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CYANOBACTERIAL COALITION TO IMPROVE PADDY SOIL QUALITY

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ABSTRACT

The rise in the number of people living on the planet over the last several decades has led to an increase in the demand for food, which may be satisfied to a greater extent by increasing agricultural output. In addition, farming practises need to become more sustainable because the use of chemical fertilisers, pesticides, and growth stimulants can lead to serious environmental issues and lead to the depletion of limited resources such as phosphorus and potash, which in turn leads to an increase in fertiliser quotas. These issues can be avoided by switching to methods that do not rely on these substances. The use of substances originating from biological sources that are known to have action in plant nutrition, safety, and stimulation is one possibility that may be considered practical for the creation of a more sustainable and evidently more productive agriculture. When it comes to these goods, the biomass of microalgae and cyanobacteria (or the extracts of these organisms) receives a lot of attention since it may give vital nutrients and metabolites that have extraordinary bioactivities and can greatly boost the amount of vegetative production. In the first experiment, a total of ten different species of blue-green algae that belonged to the Chroococaceae, Oscillatoriaaceae, Nostocaceae, Scytonemataceae, and Stigonemataceae families were found to be unicellular and either non-heterocyst or heterocyst in structure. Among each of the different locations that were investigated in Dayalbagh, the distribution of cyanobacteria varied from 0.33 0.57 to 2.66 0.57 and from 1 1.22 to 30 7.31, respectively.

Keywords: *Cyanobacterial, Paddy Soil*

INTRODUCTION

Blue-green algae, also known as cyanobacteria, have the ability to convert nitrogen dioxide (N2) in the air into organic forms of nitrogen that are easier for plants to assimilate. This process allows blue-green algae to contribute to the replenishment of nitrogen in the atmosphere. Nitrification is the name given to this process. When there are more vigorous blooms present, the likelihood of this technique being successful is greatly increased. Because of this, the incorporation of cyanobacteria into the ground causes an increase in the amount of nitrogen that is easily available to plants. Nitrogen is a nutrient that is vital to the growth of plants and is classified as a vitamin. Plants cannot grow without it. It has been demonstrated in the past that the presence of cyanobacteria in agricultural soils is linked to a number of benefits, one of which is the production of a greater variety of crops. Another benefit that has been linked to the presence of cyanobacteria in agricultural soils is an increase in crop yield. One of the advantages that has been connected to the presence of cyanobacteria is this particular benefit.

For instance, Jha and Prasad arrived at the conclusion that the application of a cyanobacterial inoculum to a rice scoop resulted in an increase in the grain and straw yields as well as an improvement in the amount of nitrogen that was supplied to the soil. This was discovered by observing what happened when the inoculum was applied to the rice scoop. They arrived at this verdict after noting an increase in the quantity of nitrogen that was added to the soil during the course of their research. In a manner that is analogous, Singh and Datta demonstrated that the spurs used increased the development of normal rice harvests by utilizing Anabaena variabilis lines in a rice discipline. This was done to ensure that the spurs were effective. This was done in order to maintain the discipline associated with rice. This comprises a rise in plant height in addition to an increase in the duration of leaves as well as an increase in the development of leaves. This also includes an increase in the number of leaves produced by the plant. In addition to this, the spurs were responsible for the increased production of seeds, grains, and straw during this time period. Rice was used as the subject of the research that was conducted by Innok et al, who found that the inclusion of Nostoc sp. When compared to the results obtained while only utilizing a nitrogen-based primary chemical fertilizer, the grain yield that was achieved by employing vegetative cells was much greater. After carrying out an investigation, they reached this realization as a result of their findings. Even though the majority of people who took part in the study believed that cyanobacteria should be utilized in rice fields, more recent studies have shown the positive benefits that cyanobacteria may have on a wider range of crops. This is despite the fact that the majority of people who took part in the study believed that cyanobacteria should be utilized in rice fields. This is despite the fact that the vast majority of respondents who participated in the study held the opinion that rice fields ought to make use of cyanobacteria in some capacity.

Nutritional Availability in the Soil

There is a possibility that the availability of a variety of vital plant nutrients can be improved by the introduction of microalgae and cyanobacteria into the soil. Microalgae and cyanobacteria, both of which are photosynthetic microorganisms, have the ability to take up nitrogen and phosphorus from certain environments (even those in which these vitamins are in limited supply) and store them in their biomass. This allows them to take up nitrogen and phosphorus from environments in which these vitamins are in limited supply. This is due to the fact that both of these bacteria include chlorophyll, which enables them to transform the energy from light into the energy that can be used chemically. There is a possibility that the byproducts of cyanobacteria and microalgae should be regarded as the principal source of these vitamins. This occurs as a result of the fact that the growth of plant life need certain vitamins in order to be successful. As a result of this, it is feasible to do away with the usage of the traditional artificial fertilizers altogether. It is conceivable for the biomass of microalgae and cyanobacteria to contain trace levels of other elements including potassium, magnesium, sulphur, and iron. This is because these organisms are complex and diverse. All of these components are essential for the formation and expansion of plant life in order for it to exist. These components are commonly involved in redox reactions and serve a very major purpose in the metabolic processes of plants. They also play a role in oxidation and reduction reactions. They also play an essential part in the metabolic processes of animals.

Because of this, the incorporation of microalgae and cyanobacteria into the soil has the potential to boost the availability of both macro- and micronutrients, which is beneficial to the development of plant life. In the past, there have been reports on this shift in the availability of nutrients that have been discovered in the scientific literature. Microalgae, bacterial flocs, and nitrogen all had a role. oculata biomass were all transplanted into a tomato lifeform in order to carry out this study's objectives. After that, the researchers analyzed the effects of various treatments on the makeup of the soil as well as the growth of the fruit. Researchers came to the conclusion that the presence of photosynthetic organisms accelerates the availability of nitrogen, phosphate, and potassium in the soil, and it also stimulates the creation of high-quality fruits by increasing the amount of sugar and the carotenoid content. Both of these benefits can be attributed to the fact that the presence of photosynthetic organisms increases the amount of sugar and the carotenoid content. Both of these advantages may be traced back to the fact that the presence of photosynthetic organisms quickens the rate at which these components become available in the soil. Tomato output was lower when organic fertilizer was utilized as contrasted to when artificial fertilizer was administered, despite the fact that this was the case.

Throughout the course of the study that was carried out on okra plants, biofilms and bacterial and cyanobacterial consortiums were utilized in order to find increased concentrations of zinc and iron in the soil. Both the production and weight of the roots rose as a result of these higher zinc and iron levels. Research was carried out by Marks and colleagues to investigate the effects on the soil's chemical make-up that would result from cultivating a subculture of Chlorella sorokiniana in basic soil. They reached the conclusion that the presence of these microalgae boosted the soil's sensitivity to nitrogen. This was one of the benefits that the microalgae brought to the soil. Microalgae and cyanobacteria both have the ability to provide higher plants with a supply of organic materials. When it comes to the growth of healthy plants, organic matter is absolutely necessary and must be present in sufficient amounts. In the beginning of the process, the carbon dioxide (CO_2) that is extracted from the air by these photosynthetic bacteria is transformed into natural biomass. In addition to this, these organisms have a tendency to produce extracellular polymeric compounds, which boost the amounts of organic carbon in the soil and help other kinds of microorganisms flourish. Other organisms and herbivores may be able to decompose the waste products left behind by phytoplankton and cyanobacteria in areas that are used for agricultural purposes. As a consequence of this, there is a rise in the total quantity of natural carbon that is present in the ground. This is not the only component that contributes to an increase in the natural carbon concentration of the soil; in fact, this is not even the most significant factor. This is not the only element that contributes to an increase in the natural carbon concentration of the soil. In the past, it has been indicated in the works of research that have been published that the introduction of microalgae and/or cyanobacteria into soils has the potential to result in an increase in the natural carbon content of the soil. This could be because the microalgae and/or cyanobacteria are able to break down the natural carbon that is present in the soil. This is the kind of thing that has the potential to make the natural carbon content of the ground go up, which would be a good thing.

Physical and Chemical Changes in the Soil

Because microalgae and cyanobacteria are able to I adjust the pH of the soil, (ii) remove heavy metals and other pollutants from the soil, and (iii) manage the amount of salinity in the soil, they are able to play a significant role in the rehabilitation of damaged soils. When it comes to the regulation of pH, a number of studies have shown that the introduction of material composed of microalgal or cyanobacterial organisms into soil either raises or lowers the pH of the soil, depending on the direction in which the shift occurs. Yet, it is essential to emphasize the positive impact that this substance has on controlling the acidic or alkaline features of a wide range of soils. This influence may be seen as both useful and crucial. Its impact may be found in a variety of different soils around the world. When looking at the salinity of the soil, a significant number of studies have indicated that higher levels of salinity are associated with greater rates of plant growth. It was determined that there was a significant connection between the two. Either by I lowering the soil's saltiness (by increasing the soil's ability to retain water), which in turn makes plants more tolerant of high concentrations of salt, or by (ii) reducing the soil's saltiness overall, this improvement either I makes plants more tolerant of high concentrations of salt. (this may be accomplished by using gibberellic acid, which is a phytohormone that is often discovered in cyanobacteria and microalgae). In conclusion, microalgae and cyanobacteria have the ability to form bonds with a wide variety of substances, including hydrocarbons, heavy metals (such as cadmium, lead, and chromium), trace elements (such as iron, zinc, copper, and manganese), and other substances (such as cadmium, lead, and chromium). Because of this, the addition of phytoplankton and cyanobacteria to the soil might potentially assist enhance the quality of the soil and the nutrients it contains, in addition to making a contribution to the overall growth of the soil.

We conducted research to see whether or not diesel and biodiesel polluted soils might be decontaminated using sleeping cells obtained from Spirulina platensis and phycocyanin formulations derived from the same species. As compared to the control, it was shown that extracts of phycocyanin and dormant cells were equally effective at removing hydrocarbons from soils that had been polluted. The removal of biodiesel was accomplished with the greatest success (88.8%) by phycocyanin extracts, whereas S. platensis latent cells were shown to be the most effective in diesel removal (63.9%). Not only are microalgae and cyanobacteria important for replenishing the soil with essential nutrients and restoring its properties, but they can also improve certain soil properties such as aggregation, porosity, permeability, aeration, and moisture. This is because microalgae and cyanobacteria are symbiotic organisms that depend on each other for their survival. In addition to this, it is important for them to contribute to the enrichment of the soil with necessary nutrients. The majority of the time, the enhancement of these traits is related to the polysaccharides that are released by a wide variety of species of microalgae and cyanobacteria.

Protection of Plants

The maintenance of plant life definitely necessitates an expansion of agricultural production that is generated from both biotic and abiotic sources. Even though certain plant species have defense mechanisms and resilience mechanisms that are built in, external security is necessary for the bulk of food items in order to attain high production targets. This is because certain plant species have these mechanisms built in. The application of microalgae and cyanobacteria (or formulations generated from these microorganisms) can induce appropriate plant protection against biotic and abiotic stressors. This is due to the large diversity of medicinal compounds that are found within these microbes.

Protection from Biotic Factors

A decline in plant output can be caused by a variety of biological reasons, and each of these variables can play a unique role. The presence of creatures such as insects, nematodes, bacteria, and fungus is one of these elements that might contribute to the problem. Polysaccharides are the primary factor in determining whether or not an organism will be protected against these harmful microbes. This is due to the fact that polysaccharides are able to differentiate between the signalling molecules that are situated in the cell wall of the pathogenic organism, which in turn causes a number of defensive responses to be activated. The activation of particular biochemical processes, the translation of genes, and the transmission of signals is a typical method of self-defense. This process, in most circumstances, leads in the synthesis of secondary metabolites such as phenols, terpenoids, and other chemicals that exhibit antioxidant, antibacterial, and antifungal characteristics. These metabolites are produced as a byproduct of the primary metabolic pathway. Microalgae and cyanobacteria, both of which contain a considerable quantity of polysaccharides, can be utilized to improve the natural resilience of agricultural plants. This is possible due to the fact that both of these microorganisms contain polysaccharides. In point of fact, it has previously been shown in the scientific literature that microalgae and cyanobacteria have the ability to trigger plant defence systems. The -1,3-endoglucanase enzyme, which destroys cellular pathogen compounds, was greatly enhanced in the development of branches and roots in the experiment after the seeds from spice cultures were inoculated with cyanobacteria Anabaena laxa and Calothrix elenkinii. This enzyme is in charge of breaking down cellular components that are produced by pathogens. In addition to this, the scientists discovered that there was an increase in plant dry weight, stalk length, root length, and increased interest in fungicidal treatments.

The Impact that Pesticides have on the Ecosystem of Agriculture and the Natural Environment

The overwhelming majority of the pesticides that are sprayed on rice fields are allowed to remain in the fields unused, which contributes to the contamination of the environment that is nearby. Rice farmers will occasionally apply herbicides five or six times during the course of a single growing season, despite the fact that a single container may be adequate to meet their requirements. This is done for a variety of reasons. In addition, the pesticide has the capability of penetrating the earth, polluting groundwater or drinking water, and being consumed by vegetation and creatures that are not its intended target. When paddy fields are inundated, pesticide residues make their way into irrigation channels, which in turn leads to an increase in the number of infectious illnesses that can be found in rivers and lakes. In addition, the use of pesticides contributes to an even more significant problem, which is known as bioaugmentation. This problem arises when beneficial organisms, such as fish, are able to accumulate and consume pesticides.

Cyanobacterial Diversity in Rice Grains

Rice paddies are regarded as an environment due to the fact that they offer a diversified range of habitats to numerous different kinds of microorganisms. These different types of environments are instances of microenvironments, and each one possesses its own distinct collection of physicochemical and biological characteristics. It is conceivable that the agronomic and biogeochemical stability of the ecosystem in the paddy agriculture region is dependent on the habitat heterogeneity that exists there. This environmental heterogeneity influences the structure and frequency of microbial groups in the atmosphere of that rice, which paves the way for a number of different techniques that can be taken in the field of microbiology. (Kimura, 2000). Cyanobacteria, also known as blue-green algae or BGA, is one of the most significant microorganisms that has a long-term deleterious impact on the environment of paddy fields. This effect occurs over the course of many years. Cyanobacteria are also referred to as BGA in some circles.

It is a community made up of a wide variety of photosynthetic bacteria that are responsible for oxygen-rich photosynthesis and it is carried out by this community. Because some cyanobacteria contain specialised cells known as heterocysts, which have the ability to repair atmospheric nitrogen, it is possible to use these organisms as natural biovaccines. This is because heterocysts are found in certain cyanobacteria. According to Kaushik (1994), the incorporation of cyanobacteria into the process of growing rice has the potential to produce an amount of nitrogen that falls somewhere in the region of 20 to 30 kg/da. According to Ibrahim (2007), cyanobacteria have the ability to improve the quality of soil by increasing the amounts of phosphorus and carbon in the soil while also increasing the capacity of the soil to retain water. Cyanobacteria have been shown to alter the morphological length of the soil, which in turn boosts the amount of available oxygen in the soil. Cyanobacteria are very likely to be found in the dirt of rice-growing regions as well as in inundated areas. Both of these environments are ideal for their growth. Both Anand and Hopper (1995) and Vijayan and Ray (2015) listed different organisms from the Anabaena, Arthrospira, Cylindrospermum, Chroococcus, Nostoc, Lyngbya, Oscillatoria, Gleothece, Gleocapsa, Microcystis, Merismopedia, Synechocystis, Leptolyngbya, Westillopsis, Syc Rice. Kerala. According to Singh et al. (1997), the paddy paddies of Nagaland contained the greatest diversity of Microcystis species and heterocyst genera, such as Anabaena and Nostoc. Some of the most common species of cyanobacteria that can be discovered in rice paddies are Anabaena, Aulosira, Calothrix, Gleotrichia, Cylindrospermum, Nostoc, Fischeiella, Scytonema, Tolypothrix, and Wollea. Among the other species is the Wollea (Rai, 2001). Several employees have conducted research on the cyanobacterial vegetation that has the potential to be discovered in rice paddies in the United States. Indeed, Indeed.

OBJECTIVES

1. Detection of pesticide-tolerant strains of cyanobacteria.
2. Efficacy testing of selected cyanobacteria to break down pesticides.

RESEARCH METHOLDOLOGY

Growth inhibition (%)

In order to calculate the percent growth inhibition (GI), which is a measure of toxicity, the following formula was used, which was based on references from El-Nahhal et al. (1988) and El-Nahhal et al. (2016):

$$\% \ GI = 100 * [(ODc - ODt)/ODc]$$

The optical densities of the processed and untreated samples, denoted by ODc and ODt, respectively, are represented by these variables in this equation.

Experimental design

In the province of Almera, two semiarid regions were examined; each of these regions had a distinct soil type and a different distribution of particulate sizes. Both of these communities are located in the approximate vicinity of one another in the southeast of Spain. First, we work with silty soil, then move on to particulate soil, and then we go back to working with silty soil. These materials have patterns ranging from very fine to very coarse across the spectrum. The distribution of particulate sizes for a number of different soil kinds is shown in Table 1. The Tabernas Desert, which is situated at 37 degrees 00 minutes North latitude and 2 degrees 26 minutes West longitude, is the source of the clay. The Tabernas Desert is characterised as a desert region due to its nearly featureless terrain, poorly developed soil structure, and insufficient levels of nitrogen and organic matter. Temperatures average 18 degrees Celsius throughout the year, and 235 millimetres of precipitation occur on a yearly basis.

DATA ANALYSIS

The findings of the tests are summarised in Table 1, which details the concentrations of accessible nitrogen (N-KCl), total nitrogen (NT), total phosphorus (P-Olsen), and organic matter (OM) found in the substrates that were evaluated. At the outset as well as the conclusion of the programme. At the beginning, the only variables observed that were substantially different between the normal soil and the test soil were those significant differences. The soil that had been mixed with inoculation effluents and sand at the conclusion of the experiment (day 26) had significantly greater levels of accessible nitrogen (N-KCl), available phosphorus, and organic matter than the soil that had been used as the control.

Table 1 Standard and test soils were analyzed to determine the nitrogen present (N-KCl), total nitrogen (NT), available phosphorus (P-Olsen) and organic matter (OM) content. Each letter means big differences.

	N-KCl (mg/Kg)		Total N (%)		P-Olsen (mg/Kg)		OM (%)	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final
Standard soil	166,3±2,5[a]	154±5[a]	0,29±0,04[a]	0,22±0,01[a]	14,95±1,06[a]	18,3±0,28[a]	8,71±0,25[a]	8,94±0,72[a]
Soil mixed with TS	140±5[b]	105±5[b]	0,16±0,02[b]	0,16±0,01[b]	8,05±0,07[b]	8,85±+0,07[b]	7,08±0,16[b]	5,7±0,33[c]
Soil mixed with TS-BG11	140±5[b]	175±5[c]	0,16±0,02[b]	0,11±0,01[b]	8,05±0,07[b]	8,2±0,14[b]	7,08±0,16[b]	7,77±0,23[b]
Soil mixed with TS inoculated	140±5[b]	224±5[d]	0,16±0,02[b]	0,14±0,01[b]	8,05±0,07[b]	10,35±0,21[c]	7,08±0,16[b]	9,14±0,04[a]

Mineralization test

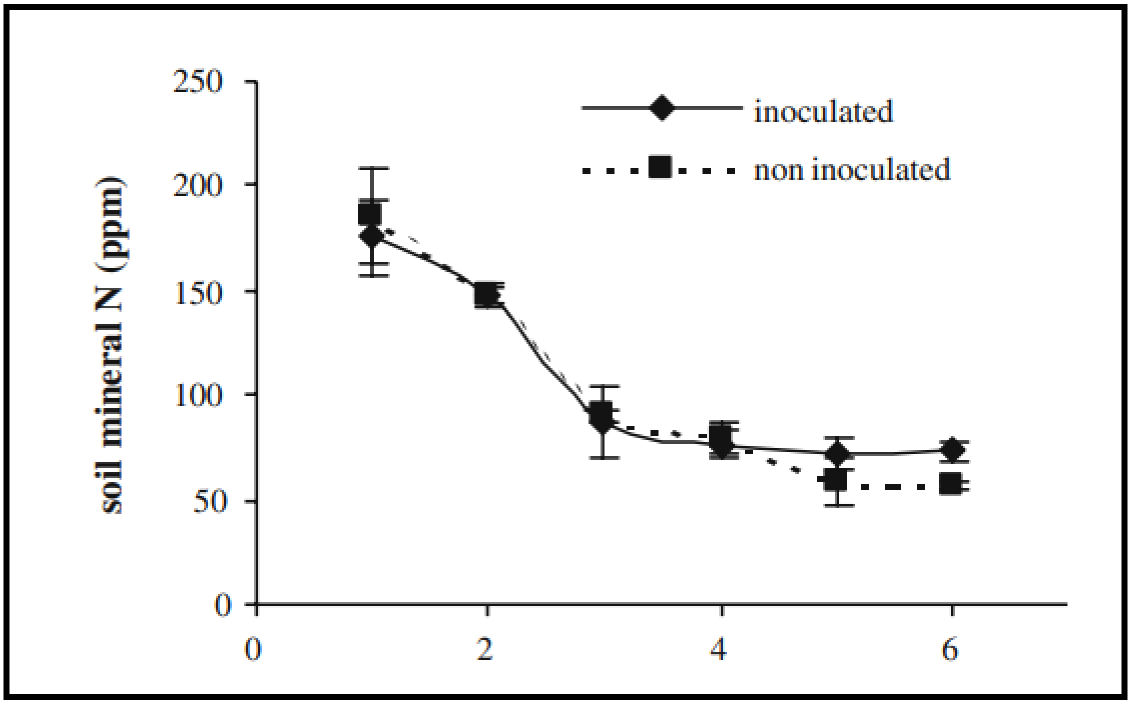
An investigation was carried out in a greenhouse by planting rice in plastic boxes, which was afterwards followed by the introduction of N-labeled cyanobacteria. The nitrogen source used in this experiment was ammonium N-sulphate, and the isolates Nostoc BI42, Anabaena BI46, and Calothrix BI 22 were cultured in BGII. After the completion of the growth process, the solution was subjected to centrifugation and then washed with HO in order to eliminate any excess nitrogen. Together with the floods, the inoculant was sprayed at a rate of 0.9 kg of nitrogen per hectare, which corresponds to 107 colony forming units nine times per square metre. Furthermore, approximately 38 percent residual nitrogen was added. The total nitrogen and accessible nitrogen content of the plants was determined by taking a sample at 25, 55, and 100 days following the inoculation and analysing it.

Table 2 Cyanobacterial nitrogen recovery efficiency

Days after inoculation	Growth stage of rice	g Ndff (Cyanobacteria)[a]	FUE %
25	Floral Primordia	45 ± 9	5.0
55	Flowering	60 ± 16	6,7
100	Harvest	105 ± 22	11,7

Values mean four replicates ± standard error.

After 5 weeks, inoculated containers had higher levels of soil inorganic nitrogen than uninoculated pots did, regardless of whether the inoculated pots contained plants or not. Uninoculated pots had lower levels of soil inorganic nitrogen. This was the case regardless of whether or not the receptacles contained seedlings that had not been inoculated with the pathogen. Cyanobacterial cells have the potential to generate nitrogen if the soil that they are grown in has a higher concentration of artificial nitrogen than is typical. However, because rice production requires nitrogen in greater proportions than other times of the year, the vast majority of it must have been processed after rice production came to a stop. However, the differing rates of growth over time may be the product of the interaction of a number of different processes, such as B. Mineralization and immobilisation can occur via a variety of mechanisms. Losses can also occur. Possible situation. Cyanobacteria might be able to assist in the assimilation of nitrogen and the prevention of its loss if certain circumstances are met at the location. They are also able to perform the role of the primary driver in the process of NH3 evaporation, which, depending on the circumstances, may be caused by daily increases in pH. Although cyanobacteria may contribute to nitrogen losses due to their encouragement of nitrification and denitrification processes by providing oxygen to the soil's bottom oxygenated layer, more evidence is required to support this hypothesis. Cyanobacteria may also contribute to nitrogen losses through their promotion of nitrification and denitrification processes.



weeks after vaccination

Figure 1 Development of mineral nitrogen (nitrate plus ammonium) in the soil after inoculation with cyanobacteria. Values shown are means of three separate tests and bars represent respective standard deviations.

CONCLUSION

Rice cultivation is one of the world's most important grain crops in terms of the staple food supply for more than 50% of the industry's population. In Asia, where 90% of rice is grown and consumed, especially in countries such as China, India, Indonesia, Bangladesh, Vietnam and Japan. Paddy rice (hard rice), the staple crop of Asian regions, is an indispensable staple food for most of the population, including the region's fearsome millions of people. India is the second largest rice producer in the northeastern and southern regions where rice is grown more than two to three times and forms the bulk of the daily diet in these regions. It depends on specific rainfall to produce good crops, but rice production can pose a significant risk of water scarcity due to global warming. . Rice cultivation is also affected by various pests including insects, diseases and weeds; It affects rice production in many ways in terms of yield and quality loss. Although rice farmers use a variety of pesticides to treat rice, pesticides not only control pests but also change the agricultural atmosphere for rice. Pesticides are caused by the lack of beneficial organisms that play an important role in a healthy environment and pesticide residues that also cause problems in paddy fields; somehow polluted near aquatic ecosystems. The rice farming environment has many micro-habitats that are home to a community of organisms of many types, including microorganisms. Microbes play a beneficial role in maintaining a healthy rice agroecosystem by recycling vitamins and increasing soil fertility.

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