameter, emergence rates decreased drastically from >80% to <20%. This was most severe in seed balls made out of manure and compost. Charcoal seed balls showed the highest and most reliable plant emergence independent of seed ball size (65-90%). Also an insufficient rain amount of 5 mm caused a germination of millet in ASA seed balls. A reliable second plant emergence after a simulated dry spell could not be measured.

Sub-surface seed ball application in 1 cm depth and of 1 cm diameter resulted in a strong inhibition of plant emergence for all seed ball variants. Charcoal seed balls and compost-ash seed balls were the least inhibited. With at-surface application of seed balls overall plant emergence increased but still led to emergence inhibition for most of the applied seed ball variants compared to the absolute control. Seed balls made out of manure-termite soil and charcoal-ash showed the best results in plant emergence of 70% and higher. The addition of 1 g gum arabic to the basic seed ball mixtures resulted in increased uncertainty in plant emergence rates and retarded plant growth.

Seed balls influenced nutrient uptake of pearl millet during early growing stages. Above ground biomass formation was significantly increased in manure-termite soil seed balls (absolute control: 229 mg dry weight and manure-termite soil: 560 mg). Charcoal-Ash seed balls caused low N contents in millet (ca. 13-15 mg g^{-1}) compared to the absolute control (22 mg g^{-1}). In pearl millet of ash treated seed balls elevated contents of P was measured (absolute control: 1.7 mg g^{-1} and charcoal-ash: 2.4 mg g^{-1}). Increasing ash levels in Char-Ash seed balls significantly increased K contents from 102 mg g^{-1} to 141 mg g^{-1}.