Document details - Development of marine algae-encapsulated seed product for sustainable agriculture production—a novel approach

Biomass Conversion and Biorefinery

2022

Development of marine algae-encapsulated seed product for sustainable agriculture production—a novel approach

(Article in press)

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Abstract

In rain-fed crop, after the first monsoon rain, the farmers plow their lands and sow seeds. Because of the lack of moisture in the soil, sown seeds fail to germinate and are eventually destroyed. As a result, the farmers suffer economic losses. To address this issue, seed encapsulation with seaweed powder was performed. Micro (Spirulina plantensis and Chlorella vulgaris) and macroalgae (Sargassum, Halimeda macrolaba, and Gracilaria) were collected from the southeast coast of India. The seaweeds were dried, powdered, and weighed about 1 g of each and were filled in a gelatin capsule. Soil profile (pH, EC, water percolation rate, moisture content, water holding capacity, capillary action, N, P, K, Zn, Fe, Cu, and Mn) was characterized before cropping. Abelmoschus esculentus, Raphanus sativus, Helianthus annuus, and Capsicum annum cultivation were done. The plant growth and yield were analyzed. The texture was clay loamy soil with micro and macronutrients present in it. In Abelmoschus esculentus, the number of leaves, plant height, and branches were increased as compared to control. Sargassum treatment shows highest yield (285.6 g) of A. esculentus. The nutritional quality was enriched in Sargassum treatment followed by C. vulgaris and S. platensis. In Raphanussativus L. cultivation, the estimated yield is as follows: in Sargassum (5.95 kg), C. vulgaris (5.10 kg), S. platensis (3.95 kg), and control (3.15 kg). The yield of Helianthus annuus L. cultivation showed increased in Sargassum treatment of about 200.5-g total seed weight. The yield was higher in Sargassum treatment as compared to C. vulgaris and Gracilaria in Capsicum annum cultivation. Sown seeds in novel seed encapsulation remain undamaged in soil until favorable rainfall occurs. Another benefit is that a marine source biofertilizer enriched with macro/micronutrients and hormones was encapsulated around the seeds, promoting plant growth and yield. The application of fertilizer to a large area is both costly and time consuming. In contrast, applying to specific roots around the plant is both effective and cost effective in terms of plant growth. This novel seed encapsulation with marine source biofertilizer has two advantages: (i) it protects the seed from damage and (ii) it supplements plant nutrition. As a result, farmers lose less and profit more by using less biofertilizer. Graphical abstract: (a) Powder of micro and macroalgae. (b) Seeds. (c) Encapsulation of seed with micro and macroalgae powder. (d) Encapsulated with macroalgae. (e) Encapsulated with microalgae. (f) Encapsulated with micro and macroalgae. (g) Dissolving of gelatin in soil. (h) Experimental field. (i) Capsule placing inside the soil. (j) Capsule in soil. (k) Seed germination. (l) Plant growth. (m) Ladies finger yield. (n) Sunflower yield. (o) Radish yield [Figure not available: see fulltext.]

Author keywords

Abelmoschus esculentus | Capsicum annum crop | Capsule | Helianthus annus | Microalgae fertilizer | Raphanus sativus | Seed encapsulation

Indexed keywords

Engineering controlled terms: Crops | Cultivation | Losses | Moisture | Rain | Seaweed | Seed | Soils | Solvents | Textures