Title: ***Nano fertilizer-coated sponge for fast seed germination with soil less agricultural***

Abstract:

The present invention relates to a novel Nano Fertilizer-Coated Sponge designed to expedite seed germination in soilless agricultural systems. The sponge's unique nano-coating, combined with its absorbent and nutrient-rich properties, provides an optimal environment for seeds to germinate rapidly and foster early-stage plant growth. This invention outlines the technical details, composition, manufacturing process, and advantages of the Nano Fertilizer-Coated Sponge for efficient and successful seed germination in soilless agricultural practice.

Nano fertilizer-coated sponge for fast seed germination with soil less agricultural

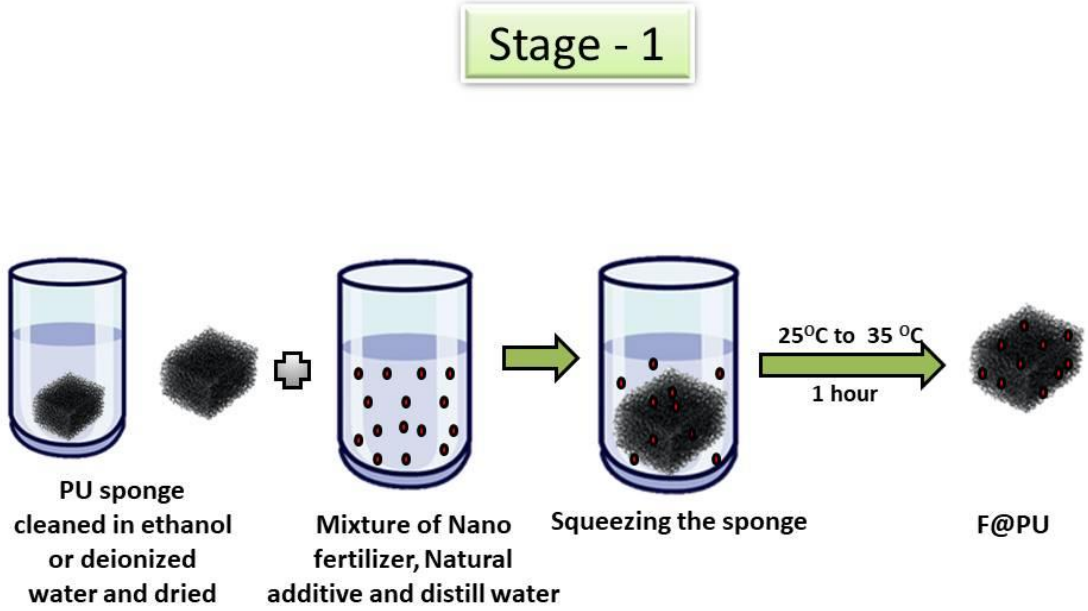


Fig.1

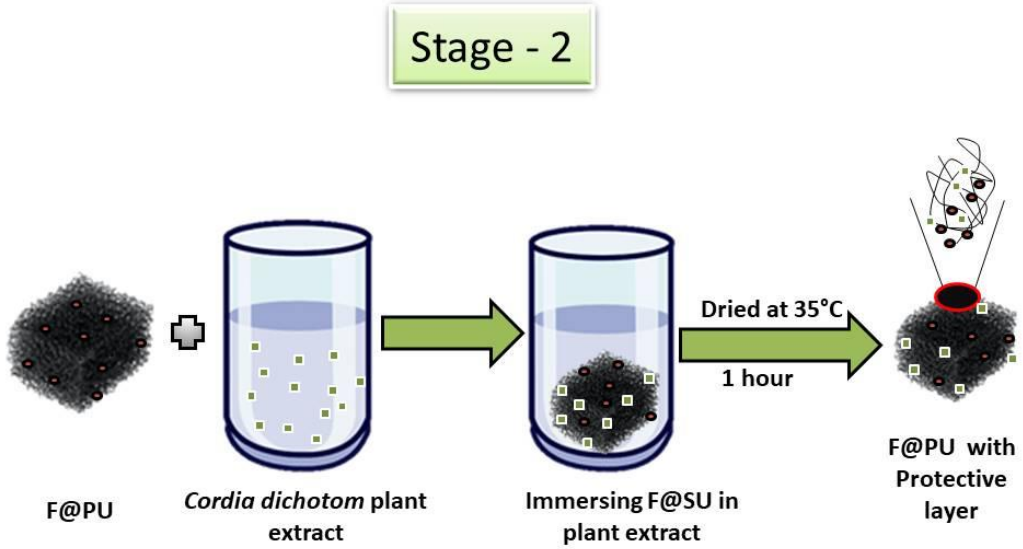


Fig.2

Figure: 3



Figure: 4

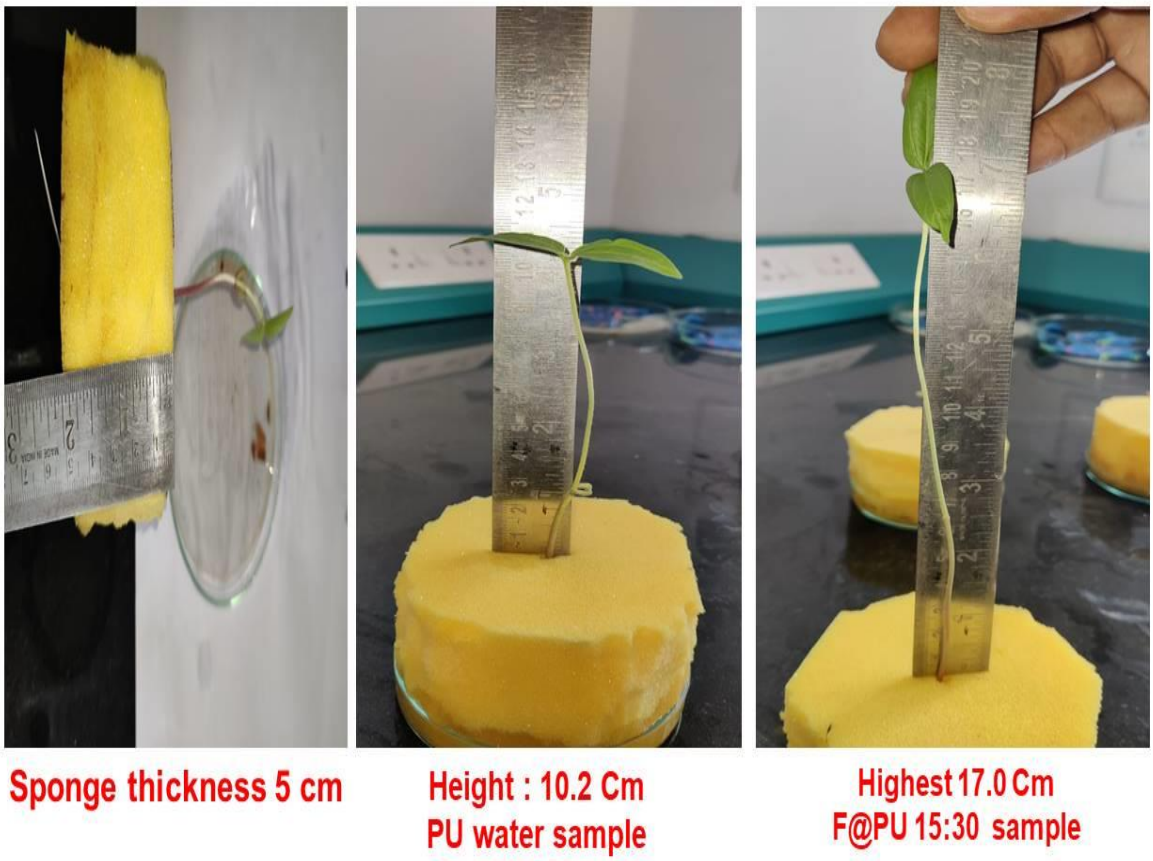
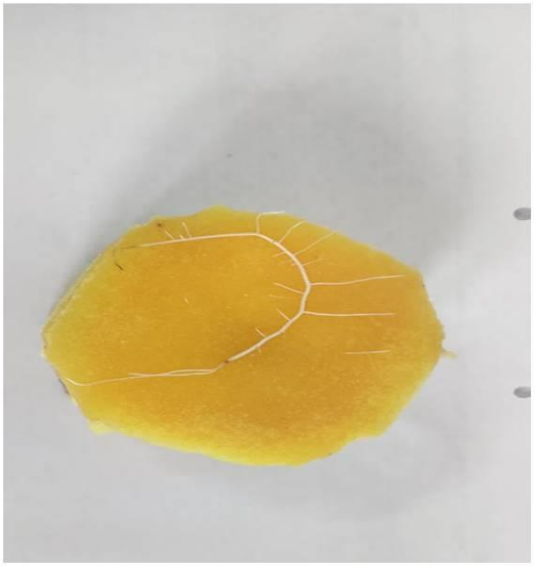


Figure: 5



PU water sample root growth



F@PU 15:30 sample root growth

25

Figure: 6



PU WATER



F@PU 15:30

FORM 2

THE PATENT ACT 1970
(39 OF 1970)
&
THE PATENTS RULES, 2003

COMPLETE SPECIFICATION

(See section 10 and rule 13)

Title of Invention

Nano fertilizer-coated sponge for fast seed germination with soil less agricultural

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The following specification particularly describes the nature of invention, and the manner in which it is to be performed.

Nano fertilizer-coated sponge for fast seed germination with soil less agricultural

Field of the Invention:

The global population is predicted to exceed 9 billion by the year 2050[1]. Current agricultural practices cannot meet the growing demand for food without the extensive application use of good formulation. The productivity of current. A healthy diet is essential for good health and nutrition. For that greater number of plantations is required and for that some technologies for fast germination of seeds are required. Soilless farming systems, i.e., hydroponics, aquaponics and aeroponics, have many advantages that are bound to appeal to farmers, agronomists and consumers.

The present invention provides development technology where we have formulated using a nano fertilizer-coated sponge for fast seed germination in soil-less agriculture as a novel approach that has the potential to improve the efficiency and effectiveness of seed germination.

Background of the Invention and Prior Art:

The actual problem that soilless seed germination systems aim to address is the variability and unpredictability of natural soil conditions. Soil quality can differ significantly from one location to another, and even within the same area, leading to inconsistent germination rates and overall plant health. Additionally, natural soil may contain pathogens, weed seeds, and other factors that can hinder successful seed germination and early growth.

By using soilless systems, growers can create a more controlled and optimized environment for seed germination, leading to more reliable and successful plant propagation. It is important to note that soilless seed germination does not eliminate the need for soil or other growing media for later stages of plant development, but it serves as a valuable tool to initiate the growth process in a controlled and efficient manner.

Present invention is related to solve the issues regarding the previously available soilless media and germination of seed by novel nano coated sponge for germination of seeds.

Prior Art Statement

CN108366537A said invention provides outdoor external member without carrying large scale equipments, the plant supporting member bearing plant, coated fertilizer and bearing plant wherein the coated fertilizer is stored in plant storage component, nutrients is provided for the root of plants, the floating

member has multiple opening portions that can removably keep the plant storage component and floatability is on the water surface. The limitation of the invention is self-explained by the inventor that the invention applies to only outdoor hydroponics plant germination and non-nanoparticles nutrients.

US7901922B2 Nutrient medium used for ex-vitro sowing, germination, growth and Conversion of plant somatic Embryos or germinant. provides a nutrient medium useful for Sowing a Somatic plant embryo or germinant of conifer species, which comprises particles of a solid component present within a flowable or semi-solid component containing water and a carbohydrate nutrient for the embryos or germinant. The nutrient medium has a fluidity such that at least some of the flowable or semi-solid component containing the carbo hydrate nutrient remains in contact with the embryos or germinant at least until the embryo or germinant establishes vigorous growth under environmental conditions effective for such growth. However, the innovation does not clarifies the conditions for seeds to be germinated and use of nutrients of nanoparticles.

"Innovative approach to rapid growth of highly clay-filled coatings on porous polyurethane foam" Yeon Seok Kim, Richard Harris and Rick Davis, ACS macro Letters describes an innovative twist to fabricating layer-by-layer coatings resulted in transparent, high-content clay coatings on porous polyurethane foam. The addition of an anionic poly(acrylic acid) (PAA) monolayer between anionic clay and cationic branched-polyethylenimine (PEI) monolayers resulted in a trilayer nanocomposite structure with an order of magnitude thicker coating using 40% less monolayers than the conventional bilayer approach. The invention is for sponge for better growth with multilayered sponge utilization. However this is not used in a practical approach in the market as of viability.

The objective of the Invention

The present invention relates to an innovative nano fertilizer-coated sponge-based seed germination system designed to provide an efficient and reliable method for growing seedlings. The system utilizes a nano fertilizer-coated sponge material as the growth medium, which provides a suitable environment for the seeds to germinate and develop into healthy seedlings. Nano fertilizer-coated sponge is specially treated to maintain optimal moisture levels, ensuring that the seeds receive sufficient water for germination while also preventing over-watering. The system is also semi-transparent and provides the necessary light and air for the seedlings to grow.

The main objective of the invention is to provide an improved germination rates, enhanced nutrient uptake, and reduced risk of fungal contamination.

Another objective of the invention is to provide the to retain moisture and control the temperature, which can be important factors for successful seed germination.

Another objective of the invention is to provide the seeds with essential nutrients for healthy growth from beginning. This can help to reduce the amount of fertilizer needed for seedlings and can also reduce the risk of seed rot.

Brief Description of Drawing

Fig.1 Stage wise process

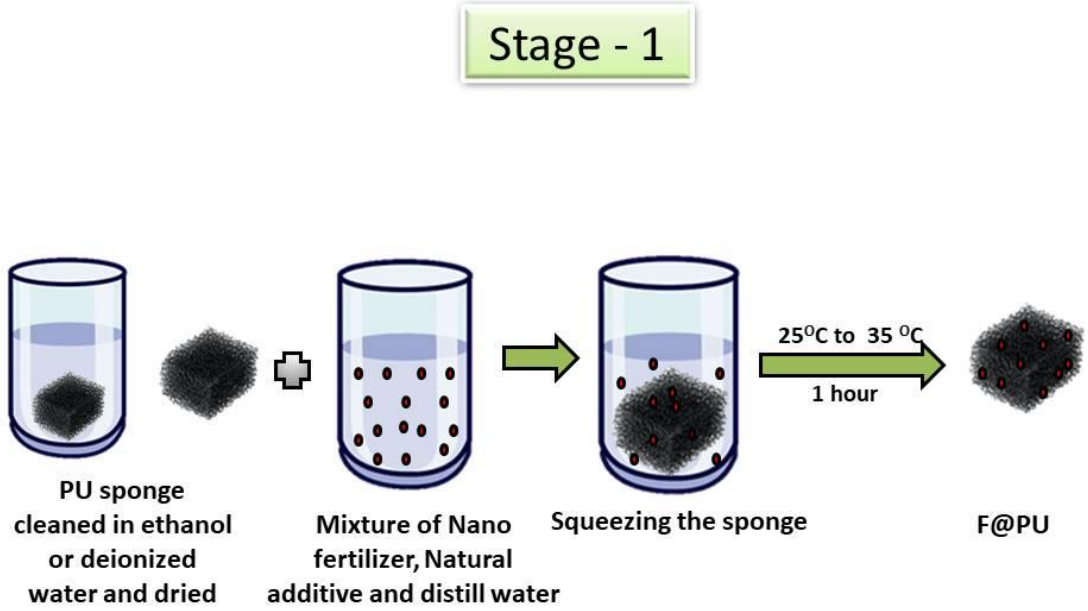
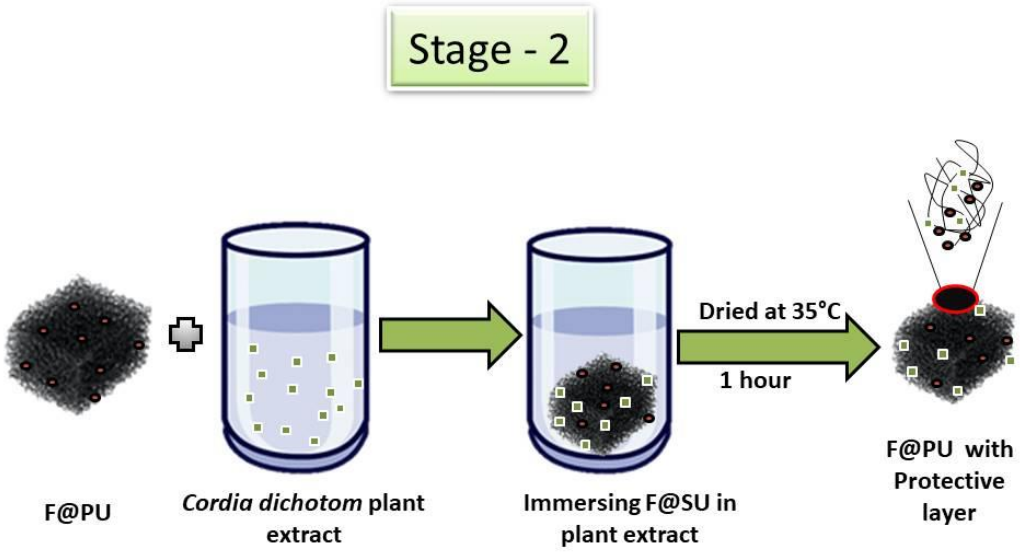


Fig.2 Stage wise process



Detailed Description

The Nano Fertilizer-Coated Sponge represents a significant advancement in soilless agricultural practices, enabling faster seed germination, enhanced nutrient availability, and healthier early-stage plant growth. Its innovative design and unique composition make it a valuable tool for modern and sustainable farming techniques, ensuring increased yields and reduced environmental impacts. This patent draft establishes the technical foundation and novel features of the Nano Fertilizer-Coated Sponge, underscoring its potential to revolutionize soilless seed germination in agriculture.

Soilless seed germination systems are used for various reasons and offer several advantages over traditional soil-based methods. The main reasons for using soilless seed germination systems are; Sterility, controlled environment, improved germination rate, space and resource efficiency easy observation and management, nutrient avaibility.

Physical and hydraulic characteristics of most substrates are superior to those of soils. A soil grown plant experiences relatively high water avaibility immediately after irrigation. At this time, macropores are filled wit water followed by relatively slow drainage which is accompanied by entry of the air into the soil macropores. Oxygen, which is consumed by plant roots and soil microflora, is replenished at a rate which may be slower than the plant demand. As water is drained or evapotranspiration, the porosity of the soil is such that atmospheric oxygen diffuse into the root zone. At the same time water is held by gradually increasing soil matric forces so that the plan has to invest a considerable amount of energy to take up enough water to compensate for transpiration losses due to atmospheric demand.

Most substrates, on the other hand, allow the simultaneous optimisation of both water and oxygen avaibility. The matric forces holding water in substrates are much weaker than in soil. Consequently, plants grown in porous media at or near container capacity require less energy to extract water. At the same time, a significant fraction of the macrospores is filled with air so that oxygen diffusion is high enough so that plants do not experience a risk of oxygen deficiency.

Another factor is that nutrient avaibility to plant roots can be better manipulated and controlled in soilless cultivation than in most arable soils.

However, two major key factors are there for soilless seed germination; one is to understand and provide the required nutrition second and major is elimination of disease organisms that needed to be controlled through disinfestation was feasible in container growth production while being virtually impossible in soil-grown plants.

Coco peat-based seed germination is a more recent innovation, and it has several advantages over soil-based methods. Coco peat is a renewable resource made from coconut coir, and it is sterile, lightweight, and easy to transport. Additionally, coco peat can retain moisture and control the pH, making it a good choice for hydroponic or aeroponic systems. However, coco peat can also be more expensive than soil, and it may not be readily available in all regions.

Cocopeat, which is made from coconut fibres, is commonly used as a growth medium for seed germination. However, there are some drawbacks associated with using cocopeat as a base for seed germination, including:

pH instability: Cocopeat has a tendency to become acidic over time, which can be detrimental to seed germination and plant growth. Regular pH testing and adjustment may be necessary to maintain a suitable environment for seed germination.

Nutrient deficiency: Cocopeat is a natural product and may not contain sufficient levels of all the nutrients that plants need for growth. Additional fertilizers or supplements may be necessary to ensure that the seedlings receive the nutrients they need.

High water-holding capacity: Cocopeat has a high water-holding capacity, which can lead to over-watering and waterlogging of the seeds, leading to reduced germination rates and potential fungal contamination.

Dustiness: Cocopeat can be dusty, which can cause respiratory problems and skin irritation in some individuals.

Cost: Compared to other materials such as peat moss or vermiculite, cocopeat can be more expensive, making it less suitable for large-scale commercial operations.

Sponge-based seed germination is another alternative that has gained popularity in recent years, and it has several advantages over traditional methods. The sponge material can retain moisture and control temperature, which can be important factors for successful seed germination. Additionally, the sponge can be pre-moistened with a nutrient solution, providing the seeds with essential nutrients for healthy growth from the start. This can help to reduce the amount of fertilizer needed for seedlings and can also reduce the risk of seed rot.

However, the effectiveness of sponge-based seed germination can depend on the type of sponge material used, the size and shape of the sponge, and the type of seeds being germinated.

The idea of using a nano fertilizer-coated sponge for fast seed germination in soil-less agriculture is a novel approach that has the potential to improve the efficiency and effectiveness of seed germination. The nano-sized fertilizer particles can be more easily absorbed by the seeds, promoting faster and more consistent growth. The sponge material can retain moisture, providing a controlled environment for seed germination, which can help reduce the risk of seed rot. Additionally, the sponge can be easily transported and used in hydroponic or aeroponic systems,

making it a convenient and versatile tool for soil-less agriculture. The innovative idea of coating nanomaterial on a sponge gives below mentioned benefits.

Improved Germination Rates: Nanomaterials can be used to coat seeds, which can help to improve germination rates by protecting them from environmental stress and reducing water loss.

Enhanced Nutrient Uptake: Some nanomaterials have been shown to enhance the uptake of essential nutrients, such as nitrogen, phosphorus, and potassium, which are critical for seed germination and seedlings growth.

Reduced Fungal Contamination: Some nanomaterials have antimicrobial properties that can help to reduce the risk of fungal contamination of seeds, which can improve germination rates and seedling survival.

Method for synthesis of Nano fertilizer-coated sponge

Step 1: Preparation of the Nano fertilizer Solution: The first step in the process of nano fertilizer coated sponge with a nanomaterial is to prepare the Nano fertilizer solution. This can be done by mixing the desired nanomaterial with a suitable solvent or dispersant to form a homogeneous mixture. After that mixed was sonicated for 10 minutes for the homogeneous solution.

Step 2: Pretreatment of the sponge: The next step is to prepare the sponge for deep coating. This may involve cleaning the sponge, applying a pretreatment solution to improve the adhesion of the nanomaterial to the sponge, or other preparatory steps as required for the specific nanomaterial and application.

Step 3: Applying the Nano fertilizer Solution: Once the sponge has been prepared, the nano fertilizer solution is applied to the sponge using a suitable deep coating method. This may involve dipping the sponge into the solution, spreading the solution evenly over the sponge, and its absorption on it.

Step 4: Drying and Curing: After the Nano fertilizer solution has been applied, the coated sponge must be dried and cured. This can be done by heating it in an oven to remove the solvent and to ensure that the nanomaterial has fully adhered to the sponge.

Step 5: Final Processing: After the nanomaterial has been dried and cured, the sponge may undergo further processing, such as cutting as required for the specific application.

In the said invention, seed of many families were checked and trialled. Seeds from families were checked from them one experimental result also shown. The families for seed germination are as below:

Flowers:

1. Asteraceae (Daisy family)
2. Brassicaceae (Mustard family)
3. Amaryllidaceae (Amaryllis family)
4. Caryophyllaceae (Pink family)
5. Lamiaceae (Mint family)
6. Plantaginaceae (Plantain family)

Fruits:

1. Solanaceae (Nightshade family)
2. Cucurbitaceae (Gourd family)
3. Fabaceae (Legume family)
4. Lamiaceae (Mint family)
5. Apiaceae (Carrot family)
6. Rosaceae (Rose family)

Vegetables:

1. Solanaceae (Nightshade family)
2. Cucurbitaceae (Gourd family)
3. Brassicaceae (Mustard family)
4. Amaranthaceae (Amaranth family)
5. Asteraceae (Daisy family)
6. Apiaceae (Carrot family)

Herbal:

1. Lamiaceae (Mint family)
2. Apiaceae (Carrot family)
3. Asteraceae (Daisy family)
4. Rosaceae (Rose family)
5. Liliaceae (Lily family)

Use of Nano fertilizer sponge for seed germination

Step 1: Soak the Nano fertilizer-coated sponge: Soak the Nano fertilizer-coated sponge in water for several minutes from 75 to 118 minutes until it is thoroughly saturated. This will help to ensure that the seeds have adequate moisture to germinate.

Step 2: Draining of Excess Water: After soaking the sponge, Nano fertilizer-coated sponge naturally drains any excess water.

Step 3: Place Seeds on the Nano fertilizer-coated sponge: Spread the seeds evenly over the surface of the sponge. The seeds should be spaced apart so that they have enough room to germinate without touching each other.

Step 4: Cover with Plastic Wrap: Cover the sponge with plastic wrap to create a moist, warm environment for the seeds to germinate. This will help to maintain the moisture levels and will also prevent evaporation.

Step 5: Place in a Warm Place: Place the covered Nano fertilizer-coated sponge in a warm, bright place, but not in direct sunlight.

Step 6: Observe Germination: Over the next two days, the seeds should begin to germinate and grow.

Preparation of nanofertilizer coated sponge with natural additive

The process of coating the polyurethane (PU) sponge with a nanofertilizer NPK mixture, along with a natural additive from the Millingtonia plant, is schematically shown in Scheme 1. Before the coating process, the original PU sponge is cut into 1 × 1 × 1 cm3 cubes for further treatment. These cubes are then washed with ethanol, deionized water, and dried to remove any impurities. These cubes are also treated with UV light to avoid any possibility of Germs and bacteria.

Step 1: Preparation of nanofertilizers Coated Sponge.

The original PU sponge is immersed in a mixture of Nano fertilizer: Natural Additive: Distill water (volume ratio = 10:20:80).

The liquid mixture is gently squeezed into the sponge. This operation is repeated three times.

The PU sponge coated with Nanofertilizer Sponge is obtained and named as F@PU.

The F@PU sponges are dried at different temperatures: room temperature, 25°C, and 35°C for 1 hour each.

Step 2: Coating of Protective Layer Natural Additive from Millingtonia plant

The prepared F@PU sponges are immersed in a solution containing the natural additive extracted from the Millingtonia plant.

The sponges are soaked in the natural additive solution for 30 second, allowing the additive to be incorporated into the sponge.

Step 3: Protective layer coated sponge again dried at 35°C for 1 hour

Evaluation of Optimal Nanofertilizers Amount:

To determine the optimal amount of nanofertilizers for best results, various amounts of nanofertilizers were tested during the coating process. The nanofertilizers-to-natural-additive ratio was varied as follows: 5:10, 10:20, 15:30, 20:40, and 25:50 (nano fertilizer in milligrams, and natural additive in millilitres).

After the coating process, each set of F@PU sponges was labeled accordingly, i.e., F@PU-5:10, F@PU-10:20, F@PU-15:30, F@PU-20:40, and F@PU-25:50.

Step 4: Coating with Protective Layer of Natural Additive from Millingtonia plant

The F@PU sponges with varying nanofertilizer-to-natural-additive ratios were immersed in a solution containing the natural additive extracted from the Millingtonia (Buch) plant.

The sponges were soaked in the natural additive solution for 30 seconds, allowing the additive to be incorporated into the sponge.

After coating with the natural additive, each set of sponges was dried again at 35°C for 1 hour to solidify the protective layer.

Step 5: Evaluation of Coated Sponges

The coated sponges (F@PU-5:10, F@PU-10:20, F@PU-15:30, F@PU-20:40, and F@PU-25:50) were subjected to a series of growth experiments using specific plant species to assess their effectiveness as nanofertilizer delivery systems.

Results and Findings:

Based on the growth experiments, it was observed that the F@PU-15:30 sponge, prepared with a nanofertilizer-to-natural-additive ratio of 15:30 (in milligrams and millilitres, respectively), exhibited the most promising results. This formulation provided optimal nutrient release and improved plant growth characteristics.

Conclusion:

Among the different nanofertilizer-to-natural-additive ratios tested, F@PU-15:30 demonstrated the best performance in terms of nutrient delivery and plant growth enhancement. Therefore, the optimal amount of nanofertilizer for the best results is the formulation with a ratio of 15 milligrams of nanofertilizer to 30 millilitres of the natural additive from the Millingtonia plant.

Results shows as below with different experiments

Figure: 3



330

Figure: 4

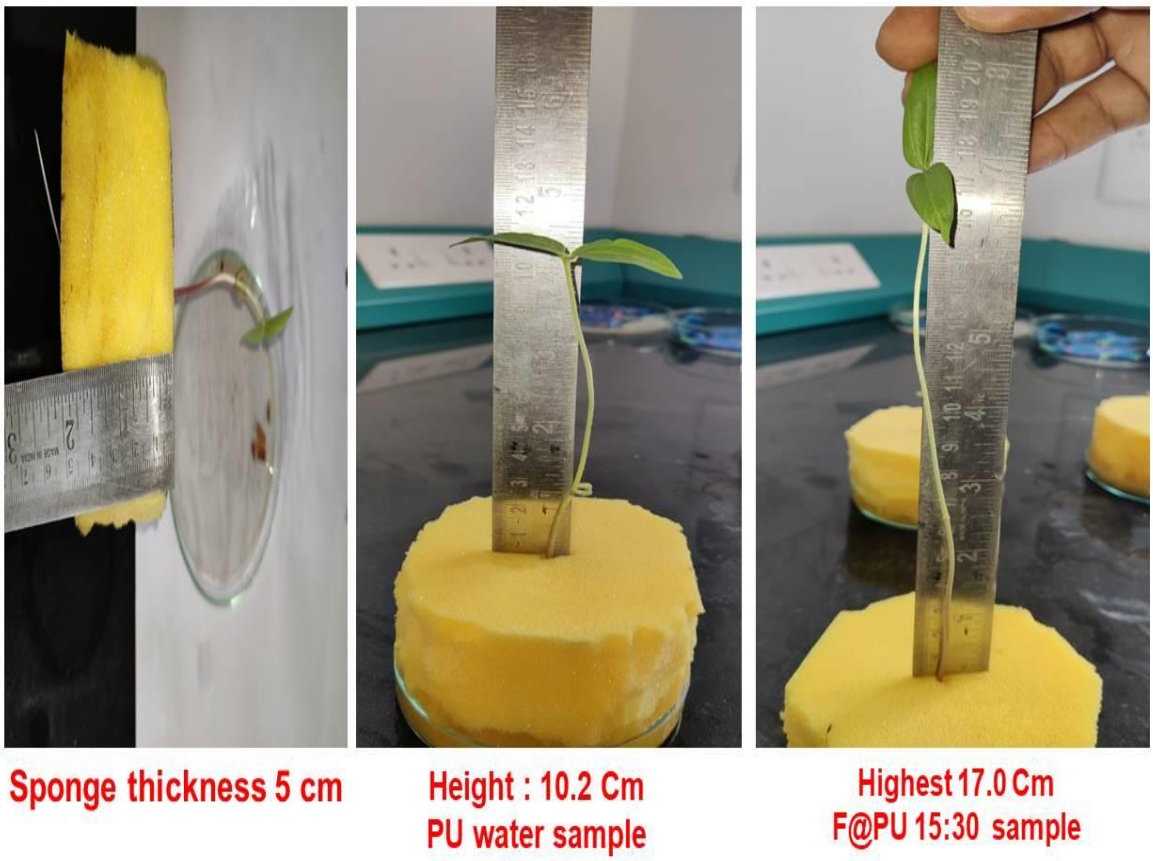


Figure: 5

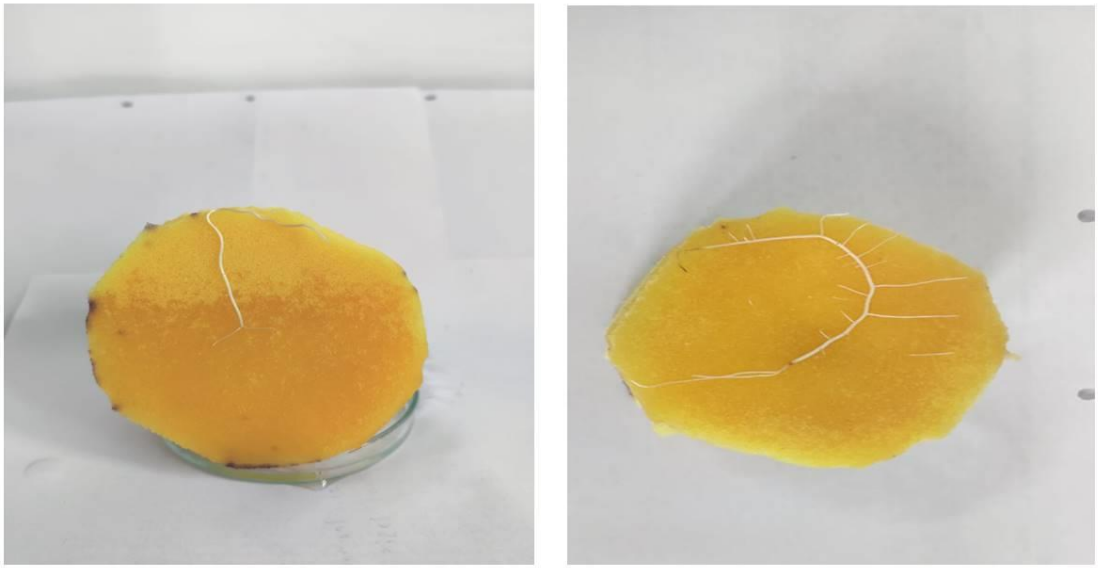
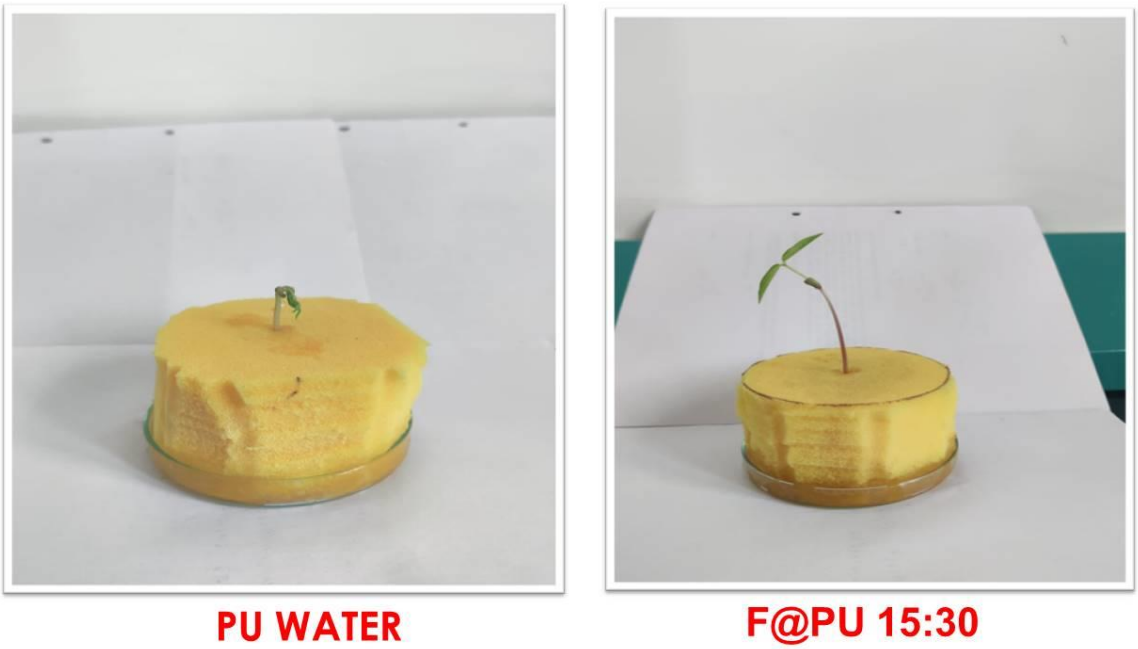


Figure: 6



The current embodiment which the invention of a novel Nano Fertilizer-Coated Sponge designed to enhance and expedite seed germination in soil-less agricultural systems. This innovative technology combines the advantages of nano-fertilization and controlled moisture retention within a specialized sponge substrate, resulting in significantly improved seedling growth rates and overall crop yields.

As explained in the above steps of nanofertilizers and sponge formation where the general recommended ranges for some essential micronutrients for good seed germination in parts per million (ppm) in growing medium are required as Nitrogen 100-500 ppm, Phosphorous 20-100 ppm, Potassium 80-150 ppm, Iron 1-10 ppm, Zinc 1-5 ppm, Manganese 0.5-2 ppm, Copper 0.1-0.5 ppm, Molybdenum 0.01-0.05 ppm, Boron 0.5-2 ppm.

As also explained in the above steps of nano fertilizers coated sponge formation the different types of sponges are used for experiments where majority of used forms are of polyethylene forms, hydroponic seed starter cubes and cellulose were used in successful experiments.

Advantage of Invention:

- The embodiment in the said invention shows the result as the invention is advantageous over the prior available solutions or utilities. Following are advantages of the invention:
- Improvement in rate of seed germination
- Enhancement of nutrient uptake by plant
- Reduces fungal contaminations
- The innovation provides a system to germinate seed where the farmers can easily adopt the method without any hesitation.

CLAIMS:

We claim,

1. The nano fertilizer-coated sponge consists of a porous sponge matrix infused with precisely engineered nanoparticles where nanoparticles are synthesized to encapsulate essential nutrients, the sponge material which can be used in soilless seed germination through the controlled release of nutrients and for growth.
2. The nanofertilizer coated sponge in claim 1, where sponge material comprises of polyethylene with spore size ranges from 100 to 600 μm
3. The nanofertilizer coated sponge in claim 1, where nano fertilizers used as nano nitrogen potassium and phosphorus containing fertilizer in concentration from 1000 to 5000 ppm and nano metal as nano zink, iron, manganese, copper, and boron with ranges of 100 to 1000 ppm.
4. In the embodiment of the nano fertilizer coated sponge prepared as in the of nano fertilizers coated to polyethylene sponge where the sponge soaked in concentration of 2 to 6 mg/L nanofertilizers for duration of 75 to 118 minutes and dried, where nanofertilizer coated sponge drained off the excess of aqueous medium and contains particles of nutrients.
5. The nano fertilizer coated sponge claimed in claim 1 prepared for the seed germination of soilless seed germination and to protect seed from attack of fungus and other microorganism while germination and growth of the same.

Abstract:

The present invention relates to a novel Nano Fertilizer-Coated Sponge designed to expedite seed germination in soilless agricultural systems. The sponge's unique nano-coating, combined with its absorbent and nutrient-rich properties, provides an optimal environment for seeds to germinate rapidly and foster early-stage plant growth. This invention outlines the technical details, composition, manufacturing process, and advantages of the Nano Fertilizer-Coated Sponge for efficient and successful seed germination in soilless agricultural practice.