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Biofertilizers: A Novel Tool for Agriculture

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Abstract: ***We must now use a variety of fertilisers, insecticides, and pesticides to boost productivity due to the growing demand in agriculture. biofertilizers offer a sustainable, eco - friendly alternative to chemical fertilizers, promoting healthier crops and soils while supporting the goals of organic and low - input agriculture. Their adoption is essential for achieving production sustainability and environmental protection in modern farming systems.***

Keywords: Biofertilizers, insecticide, pesticides, agriculture, farming

1. Introduction

Bio - fertilizers, strictly speaking, are not fertilizers that provide direct nutrition to crops. Instead, they consist of cultures of microorganisms such as bacteria and fungi, which are combined with a carrier material. Therefore, the essential component of biofertilizer is the microorganisms themselves. These microorganisms support plants indirectly by enhancing nitrogen (N) fixation and improving soil nutrient availability. [1] The phrase "Biofertilizer," or more accurately, "Microbial inoculants," can be broadly defined as a preparation that contains live or dormant cells of effective strains of nitrogen - fixing, phosphate - solubilizing, or cellulolytic microorganisms, intended for application to seeds, soil, or composting sites to increase the population of these microorganisms and expedite the microbial processes that enhance the availability of nutrients that plants can easily absorb. Biofertilizers offer a cost - effective solution for small and marginal farmers aiming to boost productivity. [2] They serve as an affordable, efficient, and renewable source of plant nutrients to complement chemical fertilizers. The microorganisms utilized as biofertilizers include bacteria, fungi, and blue - green algae. These organisms are introduced into the plant's rhizosphere to amplify their activity in the soil. Sustainable agricultural practices heavily rely on maintaining healthy soil. Ensuring soil health requires the right balance of organic and inorganic materials. Continuous application of chemical fertilizers harms soil microorganisms. In the natural environment, many beneficial soil microbes aid plants in nutrient absorption. Enhancing their effectiveness can be achieved through human intervention by identifying efficient organisms, cultivating them, and incorporating them into the soil directly or through seeds. [3]

Preparation of biofertilizer

All organic material wastes available on a forest, such as weeds, stalks, stems, fallen leaves, pruning, and dead branches were collected. Hard woody material such as dead branches and pigeon pea stalks were first crushed with the help of crusher machine before being piled. Material composts best when it is 1.25 - 3.75 cm in size. Soft, succulent tissues did not need chopping into very small pieces because they decompose rapidly. The harder or woodier the tissues, the smaller they need to be in order to decompose rapidly. [5] Chopping material with a sharp shovel is effective, when pruning plants, the material were cut into small pieces using the pruning shears. This requires a little effort but the results are worth it. For the composting process to work most effectively, the material to be composted should have a C: N ratio of 20: 1. Mixing equal volumes of green plant material with equal volumes of naturally dry plant material yields such a ratio. The green material can be grass clippings, old flowers, green pruning, weeds, fresh garbage and fruit and vegetable wastes. The dried material can be fallen leaves, dried grass, and woody material from pruning. All the ingredients are mixed together, except accelerator (EM solution). These grind particle mix with soil (soil used because soil has ability to absorb moisture and provided suitable condition for growth of microorganism) mix the mixture uniformly.2. Pit site and size: - The site of the compost pit was taken a level high enough to prevent rainwater from entering in the monsoon season; a temporary shed was to be constructed over it to protect the compost from heavy rainfall and to avoid direct contact of environmental heat during summer. The pit was made about 1m deep, 1.5 - 2 m wide and of a suitable length can vary according to the availability of land. The pit was having a slant walls and floor with 90 - cm slope to prevent water logging.3. Filling the pit: - Before making first pile in the pit, base of the pit was sprinkled with water so that it will help in maintain optimum temperature for the growth of microorganism. Adding Organic residues form first pile with soil in pit. A unit pile is about 5m (length) × 1m (width) × 1m (height) in size. The pile is sprinkled with water for adequate moisture content and EM solution (from maple orgtech India ltd, kolkata) is sprinkled on it. This procedure is repeated until the pit is full. The pit is covered with a plastic sheet. To maintain the moisture condition daily adequate amount of water is added around the pit, this continues for two to three weeks. After two or three weeks later, the whole pile was mixed in order to boost aerobic decomposition.4. The pile was turned: - The pile was turned after two weeks and then again after another week. Normally, the compost is ready after two weeks when the heap has cooled down and the height of the pile has fallen to about 70 cm. [3]

2. Observation

Observation during material preparation: - The best composting occurs when materials are sized between 1.25 to 3.75 cm. Soft, tender tissues don't require being chopped into tiny pieces since they break down quickly. However, tougher, woody materials like dead branches and pigeon pea stalks need to be crushed using a crusher machine before being stacked, as this facilitates rapid decomposition by microorganisms. Observation during the initial filling of the pit (first day): - Prior to creating the first pile in the pit, it is

essential to moisten the base with water to help maintain an ideal temperature for microorganism growth.

Observation on second day: - The pit is covered with a plastic sheet. To keep the moisture levels, an adequate amount of water was added around the pit daily, continuing for two to three weeks. Observation on the fourth day: On the fourth day, the temperature of the pit is higher than in the previous observation. The increase in temperature indicates that microorganisms have begun their process of decomposing the organic material. Observation on the seventh day: One week later, the entire pile is mixed to enhance aerobic decomposition. On the seventh day, signs of decomposition of organic material are noticed in certain areas of the pit. This suggests that microorganisms have fully commenced their composting activities.

Observation on fourteen day (second week): - After two weeks, the pile is once more turned. A pleasant smell, heat generated (observable as water vapor released during pile turning), the growth of white fungi on the decomposing organic material, a decrease in volume, and the materials' transition to a dark brown color are all indicators of rapid decomposition over a fourteen - day period. The temperature drops as the composting process comes to an end. Third - week observation on day 21: The pile's height has dropped to roughly 70 cm on day 21. as well as little to no heat. The temperature of the pit returns to normal. It demonstrates how biofertilizer made from organic forest waste is finished. [4]

3. Results

After 21 days of composting, normally, biofertilizer is ready. When the heap has cooled down and the height of the pile has fallen to about 70 cm. By analysis result we can confirm that the biofertilizer contains all essential nutrients which are required for plant growth. This shows that microorganisms totally brake down complex organic material waste into simple organic material. It further indicates that, we successfully prepared the biofertililizer from the forest waste using EM (effective microorganism) solution.

4. Discussion

By fixing atmospheric nitrogen or dissolving soil phosphorus, biofertilizers improve the availability of nutrients to crop plants. They also improve plant and soil health, which moderately increases crop yields. Salinity, alkalinity, soil erosion, and other issues are nonexistent with this natural process. In the broad fields of oil seed production and low input agriculture, as well as in crops like sugarcane, etc., these products would be very helpful in providing production sustainability. Particular attention must be paid to the creation of biofertilizers since organic farming promotion and the elimination of chemical residues in the environment are priorities. [6]

A biofertilizer unit does not produce any toxic effluents. Biofertilizer is an adaptable substance that works well for almost any kind of soil. For instance, the tiny, closely spaced particles of clay soil obstruct the movement of oxygen, nutrients, and water. The clay is rearranged into bigger, looser - packed particles by biofertilizer. The transport of water, oxygen, and nutrients to roots is enhanced by the wider gaps between the particles. [7] The roots can also reach more nutrients and delve deeper into the soil. In sandy soil, where the huge gaps between loosely packed particles allow water and its dissolved nutrients to drain too quickly for optimal root absorption, biofertilizer also helps. [8]

5. Conclusion

Biofertilizers play a crucial role in sustainable agriculture by naturally enhancing nutrient availability and improving both plant and soil health. Their ability to fix atmospheric nitrogen and solubilize soil phosphorus leads to better nutrient uptake by crops, resulting in moderate yield increases without the negative impacts associated with chemical fertilizers.

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