**Cyanobacteria as a Source of Organic Nitrogen fertilizer, a Sustainable Solution to address Global Nitrogen Challenge- A Review**

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**Abstract**

Nitrogen- a crucial element needed to sustain the production of nutrient-rich food for an exponentially growing population. To make the reactive nitrogen, the world is using fossil fuels in the Haber Bosch process to be able to provide for the protein supply but the massive production of inorganic nitrogen fertilizers is becoming a serious concern of threat in terms of sustainability and environmental health. On top of that the increasing cost associated with fossil fuels has increased 3 to 5 times the prices of reactive nitrogen. Since nitrogen is an important nutrient for protein production; the world has started producing it organically from other sources, an example of which is photo-production from Cyanobacteria. A promising strategy to produce organic nitrogen fertilizer from cyanobacteria is by Inhibition of the glutamine synthetase enzyme. This process accumulates organic nitrogen compounds and free amino acids in solution mixture. This review article will provide an overview of the different cyanobacterial strains and their potential for use in fertilizer production, as well as an evaluation of the effectiveness of glutamine synthetase inhibition in producing organic nitrogen fertilizer. Recent advancements in photo production techniques by inhibiting glutamine synthetase enzyme such as genetic engineering and scalable production methods for cyanobacterial-based organic nitrogen fertilizer will also be discussed. Lastly this paper aims to evaluate the effectiveness of using organic nitrogen fertilizer produced by cyanobacteria as a solution to global nitrogen challenge, and also discuss the implications of this process as gap to address for future research.

**Outline**

1. **Introduction** (The Nitrogen Dilemma, Global Nitrogen Requirement, Haber Bosch Process – Is it the only solution? Inorganic Nitrogen Mis-uses and Effects )
2. **Alternative Process to produce Nitrogen Fertilizers**
   1. Advancements for Slow and Controlled release of Urea
   2. Use of Microorganisms to produce fertilizers
   3. Comparison of Organic and Traditional Nitrogen Fertilizer
3. **Cyanobacteria as a source of Organic Nitrogen Fertilizer**
   1. Overview and Potential of Cyanobacterial nitrogen fixation
   2. Mechanisms of Cyanobacterial Nitrogen Fixation
   3. Potential requirements for Cyanobacterial survival
4. **Glutamine Synthetase Enzyme-mediated Nitrogen Release**
   1. Glutamine synthetase enzyme and its role in nitrogen assimilation
   2. Factors Affecting Photo-production of Organic Nitrogen fertilizer (Table including Strains, Inhibitors, Process conditions, Yields/Efficiencies, Extraction methods, and References)
   3. Recent Advancements-Genetic Engineering of Cyanobacterial Strains for fertilizer
5. **Agricultural Applications of Organic Nitrogen Fertilizer**(Table- Method of Application, Solubility Rate, suitability of drip irrigation)
6. **Conclusion/Future Prospects**