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Proceeding Paper

Potential Application of Soil Probiotics for Sustainable Soil Health and Improved Peanut Yield †

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Abstract: Conventional agricultural practices and a rapidly growing population have both contributed to an increase in interest in cutting-edge research on environmental friendly farming methods. A field experiment to investigate the potential of soil probiotics on soil and plant health is under process at IOT Smart Research Farm, PMAS-Arid Agriculture University Rawalpindi from 22 June till mid October 2022. The plots contain four different treatments (Control, Full dose NPK, Probiotics only and $\frac{1}{2}$ NPK+ Probiotics) on peanut crop. Probiotics (*Actinomycetes* sp. & *Mycobacterium neoaurum*) were applied through seed coating. Treatments were triplicated in a randomized complete block design. Different plant physiological characteristics (height, canopy, no of leaves, leaf area index, chlorophyll content, and normalized difference vegetation index) and soil properties (pH, Ec, moisture, nitrogen, phosphorous, and potassium) are under investigation. For different plant parameters different novel devices are being used, such as leaf area index meters to find the index area, and chlorophyll meters for chlorophyll content, whereas for soil parameters proximal sensors are being used. The findings of the trial up till now show the best results in $\frac{1}{2}$ NPK+ probiotics followed by probiotics, full-dose NPK and control which are encouraging, indicating enhanced crop productivity and improved soil health. This study will provide a way out for increased peanut production in an environmental friendly manner for farmers.

Keywords: NPK; NDVI; LAI

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1. Introduction

The peanut (*Arachis hypogaea* L.), also known as groundnut, is a member of the family Leguminosae, which also includes plants that produce subterranean fruits commonly called shell beans [1]. Planting peanuts improves soil quality because of the legume's ability to draw atmospheric nitrogen and convert it into usable forms. Because peanuts can utilize nitrogen from the air, they need only trace amounts of N to thrive [2].

Conventional agricultural practices and a rapidly growing population have both contributed to an increased interest in cutting-edge research on environmentally friendly farming methods. The incorporation of plant probiotics is one method for achieving the fundamental objectives of sustainable agriculture, which include the maintenance of a healthy environment, social and economic fairness, and the sustainability of the agricultural economy as population growth and food demand are inextricably linked) [3].

As the global population continues to grow, there is a need to increase food production to meet population's food needs. Furthermore, arable land has lost its natural nutrients potential over time. As a result, alternative methods such as fertilizers, insecticides, and herbicides are now utilized to reinforce the soil and increase its output [4].

This approach will not only accomplish the primary objectives of sustainable agriculture, but it will also increase the variety of microorganisms found in the soil. Increased photosynthesis and the production of bioactive substances such as plant growth regulators and enzymes, disease control, accelerated decomposition of lignin materials, stimulate the decomposition of organic wastes and residues, and release inorganic nutrients for plant uptake are just some of the ways in which the use of probiotics in agriculture can boost crop growth and yield [5].

This research is conducted with the following objectives;

- Evaluate the potential of selected microbes under natural field conditions on soil health;
- Identify their beneficial effects on crop productivity.

2. Methodology

A field experiment is under process at the IOT (internet and other things) Smart Research Farm, Arid Agriculture University Research Farm, Chakwal Road, Koont from 22 June till mid October 2022. The plots contain four different treatments (control, full-dose NPK, probiotics only and $\frac{1}{2}$ NPK + probiotics) on peanut crop. Probiotics (*Actinomycetes* sp. and *Mycobacterium neoaurum*) were applied through seed coating. Treatments were triplicated in a randomized complete block design. For irrigation purposes rainwater is used. Different plant physiological characteristics (height, canopy, no of leaves, leaf area index, chlorophyll content, and normalized difference vegetation index) and soil properties (pH, EC, moisture contents, nitrogen, phosphorous, and potassium) are under investigation. For different plant parameters different novel devices are being used, such as leaf area index meters to find the index area, and chlorophyll meters for chlorophyll content, whereas for soil parameters proximal sensors are being used.

The preliminary data collected for various characteristics was subjected to analysis of variance (ANOVA) and means compared at a 5% level of significance by least significance difference (LSD) tests [6].

3. Results

3.1. Experimental Soil Properties

The results of soil pH of the experimental area (Figure 1) shows a slightly acidic pH of $\frac{1}{2}$NPK + probiotics, whereas the pH of the control is more acidic. Peanuts grows better in slightly acidic soil (pH 6–6.5). The highest pH was observed in soil probiotics (pH 7.88) whereas the lowest pH was observed in the control (6.79). The moisture content of the field was greater in the control compared to other treatments, the control shows 24% soil water content, whereas traditional practice NPK application shows a lower water content of 15%. The pH and moisture content are shown in Figure 2.

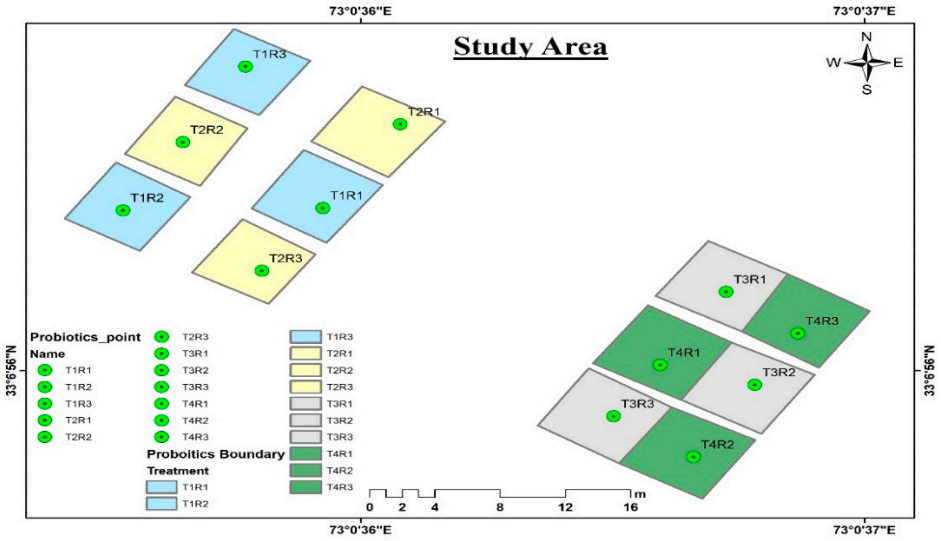

Figure 1. Study map of the experimental site.

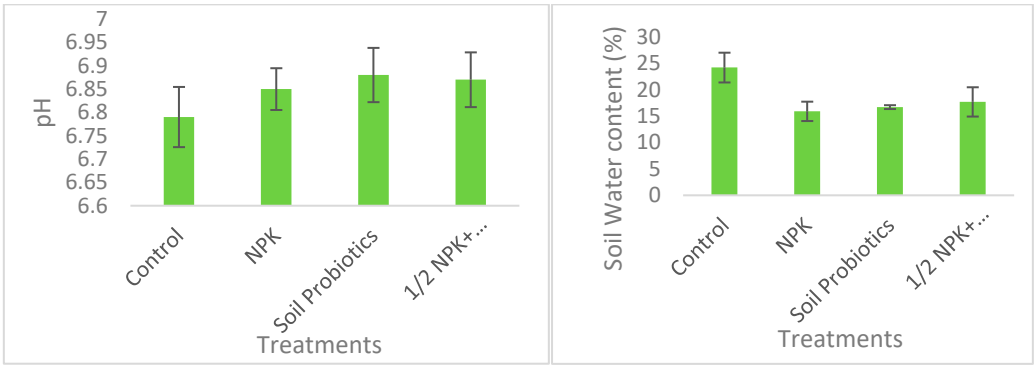

Figure 2. pH and moisture of the experimental site.

Leaf Area Index of Peanut Crop

Soil probiotics positively influenced the leaf area index (LAI) of the crop. The LAI of the $\frac{1}{2}$ NPK + probiotics treatment was greatest among all treatments, whereas the control showed the lowest LAI. The trend in LAI observed was $\frac{1}{2}$ NPK + probiotics > probiotics > NPK > control (Figure 3). At initial stages of the experiments show encouraging results.

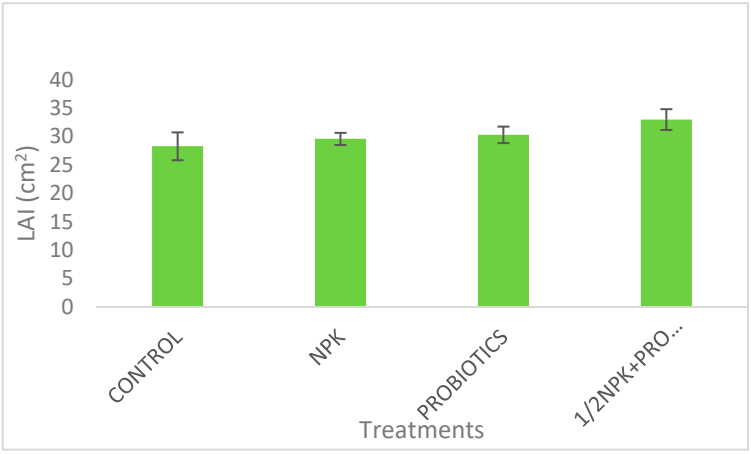

Figure 3. Leaf area index of the peanut plants.

4. Conclusions

Biofertilizers are a safe farm product for consumers and have been shown to increase food production; as a result, they continue to be the best option for ensuring the safety of crops and increasing global food security. The shortage of plant nutrients relative to their supply due to chemical fertiliser has been greater than 10 million tonnes in recent years. The initial investment and ongoing operating expenses of fertiliser facilities make long-term reliance on these inputs which is an unsustainable strategy, both financially and in terms of their impact on the environment. To combat this, biofertilizers and other forms of sustainable fertilisers are a need of hour. Therefore, probiotics, another form of biofertilizers, is an alternative approach to supress disease and pest attacks, enhance the NPK content of soil and increase nodulation that can improve the soil nitrogen contents.

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