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Contributions Of Heterocyst Bearing Naturally Growing Algal Forms In The Productivity Of Paddy

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ABSTRACT: Heterocysts Or Heterocytes Are Specialized Nitrogen-Fixing Cells Formed During Nitrogen Starvation By Some Filamentous Cyanobacteria, Such As Nostoc, Cylindrospermum, And Anabaena.[1] They Fix Nitrogen From Dinitrogen (N_2) In The Air Using The Enzyme Nitrogenase, In Order To Provide The Cells In The Filament With Nitrogen For Biosynthesis.[2]

Nitrogenase Is Inactivated By Oxygen, So The Heterocyst Must Create A Microanaerobic Environment. The Heterocysts' Unique Structure And Physiology Require A Global Change In Gene Expression. For Example, Heterocysts:

- Produce Three Additional Cell Walls, Including One Of Glycolipid That Forms A Hydrophobic Barrier To Oxygen
- Produce Nitrogenase And Other Proteins Involved In Nitrogen Fixation
- Degrade Photosystem Ii, Which Produces Oxygen
- Up-Regulate Glycolytic Enzymes
- Produce Proteins That Scavenge Any Remaining Oxygen
- Contain Polar Plugs Composed Of Cyanophycin Which Slows Down Cell-To-Cell Diffusion

Cyanobacteria Usually Obtain A Fixed Carbon (Carbohydrate) By Photosynthesis. The Lack Of Water-Splitting In Photosystem Ii Prevents Heterocysts From Performing Photosynthesis, So The Vegetative Cells Provide Them With Carbohydrates, Which Is Thought To Be Sucrose. The Fixed Carbon And Nitrogen Sources Are Exchanged Through Channels Between The Cells In The Filament. Heterocysts Maintain Photosystem I, Allowing Them To Generate Atp By Cyclic Photophosphorylation.

Single Heterocysts Develop About Every 9-15 Cells, Producing A One-Dimensional Pattern Along The Filament. The Interval Between Heterocysts Remains Approximately Constant Even Though The Cells In The Filament Are Dividing. The Bacterial Filament Can Be Seen As A Multicellular Organism With Two Distinct Yet Interdependent Cell Types. Such Behavior Is Highly Unusual In Prokaryotes And May Have Been The First Example Of Multicellular Patterning In Evolution. Once A Heterocyst Has Formed It Cannot Revert To A Vegetative Cell. Certain Heterocyst-Forming Bacteria Can Differentiate Into Spore-Like Cells Called Akinetes Or Motile Cells Called Hormogonia, Making Them The Most Phenotyptically Versatile Of All Prokaryotes.

KEYWORDS-Heterocysts, Nitrogen Fixation, Paddy, Algae, Blue Green, Photosystem

I. INTRODUCTION

Nitrogen Is One Of The Most Required Mineral Nutrients For Plant Growth And Productivity, Because It Not Only Enhances The Yield But Also Improves The Food Quality (Ullah Et Al. 2010; Leghari Et Al. 2016). Lack Of N Will Cause Plants Not To Grow Optimally. In This Study, Azolla Mixed With Goat Manure Produced The Highest N Content In The Paddy Soil. Azolla Is Usually Very Rich In N And Therefore Particularly Well-Known For Its Use As An N Fertilizer In Rice Fields (Hove And Lejeune 2002). It Has Been Estimated That Azolla Contains 3–6% N Of The Dry Weight Of The Association. This Is 3–6 Times Higher Compared To The N Content Of Goat Manure. The Symbiotic A. Azollae Is Able To Reduce Atmospheric N Through The Activity Of Enzyme Nitrogenase Present In The Heterocysts And Fulfill The Total N Requirement Of The Association (Pabby Et Al. 2003). A. Azollae Provides Azolla

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With Ammonium, Whereas Azolla Provides The Cyanobacterium With A Fixed Source Of C. Both Phototrophic And Heterotrophic Eukaryotes Can Harbour Cyanobacterial Symbionts. In The Former Case, The Functional Significance Is Probably Always Symbiotic N_2 Fixation; The Symbionts Typically Have A Large Number Of Heterocysts, And They Fix N_2 At A High Rate. In The Latter Case Nitrogen Fixation May Or May Not Be An Important Aspect Of The Association. In Some Cases The Cyantobacteria Are Incapable Of N_2 Fixation And In Others Cases The Relative Role Of Co_2 And N_2 Fixation Is Unknown. Here We Discuss Only Cases In Which The Importance Of Nitrogen Fixation Has Been Established; Other Types Of Symbiosis Involving Cyanobacteria Are Discussed Below.

Certain Mosses (Sphagnum Spp.) Are Known To Harbour The Cyanobacterium Nostoc In Non-Photosynthetic Cells Or On Their Surface; Nostoc Is Also Associated With Some Species Of Liverworts; Although Not Studied In Detail, The Functional Significance Is Probably Nitrogen Fixation. A Better Known Example Of Some Economic Importance Is The Fern Azolla That Occurs In Freshwater In Warm Climates. The Leaves Form Cave-Like Pockets That Are Colonized By The Cyanobacterium, Anabaena Azollae. In Some Places Azolla Serves A Green Manure. The Fern Grows On Flooded Rice Paddies Until Rice Plants Out Grow It, And When The Ferns Die And Decompose They Release Combined Nitrogen.[1,2,3]

Cycads Also Have Cyanobacterial Symbionts (Anabaena, Nostoc). These Occur In Cavities In Branched "Coralloid Roots" Which Are Situated Laterally. The Angiosperm Gunnera Has Glands In The Stems And At The Base Of Leaves That Harbour Nostoc Punctiforme.

Some Marine Planktonic Diatoms And Some Other Phytoplankters Are Known To Harbour Intracellular Cyanobacteria. The Association Seems To Be Common In Oligotrophic Seawater And In Some Cases N_2 Fixation Has Been Demonstrated.

There Are Examples Of Cyanobacterial Symbionts In Heterotrophic Eukaryotes Where N_2 Fixation Has Been Demonstrated, Although Photrophic Co_2 Fixation Is Also Important. Lichens Represent Symbiotic Consortia Between A Fungal Host (Ascomycetes Or Basidiomycetes) And Phototrophic Symbionts. In Most Cases, The Phototrophic Partner Is A Eukaryote, But Some Lichens Harbour A Cyanobacterium Instead. Marine Sponges Always Contain Prokaryote Symbionts; In Tropical Waters Many Species Harbour Cyanobacterial Symbionts And While The Primary Advantage For The Host Is Likely To Be Co_2 Fixation, N_2 Fixation Has Been Demonstrated In Some Cases (Wilkinson, Fay, 1979).

Cyanobacteria Like Anabaena And Nostoc Have Been Used As Biofertilisers As They Have Specialised Cells Called Heterocyst That Can Fix Atmospheric Nitrogen Into Absorbable Forms.

Role In Paddy Fields

They Are Used Mainly In Water Logged Paddy Fields Because Of The Following Reasons:-

These Organisms Can Fix Atmospheric Nitrogen. This Increases The Soil Fertility Enhancing The Growth And Yield Of Paddy.

They Add Organic Biomass To The Soil, Further Increasing Soil Fertility.

II. DISCUSSION

Nitrogen Is Globally Limiting Primary Production In The Ocean, But Some Species Of Cyanobacteria Can Carry Out Nitrogen (N) Fixation Using Specialized Cells Known As Heterocysts. However, The Effect Of N Sources And Their Availability On Heterocyst Development Is Not Yet Fully Understood. This Study Aimed To Evaluate The Effect Of Various Inorganic N Sources On The Heterocyst Development And Cellular Growth In An N-Fixing Cyanobacterium, Anabaena Variabilis. Growth Rate, Heterocyst Development, And Cellular N Content Of The Cyanobacteria Were Examined Under Varying Nitrate And Ammonium Concentrations. [4,5,6]A. Variabilis Exhibited High Growth Rate Both In The Presence And Absence Of N Sources Regardless Of Their Concentration. Ammonium Was The Primary Source Of N In A. Variabilis. Even The Highest Concentrations Of Both Nitrate (1.5 G L^{-1} As $Nano_3$) And Ammonium (0.006 G L^{-1} As Fe-Nh_4-Citrate) Did Not Exhibit An Inhibitory Effect On Heterocyst Development. Heterocyst Production Positively Correlated With The Cell N Quota And Negatively Correlated With Vegetative Cell Growth, Indicating That Both Of The Processes Were Interdependent. Taken Together, N Deprivation Triggers Heterocyst Production For N Fixation. This Study Outlines The Difference In Heterocyst Development And Growth In A. Variabilis Under Different N Sources. Bio-Fertilizers Are Formulations Of Beneficial Microorganisms That Help The Growth Of Plants By Increasing The Quantity And Availability Of Nutrients Through Their Biological Activities (El-Hawary And El-Kholy, 2019). They Are The Preparations Containing Living Cells Or Latent Cells Of Efficient Strains Of Microorganisms That Help Crop Plants For The Uptake Of Nutrients By Their Interactions In Rhizosphere. Bio-Fertilizers Are Mostly Used In Sustainable Farming For Increasing Soil Fertility And Crop

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Productivity. They Are The Most Important Component Of Integrated Nutrient Management. (Itelima Et Al., 2018). The Mostly Used Microorganisms As Bio-Fertilizer Are: Nitrogen Fixers (N-Fixer), Growth Promoting Rhizobacteria (Pgprs) Like Azotobacter, Azospirillum And Phosphorus Solubilizing Bacteria (Psb) Viz; Pseudomonas Sp. And Bacillus Sp. Endo And Ectomycorrhizal Fungi, Cyanobacteria And Other Useful Microscopic Organisms (Yasin Et Al., 2012). The Use Of Bio-Fertilizers Makes The Soil Environment Rich In All Kinds Of Micro- And Macro- Nutrients Also Helps The Release Of Plant Growth Regulating Substances, Production Of Antibiotics And Biodegradation Of Organic Matter In The Soil (Sinha Et Al., 2014). Biofertilizers, Contradict To Synthetic Fertilizer, Are More Economical And Helpful In Improving The Soil Structures And Restoration Of Environment For Leveraging Agriculture (Yasin Et Al., 2012). Bio-Fertilizers Are Thus Considered The Alternative Of Chemical Fertilizers. Rice (Oryza Sativa L.) Is A Major Cereal Crop In Nepal. Plant Nutrition Is Very Important For The Healthy Growth Of Crops. Nitrogen Fertilization Is Most Important For The Yield Of Grain In Rice Plant (Chaturvedi, 2006). The Demand And Synchronization Of Nitrogen Differ With Inbred And Hybrid Rice Varieties. Hybrid Varieties Having Genetically High Yield Potential Require Higher Amount Of Nitrogen As Compared To Inbred Varieties (Ravi Et Al., 2007). The Use Of Chemical Fertilizers Generally Urea [Co(Nh2)2] Or Ammonium Sulphate [(Nh4) 2.So4] Is Very Common In Case Of Nepalese Rice Farming System. The Nitrogen Fertilizer Efficiency Is Less Than 40% And Is Very Costly For Farmers To Purchase (Joshy, 1997). Recovery Of Nitrogen By Rice Is Very Low As 10% And Never Exceeds 50% (Vlek And Byrnes, 1986). Loss From Urea Ranges From 11 To 54% When It Is Broadcasted In Rice Field After Transplantation (Schnier, 1995).Thus,Azollabiofertification Could Be A Good Approach To Increase The Nitrogen Use Efficiency (Nue) In Rice Fields (Yao Et Al., 2018). Azollais A Heterosporouspteridophyte That Lives In A Place Having Plenty Of Water. It Is A Free-Floating Water Fern. It’s Most Common Utilization Is The Co-Cultivation With Rice, As Water-Filled Rice Paddies Provide A Perfect Habitat For The Water Fern To Propagate. Azolla Has Been Used As Green Manure Due To Its Rapid Reproduction And High Nitrogen Content(3-6% N By Dry Weight) (Watanabale Et Al.,1981). The Nitrogen Content Is Similar To That Of Legumes. It Is An Excellent Source Of Bio Fertilizerswhich Fixes The Atmospheric Nitrogen In Symbiotic Association With A Cyanobacterium, Anabaena Azollae (Carrapico, 2002). Anabaena Azollae, A Blue Green Algae Can Photosynthesize Independently. The Entire Nitrogen Requirement Of The Azolla Frond Is Supplied By The Algal Symbioant. An Anabena-Azolla Relationship Is Ideal For The Cultivation Of Rice Under Tropical Conditions Because Of Its Ability To Fix Atmospheric Nitrogen And Capacity To Multiply At Faster Rates. Azolla Can Flourish Well In Flooded Rice Fieldsthus, It Is Also Extensively Used As A Most Suitable Bio-Fertilizer For The Rice Fields To Improve The Nitrogen Content Within Few Weeks Of Its Incorporation (Bhuvaneshwari And Singh, 2015). Azolla Biomass Can Be Used In Rice Fields As Partial Or Complete Replacement Of Synthetic Fertilizers Because Of Its Ability To Provide 1.5-2.0 Million Tons Of Nitrogen Whereas The Requirement Of Urea For Same Amount Of Crop Production Is 3.3-4.0 Million Tons (Raja Et Al., 2012). Along With The Supply Of Nitrogen, Azolla Also Decreases The Soil Ph And Water Temperature, Inhibit Nh3 Volatization, And Prevents Weeds And Mosquito Prolification (Pabby Et Al., 2004). The Nitrogen Fixation Ability Of One Crop Ofazolla To The Rice Crop In About 20-25 Days Is Found To Be 20-40 Kg Nha1 And The Ability Of Anabaena Azolla System Has Been Estimated To Be 1.1 Kg N Ha-1 Day1 (Watanabe Et Al., 1977). The Integration Of Azolla With Urea Has Increased Urea Use Efficiency (Cisse 2001; Vlek Et Al., 1995).

The Application Of Azollais Donein The Field Is Either As A Green Manure Before Transplanting Or As A Dual Crop With Rice After Transplanting (Singh, 1979a,B; Rains And Talley, 1979). Both The Methods Are In Practice Under Asian Conditions, But Dual Cropping Is More In Practice As It Is Reported To Benefit The Rice Crop (Talley Et Al., 1977; Singh, 1979a,B). For Application As Green Manure, Azolla Collected From Nurseries, Ponds Or Ditches Is Applied In The Field. After 2-3 Weeks Of Application, A Thick Mat Of Azolla Can Be Seen And It Is Incorporated In The Soil. Then, Rice Can Be Transplanted In The Field. Cattle Dung, Slurry Or Single Super Phosphate (25-50 Kg/Ha) Can Be Applied In The Field. Pest Control Measures Are To Be Undertaken In Case Of Pest Infestation (Yadav Et Al., 2014). About 20-40 Kg N/Ha Is Provided By One Crop Of Azolla Application As Green Manure (Watanabe Et Al., 1977). Azolla Green- Manuring Along With Increasing The Grain And Straw Yield, Also Enhanced The Number And Weight Of Panicles And Reduces The Sterility In Grains. (Kulasooriya And De Silva, 1977; Singh, 1979a,B). In Case Of Dual Cropping, Fresh Inoculum Of Azollais Applied In The Field At The Rate Of 0.5-1 Ton/Ha After The Establishment Of Rice Seedling. Single Super Phosphate (20 Kg/Ha) Can Be Applied In Split Doses. A Thick Mat Of Azolla Is Formed In About 15-20 Days Of Time. After The Decomposition Of Azolla In The Field, In About 8-10 Days’ Time, It Releases The Fixed Nitrogen. During The Crop Cycle Of Rice, Another Crop Of Azolla Can Be Raised In A Similar Way. Each Crop Ofazolla Contributes On An Average 30 Kg N Ha–1in Case Of Dual Cropping (Yadav Et Al., 2014; Watanabe Et Al., 1977). Azolla Dual Cropping Also Helps In Suppressing The Weeds In The Rice Fields. (Moore, 1969; Lumpkin And Plucknett, 1980)[7,8,9]

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The Nitrogen Yield By Azolla Species Particularly Depends Upon Agricultural Practice, Nature Of Fertilizer Management, Presence Of Soluble Ion And The History Of Azolla Cropping In The Field. (Watanable, 1982). Azollabiofertilizerincorporation Increased The Nitrogen Recovery Of The Crop By 49–64% Anddecreased Nitrogen Loss By 26–48% (Yao Et Al., 2018). Azollafiliculoides Incorporated In Paddy Soil In Pots Has The Nitrogen Fixation Ability Of 128 Kg N/Ha In 50 Days. (Tujimura Et Al., 1957). Azollapinnata Incorporated In Rice Field Has The Average Nitrogen Fixing Ability Of 0.3-0.6 Kg/Ha/Day (Beckling, 1976). Similarly, Reported The Nitrogen Fixing Ability Of 2.3 Ha/Day In Fallow Paddy Field (Singh, 1979a). Roger And Reynaud, Found That The Nitrogen Fixation Rate Of Azollaafricana Was 0.6-1.8 Ha/Day (Roger And Reynaud, 1979)

Azolla Incorporation In Paddy Fields Increased The Yield Of Grain, Straw Yield, Caryopsis And Dry Matter (Pabby Et Al., 2004). The Nitrogen Fixation Ability Ofa. Azollae And The Nitrogen Content Of The Fern Make This Symbiosis Suitable For The Use As Bio-Fertilizer (Pabby Et Al., 2004). Peters Found That The Use Of Azolla As Bio-Fertilizer Increased The Yield Of Rice By 112% Over Unfertilized Controls When Applied As A Monocrop, When Applied As An Intercrop With Rice By 23%, And When Applied Both As A Monocrop And An Intercrop By 216% (Peters, 1978). Singh Found That Either The Application Of 30-40 Kg N/Ha Through Ammonium Sulphate, Or Incorporation Of 8-10 Tons Of Azolla/Ha Fresh Produced The Same Rice Yield, 47% Increase In Grain Yield Over Control (Singh, 1977). Combination Of Azolla With Lower Dose Of Nitrogen In Planted Paddy Fields Gave Higher Paddy Yield, Thus A Judicious Combination Of Azolla And Nitrogen Provides A Better Yield (Singh 1979 A,B). A Group Researcher Found That Azollaincorporation Increases The Paddy Yield By 8-14% (Yao Et Al., 2018). Behera Reported That The Grain Yield Increased By34% Due To The Incorporation Of 10 Ton Azolla/Ha (Behera, 1982). Kannaiyan And Bartharkur And Talukdar Reported 36.6 To 38% Increase In Grain Yield Due To Use Ofazolla As Dual Crop (Kannaiyan, 1982; Bartharkur And Talukdar, 1983). Moore Found The Increase In Rice Yield By 14-40% Due Top Azolla Dual Cropping, Whereas Le Van Reported 6-29% Higher Grain Yield By Growing A. Pinnata As A Dual Crop With Rice (Moore, 1969; Le Van, 1963). A Group Researhcers Reported The Application Of Azolla Along With Neem Cake Coated Urea Recorded The Maximum Grain Yield Of Rice (Sukumar Et Al., 1988). Benefits Of Using Azolla On The Rice Field Are: Basal Application Of Azolla At The Rate Of 10-12 Tones/Ha Enriches Soil Nitrogen Content By 50-60 Kg/Ha And Reduces 30-35 Kg Of Nitrogenous Fertilizer Requirement Of Rice Crop. Inoculation Of Green Azolla At The Rate Of 500 Kg/Ha Increases The Soil Nitrogen Content By 50 Kg/Ha And Reduces The Nitrogen Fertilizer By 20-30 Kg/Ha (Roy Et Al., 2016). Inoculation Of Azolla On Flooded Water Decreases The Nh3 Volatilization By 12–42% (Yao Et Al., 2018). Due To Its High Biomass Production Rate, Azolla Improves The Soil Physical Structure By Supplying Huge Amount Of Organic Matter On Its Incorporation To Soil (Subedi And Shrestha, 2015. Azolla Also Solubilizes The, Zn, Fe And Mn And Make Them Available To The Rice Crop. It Releases Plant Growth Regulators And Vitamins That Enhance The Growth Of The Rice Crop. It Reduces The Evaporation Rate From The Rice Field, Reduces Disease Occurrence, Suppresses Weed Growth, Enhances Flowering Fruiting, And Increases Plant Establishment And Survival At Seedling Or Transplanting And So On (Biswa Et Al., 2005; Monajjem And Hajipour, 2010). Azolla Also Reduces The Intensity Of Light Penetration, Water Evaporation, And Suppress Different Weeds Like Echinochloa Crus-Galli, Cyperus Spp., Paspalum Sp. And So On And Thus, Lead To Improved Crop Growth And Productivity (Biswa Et Al., 2005; Monajjem And Hajipour, 2010). The Fundamental To Successful Rice Production Is The Optimum Amount Of Nitrogen Input And Anabaena Azollae Symbiosis Has Been Known To Increase Nitrogen Input In Rice Cultivation. The Amount Of Rice Production Will Be Increased Due To The Inoculation Of Nitrogen Fixing Bacteria. Therefore, The Effective Strains Of Azolla In Terms Of Nitrogen Fixation From Different Agro Ecological Zones Are To Be Screened And Their Contribution To Rice Production Needs To Be Evaluated. Better Extension Strategies Are Also The Need Of Hour To Promote The Use Of Bio-Fertilizer With Other Benefits.Concerted Efforts Are Required From The Part Of Policy Makers, Scientists And Farmers To Promote Azolla As A Viable Bio-Fertilizer For Sustainable Rice Production.[10,11]

III. RESULTS

Blue-Green Algae (Bga) Are Known To Contribute Up To 80 Kg N/Ha Per Season In The Rice Ecosystem (Kannaiyan Et Al., 1983) [2] . Under Water Logged Conditions Of Rice Fields, Blue Green Algae Plays A Vital Role In Maintaining Soil Fertility And Crop Yield Even In The Absence Of Any Added Agrochemicals. In Recent Years, Algalisation Has Been Recognized As An Important Input In Rice Cultiva-Tion As Its Form A Per-Petually Renewable Source Of Nutrients And Improve Soilhealth (Venkatraman, 1981; Goyal, 1993) [6, 1] . Cyano Bacteria Biofertilizer For Rice Cultivation Is An Eco Friendly, Easily Manageable In-Put Forming A Self Generating System Contributing To About 25 Kg N/Ha Per Season And Also They Add Or-Ganic Matter And Growth Promoting Substances To The Soil (Roger And Kulasooriya, 1980)[5] . The Application Of Biofertilizer Is Cheaper Than The Inorganic Fertilizers. The Biofertilizer Do Not Causes Damage To The Soil And Environment Like Inorganic Fertilizers. Rhizobium,

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Azotobacter, Azospirilium And Pseudomonas Fluorescens Bga Have Been In Use A Long Time. Leguminous Crops Used To Rhizobium (Ojha Et Al. 2016) [3] . Rice (Oryza Sativa L.) Is One Of The First Leading Ancient (3,000b.C.) Cultivated Crops Of The World. Now The Food Habit Of Global People Is Changing Rapidly And Cultivation Of Rice Is Also Increasing Tremendously Through The World. (Paudel Et Al 2012)[4] . Materials And Methods 1. Production Method Of Blue Green Algae Organic Fertilizer 1 Make 5 Meter Long, 1 Meter Chara And 10 To 15 Cm Deep Pavement Tank. The Length Of The Tank, The Reduction Can Be Increased As Needed. The Tank Should Be In High And Open Space. At The Place Of The Tank, About 12 To 15 Cm Deep, 1 Meter Wide And Can Make A Long Crude Crust As Needed. Lay 400-500 Gauge Thick Polythene In The Raw Pit. 2. Fill The Water In The Tank And Pit By 5 To 6 Inches And By Adding One Hundred And A Half Kilograms Of Clean Soil, 100 Grams Of Single Super Phosphate And 10 Gram Carbohydrane According To The Length Of Meter And Mix Well And Two 7 Three Leave For Hours. 3. If The Soil Is Saturated, According To The Length Of 100 Grams Per Meter, Algae Starter Culture Should Be Scattered Evenly Over The Water. 4. Almost 1 Week Becomes A Thick Layer Of Algae. At The Same Time Water Also Dries Up. If The Water Becomes Dry Before The Layer Becomes Due To The Strong Sunlight, Then Pour More Water Into The Tank, Carefully Pour The Water Carefully From The Edges. 5. Leave The Tank To Dry In The Sunshine. After Drying, After Collecting The Algae, Keep It In The Polythene Bag And Keep It For Use In The Fields

6. If After A Week Of Becoming A Thick Layer Of Algae, If The Water Is Filled With Gates And Tank, Then Carefully Remove It From The Compartment Etc. 7. Sendy Loame Soil Is Most Suitable For The Production Of Bio-Fertilizer Of Neel-Green. April, May, June Are Suitable For Its Production. Precautions In The Production Of Blue Green Algae Organic Fertilizers: 1. Blue Green Algae Should Be Clean And Tidy To Be Used In Organic Fertilizer Production. 2. The Soil Being Used In The Production Should Not Be Of The Soil In The Soil. 3. Filter The Pebble With Stone And Grass In The Soil. 4. Use Only Good Quality Starter Culture Tested By The Laboratory For Bio Fertilizer Production. 5. Make Sure Scientists Examine The Quality Of Organic Fertilizers Produced Here. 6. Use Algae Organic Fertilizers With Nitrogen Fertilizers.

Blue Green Algae (Bga) Are Considered To Be One Of The Remarkable Group Of Photosynthetic Simple Plant Forms. The Cellular Organization Of Bga Is Prokaryotic, Characterized By The Lack Of Membrane Bound Organelles Including Nucleus, Chloroplast Or Mitochondria. Thus, They Are Very Much Identical To Photosynthetic Bacteria And Represent A Link Between Bacteria And Green Plants. Bga Are Often Called As Cyanobacteria Or Cyanophycean Algae. Bga Are Oxygen Evolving And Nitrogen (N2) Fixing Prokaryotes Using Sun Light As The Sole; Energy Source For The Fixation Of Nitrogen. The Heterocysts Are The Main Sites Of Nitrogen Fixation Under Aerobic Condition. The Study Of Bga Is Becoming “Fashionable” Since The Last Two Decades For Many Academic And Practical Reasons. The Role Of Nitrogen Fixing Bga In The Maintenance Of The Fertility Of The Rice Fields Has Been Well Substantiated And Documented[12]

IV. CONCLUSION

Symbiotic Nitrogen Fixation (Snf) Is A Mutualistic Association Between Plants And Microbes. The Symbiotic Nitrogen Fixing Microbes Have The Capability Of Fixing Atmospheric Nitrogen Symbiotically And Provided Access To All Types Of Plants. Mutualistic Relationships Begin Once The Plant Starts To Secrete Flavonoids And Iso-Flavonoids In Its Rhizosphere, Where It Is Identified By Rhizobium [4]. Rhizobium, Sinorhizobium, Bradyrhizobium, And Mesorhizobium Are A Few Examples Of Bacteria Living Symbiotically With Leguminous Plants, Frankia With Non-Leguminous Plants And Shrubs [5]. Out Of These Symbiotic Nitrogen Fixing Bacteria, Rhizobium Is The Leading Cause Of Legume Crops' Symbiotic Nitrogen Fixation. Besides Bacteria, Some Small Fern Is Also Working As Symbiotic Nitrogen Fixers. For Example, Azolla Is A Small, Free-Floating Aquatic Fern That Collaborates With Cyanobacteria (Anabaena) To Fix Atmospheric Nitrogen. The Appropriate Environment, Phytohormones, And Nutrients Are Provided By Azolla To Anabaena In The Interchange Of Fixed Nitrogen. In Anabaena, The Phenomenon Of Nitrogen Fixation Happens In Heterocyst Cell. Azolla Contributes Primarily To Rice Cultivation By Fertilizing The Soil With Nitrogen And Incorporating Biomass. Actinomycetes, For Example, Frankia Can Produce Root Nodules For The Actinorhizal Plants. Frankia Can Be Nodulated By Certain Other Genera, Such As Allocasuarina, Myrica, Eleagnus, Coriaria And Casuarina. They Are Monocot Plants With A Promising Future In Agricultural And Land Reclamation. N Is Fixed By Azotobacter And Bacillus Species, And They Also Help In The Growth And Development Of Maize Plants And Forest Crops [6]. Inoculation Of Bradyrhizobium Japonicum Enhanced Plant Growth, Nodulation, And N Fixation In Rice[13]

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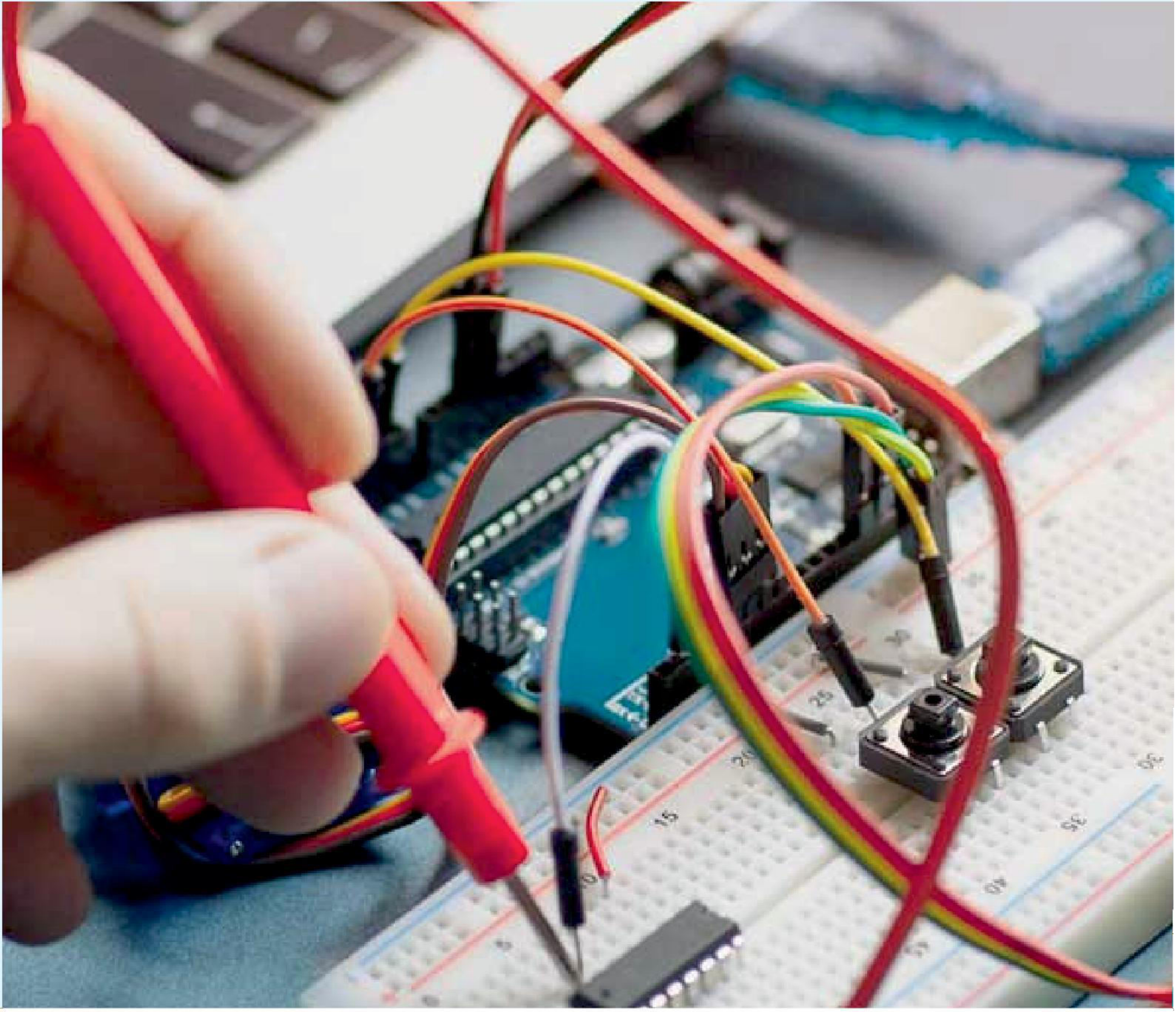

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