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RESEARCH ARTICLE

USE OF BIO. FERTILIZERS IN CROP PRODUCTION AND SOIL FERTILITY IN UT OF JAMMU AND KASHMIR (INDIA)

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Abstract

Modern Horticulture as well as Agriculture involves usage of pesticides and chemical fertilizers with an essence of increasing the world's food production fertilizer's, though they are vital as a nutrient supplement to plants and comprised mainly nitrogen (N), Potassium (K) and phosphorus (P), Urea, etc. They also cause several health, hazard. Researchers have found Bio fertilizer as an excellent alternative to chemical fertilizers which provide nutrients through the action of nitrogen fixation, solubilizing phosphorus, and trigger plant growth. The study reviews these continuously accessible and ecofriendly nutrients, types and their potential for crop production based on relevant literature and research work carried out by numerous researchers.

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Introduction:-

India is a developing nation. Its economy is growing, poverty is still a major challenge. In fact based on the global bank 60% of the India lives under the standard global poverty line. However the covid 19 pandemic is expected to drive an additional people into extreme poverty, Depending on the severity of the economic contraction. Though we have vast cultivable land and enough water in this planet, still we are unable to fulfill the basic needs of the people. It is estimated that one billion people in the world suffer from hunger and malnutrition in their day to day life.

It is rough estimated that about 25000 people die every day from hunger or hunger related causes. Also the majority of hunger deaths are caused by chronic malnutrition. Conventional agriculture plays a pivotal role in the growth and survival of nations, therefore maintaining its quantity and quality is essential for feeding the population and economic experts. Also however the covid-19 pandemic is expected to drive an additional people into extreme poverty, depending on the severity of the economic contraction poverty. In order to increase the crop production for fulfilling the nutritional requirements of the day by day increasing population and over the years, agriculture has undergone various scientific innovations in order to make it more efficient [A]. Modern agriculture involves usage of pesticide and chemical fertilizers with an essence of increasing the world's food production, as these serve as fast food for plants causing them to grow more rapidly and efficiently. Continuous application of chemical fertilizers and pesticides tremendous harm and leads to decay of soil quality and fertility. And affecting the fruit nutritional value and edibility [B]

Hence in the recent years, many organic fertilizers have been introduced that act as natural stimulators for plant growth. A particular group of organic fertilizers includes outcomes based on plant growth promoting. Micro-

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organism identified as Bio fertilizers. These bio- fertilizers add nutrients through the natural process of fixing atmospheric nitrogen, or phosphate solubilizing micro-organisms. Organic farming has appeared as a prime concern area globally in aspect of the growing demand for safe and healthy food, durable sustainability and issue in environmental pollution associated with random use of agrochemicals_[C].

Organic farming is one of such strategies that not only ensures food safety but also adds to the biodiversity of soil_[D]. The additional advantage of bio fertilizers includes longer shelf life causing no adverse effects to ecosystem_[E]. Organic farming is mostly dependent on the natural micro flora of the soil which constitutes all kinds of useful bacteria and fungi including the arbuscularmycorrhizafungi (AMF) called plant growth promoting Rhizobacteria (PGPR) .

Bio-fertilizer keep the soil environment rich in all kinds of Micro- and Macro-nutrients via, nitrogen fixation, plant growth regulating substances, production of antibiotics and bio-degradation of organic matter in the soil_[F]. When bio fertilizers are applied as seed or soil inoculants, they multiply and participate in nutrient cycling and Benefit crop productivity_[G] , In general, 60% to 90% of the total applied fertilizer is lost and the remaining 10% to 40% is taken up by plants . In this regard microbial inoculants have paramount significance in integrated nutrient management system to sustain agriculture productivity and healthy environment _[H].

A fertile soil should possess all the macro and micro-nutrients as these minerals promote plant nutrition. Good fertility is basic for successful plant growth and the approach of fertilizers and manures is a necessary activity. The maintenance of sufficient levels of nutrients in soil is important for healthy plant growth _[I].

Bio-Fertilizers:-

From long –ago, the chemicals pesticides and fertilizers have played a vital role in improving agricultural production. Although they have a short history in modern agriculture, their instant action and low cost managed to bring them quickly into the center of attention. Thus their adverse effects on environment, plant, animal and human life have diverted the priority on ecofriendly plant protection. The term bio fertilizer, depict everything from manures to plant extract _[J]. Bio fertilizer is a material which contains living micro-organisms, when applied to plant surface they promotes plant growth by increasing the supply of primary nutrients to the host plant. Bio-fertilizers add nutrients through natural process such as nitrogen fixation, solubilizing phosphorus and stimulating plant growth along with the synthesis of growth promoting substances. Bio- fertilizer is technically living. It can be mutually beneficial in association with plant roots.

Biological nitrogen fixation:-

Nitrogen fixation was assigned by the German scientists Hellricgel and wilfarth in 1886, who reported that legumes being root nodules could use gaseous nitrogen. Soon after in 1888,

Nitrogen is the element of protein and nucleic acids and chlorophyll. Therefore, nitrogen supply to the plant will have important on the amount of protein, amino-acids, protoplans and chlorophyll formed. Hence moderate supply of nitrogen is vital to achieve high yields of crops. Nitrogen makes up 78% of atmospheric, but is present in unavailable form for use by organisms. In every one hectare of land, there are 80000 tons of remote nitrogen. To convert it into available form, it needs to be fixed either by industrial process or through Bio-logical nitrogen fixation (BNF). Nitrogen deficiency is commonly a prime limiting, factor for crop production it is a vital plant nutrient, widely applied as N- fertilizer. To enhance yield. Differential bacterial genera are key components of soil. The word plant Growth Promoting Rhizobacteria was first explained by Kloepper and schroth in 1978_[K]

Rhizobium:-

Rhizobium belongs to family the Rhizobiaceae. They are gram negative, motile, non-sporulating rod shape free living organisms present in soil and have the tendency to fix the atmospheric nitrogen (N) in symbiotic manner. They are known as an endo symbiotic N fixing micro-organisms related with roots of legumes. It penetrates into the plants through the root system and later forms nodule. The fixation of N in root system and later forms nodule. The fixation of N in root nodules reacts with the available H molecules present and then forms NH₃ for which the energy required is gained from the host. The carbohydrate produced by the legume. Plants one transfer to the nodules and are used by Rhizobium as the only source of hydrogen in the conversion of N to ammonia.

The root nodules thus act as a micro-fermenter for organic N fixation where they can convert atmospheric nitrogen into ammonia. Rhizobium is able to influence the shoot and root growth in rice plants. Its interaction with legume host is quite specific and it will fix N in the particular host plant.

Rhizobium is a genus of gram-negative soil bacteria that fix nitrogen. Rhizobium species from endosymbiosis nitrogen fixing association with roots of (Primary) legumes and other flowering plants. The bacteria colonize plant cells within root nodules, where they convert atmospheric nitrogen into ammonia using the enzymes Nitrogenase and then provide organic nitrogenous compounds such as glutamine or urecides to the plant in them provides the bacteria with organic compounds made by photosynthesis.



Rhizobium

Cynobacteria:-

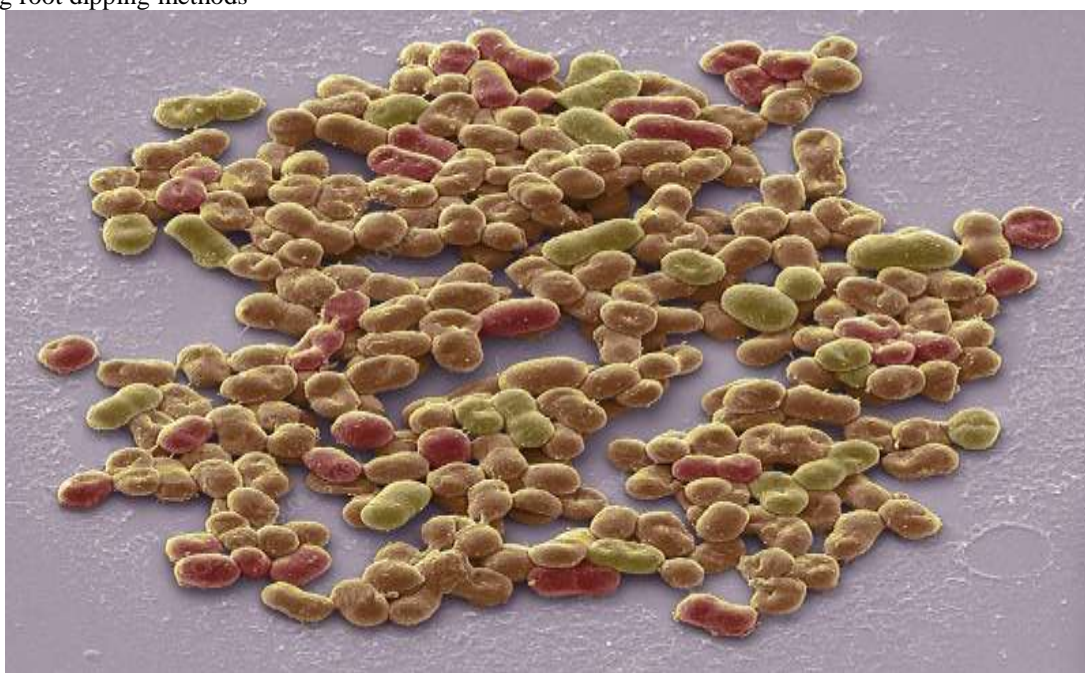
Cyanobacteria are essential for global nitrogen cycle. N fixing cyanobacteria are between the most widespread and important N fixers on earth. Cyanobacteria/ blue green algae are various groups of prokaryotes that generally form complex associations with bacteria and green algae in structures known as cyanobacteria. These are the main N-fixers in freshwater and marine systems. In large areas of the world's oceans, nitrogen fixing micro-organisms provide a vital source of nitrogen in many terrestrial environments, from rainforests to deserts. Cyanobacteria environments, from rainforests to deserts. Cyanobacteria are able to survive in severe environments because of rare adaptations such as their ability to fix nitrogen and their resistance to desiccation cyanobacteria mats have been used as bio fertilizer in current agriculture_[L]



Cynobacteria

Azotobacter:-

Azotobacter is a genus of usually motile, oval or spherical bacteria that form thick-walled cysts and may produce large quantities of capsular slime. They are aerobic free-living soil microbes that play an important role in the nitrogen cycle in nature, binding atmospheric nitrogen, which is inaccessible to plants. Azotobacteria are free living bacteria which grow well on a nitrogen free medium. Such bacteria utilize the atmospheric nitrogen gas for their cell protein syntheses. This cell protein is later mineralized soil after the death of Azotobacter cells. Thus contributing to the nitrogen availability of the crop plants. Azotobacter spp. are sensitive to acidic pH, high salts, and temperature of 35 degree Celsius. Besides N₂ fixation, Azotobacter synthesizes and secretes large amounts of organically active substances and secretes large amounts of organically active substances, such as B vitamins, nicotinic acid, pantothenic acid, biotin, heteroxins, and gibberellins etc. which improve the root growth of plants. Other characteristic of Azotobacter associated with crop improvement is the secretion of ammonia in the Rhizosphere in the presence of root exudates, which helps in modification of nutrient uptake by the plants. Improvement in crop production due to Azotobacter inoculation has been reported in a number of crops. Azotobacter increases the production of the agriculture crop plants by 10-12%. Azotobacter can also improve growth and grain yield in wheat crop. Azotobacter acts as one of the vital bio fertilizers for rice and other cereals, it can be applied by seed dipping and seedling root dipping methods.



Azotobacter

Azospirillum:-

Azospirillum is a Gram negative motile bacteria belonging to the order Rhodospirillales, related with roots of monocots, including essential crops, particularly wheat, corn and rice. It is the main productive phytostimulator inoculant for cereals worldwide. Azospirillum can be established as an associative symbiosis with cereals, but unlike mutualistic symbiosis, the association is not shown by the formation of new organs. Azospirillum benefits the plant directly, through associative nitrogen fixation, synthesis of phytohormones. And regulation of plant hormonal balance by deamination of the ethylene precursor. It is an associative type of microorganism effective in colonizing the root surface of the plants. By establishing a symbiotic organization, it helps the plants to obtain nitrogen from the atmosphere.



Azospirillum

Vascular Arbuscular Mycorrhiza (VAM):-

Mycorrhizae are common beneficial relationship between fungi and plant roots. VAM fungi contaminate and spread inside the root. They have special structures known as vesicles and arbuscules. The plant roots transfer substances to the fungi, and fungi aid in transferring nutrients and water to the plant roots. The fungal hyphae may increase the root lengths to 100-fold. The hyphae reach further and wetter soil areas and help plants absorb many nutrients such as phosphorus, zinc, molybdenum and copper, several VAM fungi form a kind of sheath around the root, sometimes giving it a hairy, cottony appearance. Because they provide a protective cover, mycorrhizae improve seedling tolerance to drought, high temperatures, infection by disease fungi and even to extreme soil acidity. Application of VAM produces preferable root systems which engage root rotting and soil borne pathogens. The considerable growth response to mycorrhizal fungi is likely seen in plants in highly weathered tropical acid soils that are low in basic cations and P, and may have toxic levels of aluminum. Plants with limited root systems would be the most beneficial.

The function of bio fertilizers in crop production:-

Soil micro-organisms play an important role in regulating the dynamics of organic matter decomposition and availability of plant nutrients such as N, P and S. It is well-recognized that microbial inoculants constitute an essential component of integrated nutrient management that leads to sensible agriculture. Additionally, microbial inoculants can be used as an economic input to enhance crop productivity, the dosage of fertilizers can be lowered and more nutrients can be harvested from the soil.

Bio fertilizer could be used as nutrient source for soil microbiology by maintaining fruit yield and quality and promoting nutritionally supplied plants with lower production costs. Nitrogen fixing microorganisms play a vital role in improving yield by converting atmospheric nitrogen into organic forms which are usable by plant.

Rhizobia are mutually associated with legumes and nitrogen fixation occurs within the root or stem nodules where the bacterium is located. Rhizobium inoculation helps to enhance root nodulation, plant growth and produces higher grain yield by 10-15% under cultivated condition than a crop that has not been inoculated.

Nitrogen fixation by unique annual legumes has been reported to vary from 35-270 kg/ha in a year.

Bio fertilizers stimulate nutrients that favor the development of biological activities in soils which help in maintaining plant health. This is enhanced by the addition of balanced nutrient, which provide food and growth of microorganisms, and also beneficial soil worms are required. As an outcome of good structure provided to the soil, root growth and organic matter in soil are enhanced. Mycorrhizal development is greatly influenced by the application of bio fertilizers, which in turn is responsible for the availability of high phosphorus content in the soil.

Conclusion:-

In current agriculture practices, chemical fertilizers have reduced the fertility of soil, making it unsuited for raising crop plants. Additionally, the excessive use of these inputs has also led to severe health and environmental hazards such as soil erosion, water contamination, pesticide poisoning, falling ground water table, water logging and depletion of biodiversity. Biofertilizers spontaneously activates the microorganisms found in the soil in an effective and eco-friendly way, thereby gaining more importance for utilization in crop production, restoring the soils fertility and protecting it against drought, soil diseases and thus stimulate plant growth. The application of bio fertilizers can minimize the use of chemical fertilizers, decreasing environmental hazards, enhance soil structure and promote agriculture. Bio fertilizers are cheaper and remarkable in affecting the yield of cereal crops. Bio fertilizers being important components of organic farming play a key role in maintaining long term soil fertility and sustainability by fixing insoluble P in the soil fertility and sustainability by fixing insoluble P in the soil into forms available to plants, thus increasing their effectiveness and availability.

In bio fertilizers , beneficial bacteria are Azotobacter, Azospirillum, Rhizobium, Mycorrhizae which are very essential in crop production. Bio fertilizer can also make plant resistant to unfavorable environmental stresses.

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