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REVIEW ARTICLE **OPEN ACCESS**

Microbe's role in Environment Protection for Sustainable Agriculture

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ABSTRACT
Microbes play significant role as symbionts in crops contributing indirectly for sustainable agriculture through nutrient recycling and in turn plants release their waste as food for microbes. These microbial formulations can be used as chemical fertilizers which substitute these agrochemicals eventually regulating over dosage of chemicals and increasing productivity of crops. Our paper summarizes the contribution of microbes in different forms for the maintenance of environment for sustainable agriculture.
Keywords: *microbes, chemical fertilizers, sustainable agriculture*

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INTRODUCTION

The problem of population expansion at the global level will be doubled by 2033 which will be multiplied by external pressures developed because of low productivity caused due to poorly poor efficiency and drawbacks of traditional farming. The other factors such as over use of chemical pesticides, enhanced resistance to pest among crops and declining crop yield. Many crops depend on microbes for their nutrient recycling including: Nitrogen, Sulphur, Phosphorus and more [4].These plants require essential elements fixing and assimilating microbes to increase fertility of soil in form of "nodules "&"external structure". Secondly microbes also ensure measures against various threats causing biodiversity issues as a result of global pollution and unfavourable climatic issues [10].

MICROBES AND THEIR ROLE IN AGRO- BIOTECHNOLOGICAL APPLICATION

Microbes are minute invisible organism which are visible through microscope only and belongs to group of "prokaryotes". They are the inhabitant of water, soil, food, water and human intestines. Microbial diversity aids in production of various of industrial and agricultural products of significance importance, such as cheese, yogurt, bread, bio fertilizers, bio pesticides, bio herbicides and bio insecticides (fungal and viral based).The application of microbes supports agriculture in facing challenges in supply of food due to diseased animals and plants. Microbial biotechnology supports in bioremediation of soil and promotes bio-control of soil promotes bio control of pests of animals and plants and reduced virulence of plants and animals pathogen to ensure food security, food safety, new value added agricultural organic products and protection of endangered animals, plants which are future major menace of climatic fluctuations for agricultural field.

The applications of microbes for agricultural issues in response to different problems of nutrition deficiency in soil, insect-pest infestations in crops, over dosage of pesticides and fetilizers, weeds over growth are summarized below in Figure 1.

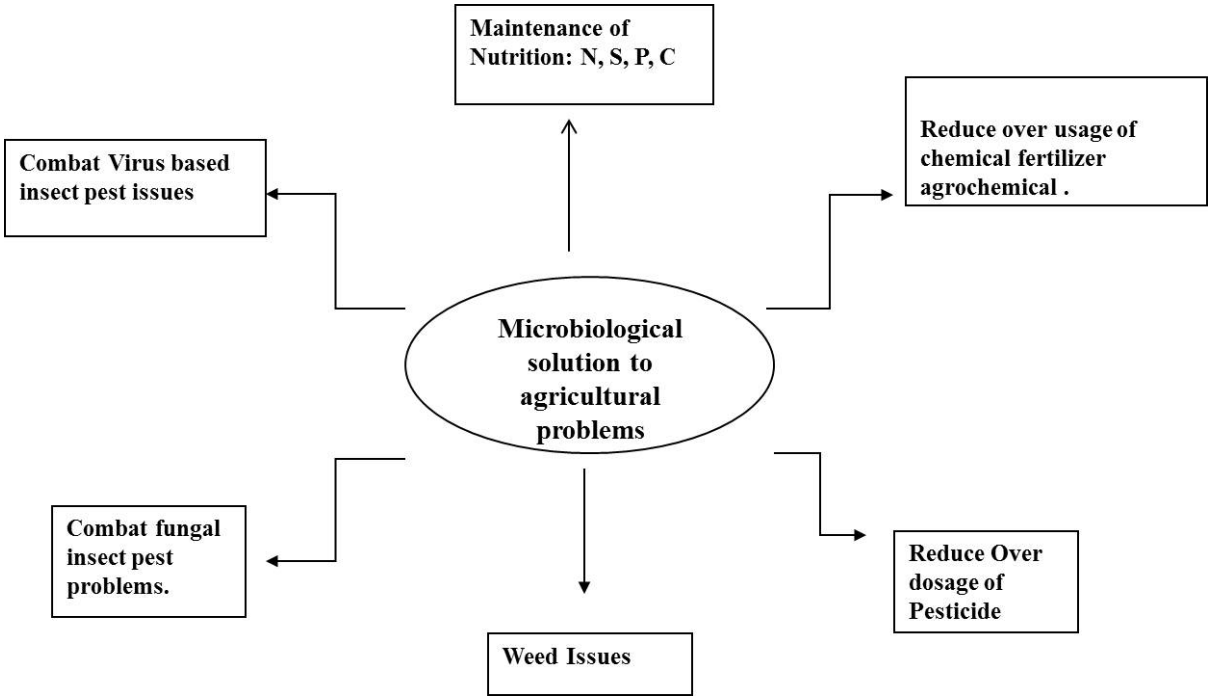

Figure 1. Microbiological solution to various problems in agriculture

MICROBIOLOGY CONTRIBUTES IN ECOLOGY FOR AGRICULTURE SUSTAINABILITY

For the accelerated productivity of food, plants and animals were overly and artificially treated with different factors which eventually affected climate. Vice-versa with these affects climatic conditions agriculture practice got influences disturbing the environmental as well as reductions of crop yield. Agricultural microbiology affects suitable possibilities in combating climatic variation and also production of food. The hazardous chemical pesticides, insecticides can be replaced by symbiotic microbes for increasing quality and quantity of crops and protection from pests, pathogens, pollutions and environmental stress [10].

The union of microbial ecology environmental biotechnology promise the production of good yield and maintenance of environment to face challenges of food insecurity as well as environmental pollution via developing "bio control agents " [9, 3] & through plant-microbes [1] in increasing productions of leguminous crops [5].

Microbial diversity also contributes in enhancing crop production through combinational approach of nutritional characteristics and defensive attributes of M.O in form of composite microbial inoculants to propagate natural communities of microbes and plants. These equilibrated composite inoculants may serve as a source of N&P such as VAM & endosymbiotic rhizobia [4].

The microbe host symbioses may support the food production as one of possible solution to food security issues cause environmental climatic fluctuations. These microbes sustain as plant-microbe, animal microbes, soil-microbes interactions as niche in service of agriculture sustainability [2].

Microbiology union with molecular biology using proteomic and genomic methodologies have major role in screening, selection & propagation of these industrially and agriculturally efficient organisms with such highly précised techniques "Uncultivated M.O" can be grown and treat issues of detoxification of waste water, sludge treatment, pathogen issues, biomass for production of renewable energy as they have immense capability to convert organic waste energy to bio-fuels. The contributions of microbiology are summarized in Table 1:

Table 1. Summarizing Contributions of Microbiology to agricultural issues

S.No.	**Problems**	**Application**
1.	Agrochemical over dosage and environmental threat to soil and crops.	➢ Bio fertilizers ➢ Rhizobia N&P fixing bacteria in root nodules ➢ Reduces in use of chemicals. ➢ Compact crop stress tolerance & maintains their quantity & maturity. ➢ Increase soil & crops fertility.
2.	Control of Over-use of Pesticides	➢ Regulation of pesticides through composite inoculums of microbes control attachment pathogenic viruses, fungi & bacteria in soil ➢ Substitution of synthetic pesticides by organic formulations.
3.	Regulated usage of Bio herbicides to control Weeds.	➢ Replace Synthetic Herbicides. ➢ Cheaper than synthetic formulations. ➢ Prolonged sustenance to control next season weeds. ➢ Environmental friendly. ➢ Do not affect non-target organism.
4.	Fungal-Insects Issues.	➢ Fermentation technology that supports mass production of broad spectrum insects killing fungi ➢ Long term insects regulation
5.	Virus-insect based pest problems.	➢ Viruses which acts as disease causing agent to pests are used as specific strain for "Bio-control"
6.	Maintenance of Soil nutrition and Fertility.	➢ Helps plants to absorb more nutrition. ➢ Absorption of essential elements from Soil. ➢ Nutrient recycling. ➢ Assistance in plant growth. ➢ Bio-remediation.
7.	Food Insanity & Safety	➢ Production of nutritional food through "diverse" strains such as cheese, yoghurt, bread & processed milk. ➢ Production of antibiotics, enzymes & vitamins through "fermentations" technology.

CONCLUSION

Microorganisms have a significant function in agriculture field and they are well known game changers upon their interaction with plants. They can enhance soil fertility by absorption of nutrients which are not available to plants in readily available form. Microbes also cause degradation of organic matter and allow nutrient soil transformations through process of biogeochemical cycle and nutrient recycling. The process of bioremediation has its own importance in contributing agricultural practices. The problems of fungal-pest and virus pest issues are also the major target of microbial formulations designed by industries where these formulations may contribute by protecting crops from pests and diseases and boost up crops defense mechanism and simultaneously their yield. PGPR and AFM formulations and other microbial

solutions are major contributors of the agricultural biological industry against the over usage of pesticides and fertilizers. These all problems and their expected formulations and solutions invite future research for the development and optimization of effective and efficient microbial formulations for agriculture field based threats and issues.

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