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Raising the Yield like Never Before: Rhizobium Bacteria as A Crop Growth Promoter

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Abstract: Rhizobium bacteria are known to have symbiotic relationship with legume plants whereby, the bacteria thrive while providing energy to the plant. Little research has been done about relationship between Rhizobium and non- legume plants, especially during the germination stage. I investigated the use of Rhizobium bacteria as a germination aid for cereal crops. Using homemade equipment, I carried out germination and growth-based experiments over 2 months. Based on our exclusive experimental results we succeeded in showing that two strains of Rhizobium bacteria can significantly accelerate the rate of crop germination for

R. leguminosarum and R. japonicum. We believe that the biochemical mechanism that produced the noted improvements is triggered when flavonoids from the crop prompt the release of Lipochitoligosaccharides which catalyse accelerated seed growth. These results have significant potential for increasing crop yield of food crops and reducing losses due to adverse weather conditions. They also offer opportunities for reducing the environmental footprints of agriculture by reducing fertilizer usage. As demand for cereals increases with population growth, this discovery could act as a potential solution to the impending food poverty crisis.

Keywords: Rhizobium, Legumes, Germination, Fertilizer, Flavanoids.

I. INTRODUCTION

I became aware of the food poverty crisis after attending a webinar on food security. Food security is an ever growing issue in todays world due to rising populations food demand is rapidly increasing. The idea for our research was inspired by this problem and my desire to make a difference. I found out about Rhizobium bacteria when my mom was gardening and found nodules on the root of her pea plant.

After conducting research and consulting to my biology teacher, I discovered that the nodules contained a natural bacterium called Rhizobium. The aim and objectives of the study is to benefit farmers and to face the food crisis. I aim to give our level solution to the global food crisis. I was much worried about the Africa crisis of 2011 which affected 13 million people. Still scientists are working on new strategies, including GM crops but still there is no other alternate solution instead of Fertilizers. So, my research could help and be a partial solution and this cam act as cereal crop growth promotor. This can also be used to address the growing issue of food security. Growth promoting natural bacteria such as Rhizobium can combat this challenge or at least provide a partial solution.

II. HYPOTHESIS

After the Need statement outlined later, our hypothesis was:

A. If we inoculate cereal crop seeds with Rhizobium bacteria, their germination speed will be increased.
B. If we inoculate cereal crop seeds with Rhizobium bacteria at an early stage the plant growth will be positively affected.
C. If we obtain the dry mass of the plant with Rhizobium bacteria can be positively increased

III.NEED STATEMENT

The EU impact research proposes that if bacteria could be used as an alternative to fertilizer it would benefit the environment. It considered the use of beneficial bacteria like Rhizobia as a way of improving the Rhizosphere. The Paiyur agricultural research centre have show their great interest in our investigation given the potential to give flexibility to farmers to sow crops quicker when the weather conditions are changeable. Once the germination stage passes seedlings are more robust and not impacted as significantly by disease and ground conditions. Improvements that increase yield, or allow early season sowing on cooler climates would be of notable benefit.

IV. METHODOLOGY

A. *Experiment 1: Germination Test.*

A natural strain of Rhizobacteria was obtained from Paiyur Agricultural Research Centre. The crop seeds were inoculated by same amount of Rhizobium. The samples were arranged on containers inoculated with 0.05ml of culture of Rhizobium. Control samples were prepared using water instead of inoculant. The containers were placed in a constant temperature incubator and manually inspected for germination at fixed time intervals.

Results

i) Germination of the seeds:

Seed sample	R. Japonicum	R. Leguminosarum	Control sample
Millet	9	10	6
Sorghum	10	9	5

ii) Percentage of germination:

Seed sample	R. Japonicum	R. Leguminosarum	Control sample
Millet	90%	100%	60%
Sorghum	100%	90%	50%

B. *Experiment 2: Growth analysis.*

The seeds which are already germinated are used in this growth analysis. 3x2 growing bags were filled with soil by half. A hole of standard size was made and a germinated seed was inserted. It was then filled with coco-peat and 15 ml of water was added to it. The trays were held for a week. The plants were harvested and the growth was recorded based on the stem height and the number of leaves.

Results

I) Stem height:

Seed sample	R. Japonicum	R. Leguminosarum	Control sample
Millet	5-6 cms	6-6.5 cms	3-4 cms
Sorghum	6-6.5 cms	5-6.5 cms	3-4.5 cms

II) Number of leaves:

Seed sample	R. Japonicum	R. Leguminosarum	Control sample
Millet	8-10 leaves	9-11 leaves	6-8 leaves
Sorghum	8-9 leaves	8-9 leaves	5-7 leaves

Experiment 3: Dry mass analysis.

The plants grown in the previous experiment – growth analysis was used. The plants were dehydrated using Hot air oven. It was stored in non – heat sensitive zip lock bags to prevent any loss of weight or degradation. The dry mass of the plants were recorded.

Results

Seed sample	R. Japonicum	R. Leguminosarum	Control sample
Millet	0.59g	0.49g	0.32g
Sorghum	0.56g	0.54g	0.47g

V. RESULTS

After the complete analysis of the extensive experiments, I've concluded few results:

1) R. Japonicum had fasten up the plant growth than that of R. Leguminosarum.
2) R. Leguminosarum had increased the plant's density and I found the plants healthier than other two samples.
3) The hypothesis had been proven true successfully.
4) We found that the germinated seeds were very greenish and healthy. There were no harms of using Rhizobium on plant and it in turn enriches the soil health.
5) R. Japonicum had subsequently increased the dry mass of the plant.

VI. FUTURE PLAN

We aim to investigate our observations at a trace biochemical level to fully understand why the use of Rhizobium bacteria is speeding up the germination rate. Testing of bacteria in the presence of seeds for the release of LCO or other growth promoters would be appropriate next step in the project. For this we need advanced analytical equipment and facilities. I also plan to carry out extensive field trails to fully investigate the viability of Rhizobium bacteria as a growth promotor. I hope to experiment with different symbiotic bacteria and different crop species to expand the use of this discovery.

VII. CONCLUSIONS

In all test groups seed treated with R. japonicum and R. leguminosarum germinated faster approx. 50%. Both bacterial strains increased the crop yield by an average of 30% with some exceeding 70%. This will be beneficial to agriculture and the developing world as it has the potential to increase crop yields and assist food production in challenging climates.

I can conclude from these results that our hypothesis: " If we inoculate cereal crop seeds with Rhizobium bacteria their germination speed will be increased" and "If we inoculate cereal crop seeds with Rhizobium bacteria at an early stage, the plant growth will be positively affected" have been successfully statistically proven at 95% confidence level. I am confident in statistical validity of our results due to our large sample sizes and experimental controls.

VIII. ACKNOWLEDGMENT

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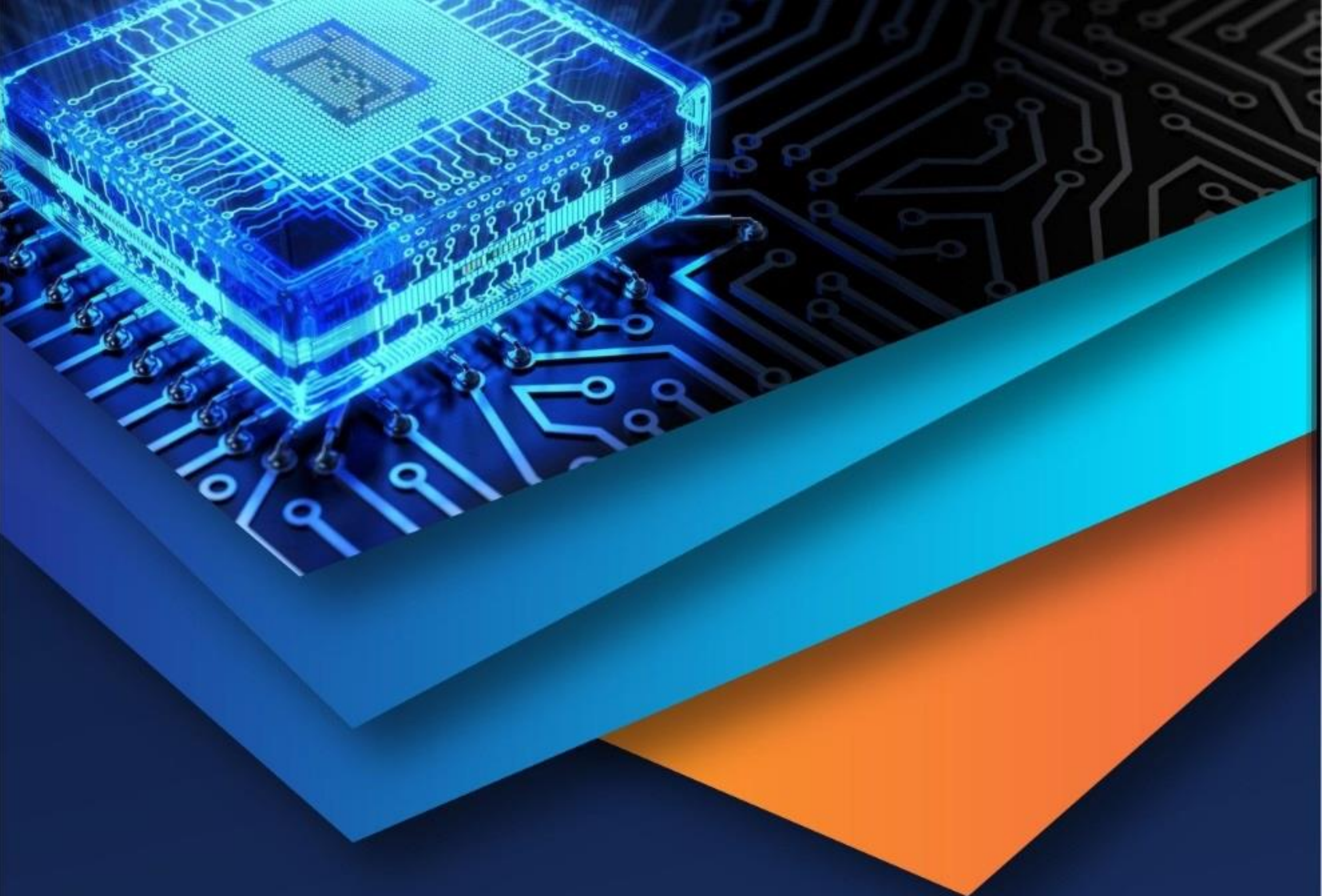

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