Bioenriched Organic Jiffy Blocks – Innovative Tool For Efficient And Ensured Indoor Plant Growth

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Abstract: Various soil-less media have been intensively investigated in order to obtain an efficient indoor plant growth. One among the soil-less media is Jiffy blocks – OPSGEM (Organic plant-derived soil-less growing (enriched) medium for plants. These Jiffy blocks are made using coconut based products further fortified with gel, nutrient and fertilizer mix. The use of the fortified jiffy blocks would be advantageous in various prospects, because the fortification improves shelf life and integrity of the blocks with well-balanced nutrient supplements, thereby creating a micro environment mimicking soil environment that eventually leads to an enhanced seed germination and plant growth. In this work, a comparative study was made on plant growth in jiffy blocks with and without fortification. Based on the investigation, it was evident that formulated jiffy blocks with bio polymer, N& P providing bio-fertilizers and growth-assisting nutrient mix promoted better growth in grass varieties and vegetable yielding plants.

1. Introduction

The soil is considered to be the best available source of nutrients for plant growth. Urbanization and industrialization resulted in decrease in land availability and nutrients in soil. Owing to the growing demand for cultivating food crops, soil-less culture has emerged in recent years due to the fact that it promotes indoor gardening and occupies less space. Nowadays a lot of soil-less culture techniques are available [1].

The most common method among the soil-less culture is Hydroponics. Hydroponics is a method of growing plants in a soil-less media with nutrients [1]. The selection of soil-less medium depends on the type of plants. Due to the fact that most of the hydroponic systems are indoor and located in green houses they rarely be affected by the external environment factors. The hydroponic system can successfully assist in generating crop yield in countries where the soil conditions are highly saline [2].

Various materials are being used in the hydroponic systems such as Rockwool, vermiculite, coconut fiber / coconut chips, etc. Organic substrates are widely used due to their biodegradable nature and low cost [3]. Coir products has been increasingly used in hydroponic systems across the world. Coir is obtained by extracting fiber from coconut husk. Coir chips has higher water retention capacity and it also improves aeration [4]. The advantage of hydroponic system is the availability of nutrients in it. Desired nutrients are added in respective volume in various forms in the hydroponic system [5]. A wide range of organic fertilizers is being used in the hydroponics based on the type of crops [6]. In this study Innovative Jiffy Blocks were made by incorporating plant growth promoting components (PGPCs) derived from microbes. The fortification for jiffy blocks was done using three components (a) binding assisting gel (b) PGP bacteria (c) nutrient recipe. Specifically the objective of this study was to make a comparison between jiffy blocks with and without fortification.

2. Materials & Methods

(i) Preparation of Bio-polymer (Dextran)

Medium composition and cultivation of culture

For the dextran production the culture, Leuconostoc mesenderoids was grown in a medium containing sugar cane juice, 2 % ammonium sulphate, 1.5 % press mud extract. The pH of the medium was adjusted to 7 followed by sterilization of medium at 121°C for 15 minutes. After inoculation and the culture was incubated for 36 hours at room temperature [7]

Dextran precipitation using solvent.

After 36 hours, the liquid culture containing Leuconostoc mesenderoids was centrifuged at 7000
rpm for 12 minutes and the supernatant was collected. To the supernatant obtained, suitable solvent such as ethanol was added in 1:1 ratio. Dextran would get precipitated during this process. Further the solution was filtered using filter paper to obtain dextran (residue) [7].

(ii) Preparation of N&P providing bio-fertilizers

For the nitrogen and phosphate providing bio-fertilizers production, *Azospirillum* and *Phosphobacteria* culture was grown in a medium containing sugar cane juice, 2 % ammonium sulphate, 1.5 % press mud extract, 1 % phosphate salt. The pH of the medium was adjusted to neutral, followed by autoclave sterilization. After inoculation, the liquid medium containing culture was incubated for 36 hours at room temperature.

After 36 hours of incubation, the liquid culture was centrifuged at 10000 rpm for 10 minutes and cell pellets were obtained.

(iii) Preparation of growth-assisting nutrient mix

Pressmud was collected from sugar factory. 50 gm of pressmud was dissolved in 250 ml of water and then the mixture was stirred for 1 hour using a magnetic stirrer followed by filtration of the mushroom and then the matrix was treated with 0.5% hydrogen peroxide and then chopped into pieces. The chopped pieces of matrix were crushed and extract was obtained. Press mud extract (filtrate) and organic extract (extract from the matrix) were mixed in 1.1 ratio.

(iv) Preparation of Jiffy blocks

Jiffy blocks were made using: binding chips of coconut husk, fibrous fraction of coconut husk (pulverized), coconut shell powder in the ratio 9.0:0.60:0.40.

(v) Preparation of OPSGEM

To the jiffy block mixture, polysaccharide gel (obtained from 300ml culture), cell pellets (obtained from 150 ml culture of *Azospirillum* and 150 ml culture of *Phosphobacteria*), 20 ml of nutrient mix were added, mixed and compressed.

Method

In our experimentation, four different combinations of jiffy blocks were used. They are A= OPSGM (with no enrichment), B= A+ polysaccharide gel (*Leuconostoc*) mix, C= B + N&P providing bio-fertilizers and D= C + growth assisting nutrient mix. The four types of Jiffy blocks were seeded with a vegetable (*Abelmoschus esculentus*), maize (*Zea mays*) and Amaranthus. The Jiffy blocks A, B, C and D were seeded with 30 seeds of Amaranthus, 4 seeds of *Abelmoschus esculentus* and 4 seeds of maize and the plant growth was monitored.

Figure 1. Overall process involved in making OPSGEM

3. Results and Discussion

3.1 Properties of innovative blocks

| Basic material(s): | chips & fibers from coconut husk & shell powder |
| Dimensions | 50 mm diameter; 15 mm height |
| Water holding | 5-6 times the volume |
| Strength | intact |
| Color | soil brown |
| Enriched with | Polysaccharide gel mix + N&P providing bio-fertilizers + growth-assisting nutrient mix. |

3.2 Major characteristics of OPSGEM

1. 100% renewable resource
2. High water-holding capacity
3. Ideal pH in the range 6-6.7
4. Light in weight
5. Promotes better root systems in a short time
6. Inhibits pathogens
7. Life of three to four years

3.3 Seedling emergence of crops
Seedling emergence is an essential event for a successful plant growth. In the D type jiffy blocks germination and emergence of seeds were rapid when compared with the other blocks. Although the emergence of seeds of Amaranthus and okra in C and D type blocks started at day 3 and day 5 respectively, the number of seeds germinated in D type blocks was high when compared with the C type blocks. The rate of seedling emergence was low in A type blocks when compared with other blocks. Based on the results of seedling emergence of the crops, it is evident that the D blocks promote rapid germination and seedling emergence when compared with the other 3 blocks.

3.4 Germination rate of seeds in Jiffy blocks

On comparing the germination rate of crops such as Amaranthus, okra and maize in jiffy blocks (figure 3), germination percentage was high in D type blocks. The addition of bio-polymer increases the shelf-life and integrity of the blocks and the jelly polymer (dextran) further enhance the life of PGP microbes and also increases moisture availability and that is the reason B type jiffy blocks have a higher germination percentage when compared with A. Nitrogen and Phosphorus are made available to the plant by the incorporated microbes and Many plant growth-promoting (PGP) substance are secreted by plant growth-promoting bacteria (PGPB) [8] and that could be the possible reason for enhanced growth in C type blocks when compared to B and A. The nutrient solution introduced in the D type blocks possess the capability to maintain the nutritional balance [9] and thereby supporting a fast rate of growth in plants. Since the D type blocks are formulated with nutrient recipe, jelly polymer and cell pellets from Azospirillum and Phosphobacteria, the crops seeded has rapid germination, highest germination percentage and also fast growth.

3.5 OPSGEM- a better soil-less media
Image (a) growth of green peas in jiffy blocks, (b) Jiffy blocks in dehydrated form, (c) Jiffy blocks after hydration, (d) growth of maize in A and D type jiffy block.

The jiffy blocks are well suitable for a wide variety of crop cultivation due to its water holding capacity and nutrient availability which could be observed in the images(a,b,c&d). The enrichment in the D type blocks has resulted in the enhanced growth of maize and a difference in growth pattern of maize can be well observed in the image (d). Thus the jiffy block possesses the capability to act as the best organic plant-derived soil-less medium for plants.

4. Conclusion

OPSGEM could be used in hydroponics and also in the indoor cultivation. This innovative block is eco-friendly, promotes excellent drainage and aeration and very easy to rehydrate after dehydrated. The water holding capacity, nutrient availability and PGPB of the Jiffy blocks make them a suitable medium for plant growth.

References


