Increase the agriculture soil health and production using the biofertilizers

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Abstract

The worldwide expansion in human population poses a serious threat to each person's food security, as agricultural land is restricted and, in some cases, disappearing. As a result, agricultural production must be greatly increased during the next few decades to fulfil the high food demand of the rising population. Not to add, a heavy reliance on chemical fertilisers for increased agricultural productivity eventually harms the environment, human health, and soil health. Microbes as bio-fertilizers are being explored as a possible replacement to chemical fertilisers in the agriculture industry due to their vast potential.

Keywords: crop production, soil health, bio-fertilizers

Introduction

The term "bio-fertilizer" refers to a substance that incorporates living microorganisms. They beautify plant improvement through boosting the supply of number one vitamins to the host plant whilst implemented to plant surfaces. Natural tactics consisting of nitrogen fixation, phosphorus solubilisation, and plant increase stimulation, in addition to the manufacture of increase-selling compounds, are used to feature vitamins to bio-fertilizers. Growth is increased by 20-30%, artificial nitrogen and phosphorus are substituted by 25%, and plant growth is enhanced. It may provide resistance to drought and several soil-borne illnesses. When applied to seeds, roots or soil, biofertilizers are ready-to-use living constituents of useful microorganisms. It improves the health of the soil by causing the availability and usefulness of microorganisms (Bhattacharjee and Dey, 2014) [11].

Agriculture is important to a country's increase and existence, consequently keeping its amount and excellent is important for feeding the populace and exporting goods. Agriculture has skilled numerous medical breakthroughs over time that allows you to turn out to be extra efficient (Ajmal, 2018) [6]. Pesticides and chemical fertilisers are utilized in current agriculture with the purpose of growing worldwide meals deliver seeing that they act as a quick meals for plants, supporting them to develop extra quick and efficiently. Chemical fertilisation is used indefinitely, inflicting soil excellent and fertility to deteriorate, in addition to the buildup of heavy metals in plant tissues, affecting the fruit dietary price and edibility.

In this regard, in recent years various organic fertilizers have been introduced that act as natural stimulants for plant development. A “biofertilizer” is a type of organic fertilizer that contains results based on microorganisms that promote plant growth. Nitrogen fixing or phosphate solubilizing microorganisms that work effectively. Growing demand for safe and wholesome food, long-term sustainability and environmental damage caused by the indiscriminate use of pesticides led to the emergence of organic agriculture. as an area of serious concern worldwide.

Biological fertilizers use natural resources along with fertilizers, natural waste, domestic sewage, animal manure and microorganisms as well as fungi and bacteria. They improve nutrient fixation within the rhizosphere, cultivate plants that provide growth, increase soil stability, provide organic control, biodegrade materials, reuse nutrients, promote mycorrhizal symbiosis, and pollute with persistent materials. used to develop bioremediation procedures in degraded soils. Fertility and antagonism against plant pathogenic organisms and organic controls.

Classification of bio-fertilizers

In the creation of bio-fertilizers, a variety of microorganisms and their interactions with agricultural plants are used. They can be classified in a variety of ways depending on their nature and purpose.

Rhizobium

Rhizobium is a bacterium that colonizes the roots of legumes and fixes atmospheric nitrogen in a symbiotic relationship. Rhizobium has a variety of morphologies and physiologies, from free-living to tuberous bacteroids. It is the most effective biofertilizer in terms of amount of fixed nitrogen. They are classified as a cross-inoculation group because they contain 7 genera and are highly selective for the nodules of leguminous plants.

Azotobacter

Chroococcum are the most common Azotobacter species found in arable soils and this is fully capable to fixing the N_2 (2-16mg of N_2 fixed g^{-1} of co^2) in the culture conditions. Bacteria produce a lot of slime that helps the soil stick together. Because of the poorest organic matter and the presence of hostile bacteria in Indian soil, the population of A. chroococcum rarely reaches 105 g^{-1} soil.

Azospirillum

Azospirillum lipoferum and Azospirillum brasilense (Spirillum lipoferum in previous literature) inhabit turf soils, rhizospheres and intercellular spaces. They form associative symbiosis with herbaceous plants. Besides nitrogen fixation, *azospirilla* inoculation has many non-synthetic benefits. Material growth (IAA), disease resistance and drought tolerance.

Cyanobacteria

Free-living, symbiotic cyanobacteria (blue-green algae) have

been used in rice cultivation in India. It was once widely promoted as an organic fertilizer for rice crops but no longer attracts the attention of rice farmers in India. Under ideal conditions, the algal benefit can reach 20-30 kg N ha-1, but the labor-intensive technology of BGA biofertilizer production itself is a limitation.

Methods of application of bio-fertilizers

Seed treatment

The 200g of bio-fertilizer is suspended in 300-400 ml water and gently combined with 10kg of seeds are using the adhesive such as gum acacia, jiggery solution, etc. The seeds are then spread out to dry on a clean sheet/cloth in the shade and used for sowing right away.

Seedling root dip

This procedure is utilised for transplanted crops. For rice crop, a bed is made in the field and filled with water. This water is mixed with recommended bio-fertilizers, and seedling roots are plunged for 8-10 hours before being transplanted.

Soil treatment

In the 200kg of the compost, 4 kilogramme of each of the necessary bio-fertilizers is mixed and left overnight. When sowing or planting, this mixture is absorbed into the soil.

Potential characteristic features of some bio-fertilizers-biological nitrogen fixation

The German scientists Hellriegel and Wilfarth had been the primary to realise nitrogen fixation in 1886, once they determined that legumes with root nodules may want to utilise gaseous nitrogen. In 1888, a Dutch microbiologist named Beijerinck succeeded in setting apart a bacterial stress from root nodules. This stress of Rhizobium leguminosarum became remoted. According to Stewart (1969), the microbiologists Beijerinck and Lipman diagnosed Azotobacterspp. in 1901 and 1903, respectively, even as Winodgradsky (1901) remoted the primary stress of Clostridium pasteurianum. Later, nitrogen solving in blue-inexperienced algae became determined to be innovative. At present, studies efforts in those fields have confirmed numerous useful characters (Barman *et al.*, 2017) [8].

Rhizobium

Rhizobium spp. are a symbiotically fixing atmospheric N_2 and enhancing plant development. The bacteria's enzyme system delivers a steady supply of reduced nitrogen to the host plant, which in turn gives nutrients and energy for the bacteria's activities.

Azospirillum

Plant growth enhancement inoculation with has resulted in considerable modifications in various plant properties. Azospirilluminoculation increases germination rate, nitrogen dry weight accumulation, and grain yield, as well as changing the length of the plant's growth phases.

Azotobacter

Azotobacter is able to create additional plant hormones such as gibberellins and cytokinins, reducing stress in plants and maintaining yields (Bhardwaj *et al.*, 2014) [9]. Positive plant growth responses following inoculation with related N_2 fixing bacteria were discovered under water stress circumstances.

Azolla

Azolla is a floating pteridophyte, which contains as endosymbiont the nitrogen-fixing cyano bacterium *Anabaena azollae*. Manjianghong can provide more than half of the nitrogen required by rice crops, resulting in many changes in wetland rice fields, including preventing pH rise, lowering water temperature, limiting volatilization of NH3 and suppressing weed and mosquito breeding. Manjianghong can be used as an alternative source of nitrogen fertilizer to increase crop yield in rice-wheat cropping systems. The use of red duckweed also increased soil organic matter and potassium content.

Phosphorus Mobilizers

In acidic soils, a large proportion of P provided as fertiliser enters the immobile pools via precipitation reactions with highly reactive Al3+ and Fe3+, and in calcareous or normal soils, Ca2+. Even while the overall P pool is large, only a small portion of it is available to plants. As a result, increasing soil P availability requires the release and mobilisation of insoluble and fixed forms of P. Mycorrhizae are root-symbionts that get their nutrients from the plant and give the host plant minerals like N, P, K, Ca, S, and Zn. Cucumber seedling survival and fruit yield were greatly improved by mycorrhiza inoculation, as were P and Zn shoot concentrations. Arbuscular mycorrhizal fungi colonisation can provide a variety of benefits, including enhanced nutrient uptake, drought tolerance, and disease resistance. Plant community growth, nutrient uptake, water relations, and above-ground productivity are all influenced by arbuscular mycorrhiza, which develops symbiotic relationships with the majority of plants.

P Solubilizers

Only 10-20% of the supplied phosphorus fertiliser is accessible to the plants; the rest changes to insoluble phosphate forms such as rock phosphate and tri-calcium phosphate.

PSB (phosphate solubilizing bacteria) aids in the release of this insoluble inorganic phosphate, making it available to plants. The germination index of NPK-treated soils with PSB was higher than that of control soils as well as NPK-treated soils without PSB. In maize and wheat crops, PSB inoculation combined with phosphate rock fertilization promoted crop growth in terms of shoot height, shoot and root dry biomass, grain yield, and seed yield. total phosphorus intake. PSBs promote plant growth by increasing the efficiency of biological nitrogen fixation, producing phytohormones and increasing the availability of trace metals such as zinc and iron. After 15 days, plants from each treatment with or without NPK fertilizer had significantly higher root length, shoot length and total biomass than the control and NPK alone ($P < 0.05$). Some phosphate-solubilizing bacteria can accumulate heavy metals, reduce phytotoxicity and promote plant development.

K Solubilizers

With the development of high-yielding crop types and the continuous intensification of agriculture, soil K stocks are rapidly depleting. Many bacteria, such as Acidothiobacillus ferrooxidans, Paenibacillus spp., Bacillus mucilaginosus, Bacillus edaphicus, and Bacillus Circulans, dissolve silicate

minerals (*e.g*., biotite, feldspar, illite, muscovite, orthoclase, and mica) and release potassium through the production of organic and inorganic acids, acidolysis.

Under greenhouse and field circumstances, inoculating seeds and seedlings of several plants with KSB resulted in significant increases in germination percentage, seedling vigour, plant growth, yield, and K uptake by plants. Pepper and cucumber, maize, wheat, Sudan grass and Okra all grew better after being inoculated with KSB.

Conclusion

By solving atmospheric di-nitrogen and mobilising constant macro and micro vitamins withinside the soil into paperwork to be had to plants, bio-fertilizers, which can be essential additives of natural farming, play a vital function in making sure long-time period soil fertility and sustainability. There is already a ten million tonne hole in plant vitamins among crop elimination and chemical fertiliser supply. Excessive reliance on chemical fertilisers, in phrases of each value and environmental impact, isn't always possible in the end because of the prices of putting in fertiliser factories and keeping output, each in phrases of home assets and overseas exchange. In this context, bio-fertilizers will be the possible alternative for farmers to growth productiveness consistent with unit area.

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