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EFFECT OF DIFFERENT STRAINS OF RHIZOBACTERIA ON PHYSICOCHEMICAL PROPERTIES OF SOIL AND PERFORMANCE OF CHICKPEA GROWTH

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Abstract

To assess the impact of rhizobacteria strains on soil health and chickpea growth. The use of PGPR for crop production is an alternative of chemical fertilizer. (PGPR) are important soil microbe's which enhance plant growth through direct and indirect mechanisms. These microorganisms play significant role by effect biogeochemical cycles and improve legume productivity. PGPRs create compounds that stimulate leguminous crop growth and function at various phases of development. The aim of the study was to evaluate the impact of bio fertilizer on Chickpea growth and soil health. Five bacterial strains were utilized for this purpose. Which were isolated from rhizoshpere of legume crops).they were screened and identified morphologically. Pot dissertation was conducted at arid zone research center D.I.Khan. The results revealed that treated plots with rhizobium strain inoculation showed that the plant height was statistically greater then control (36.66cm) while shoot fresh weight and dry weight of was significantly greater than other treatments. Which showed greater weight (37.66g) (7.00 g). The study found that rhizobacterial strains treated plots significantly increased chickpea crop growth. This combination thus increases the uptake of nitrogen and phosphorus in treated plots of rhizobacteria strains T4 treated chickpea pots.Thus the combination of PGPR increase soil Nitrogen and Phosphorus content from soil. It is concluded that use of PGPR Rhizobium ceceri and Pseudomonas putida, play vital role in absorption of soil nutrient and development of chickpea.

Keywords. Chickpea, Growth, Rhizobacteria,

抽象的

评估根际细菌菌株对土壤健康和鹰嘴豆生长的影响。 PGPR用于作物生产是化肥的替代品。(PGPR) 是重要的土壤微生物，通过直接和间接机制促进植物生长。这些微生物通过影响生物地球化学循环和提高豆类生产力发挥重要作用。 PGPR 产生的化合物可刺激豆科作物在不同发育阶段的生长和功能。该研究的目的是评估生物肥料对鹰嘴豆生长和土壤健康的影响。为此目的使用了五种细菌菌株。它们是从豆科作物的根茎中分离出来的。对它们进行了形态学筛选和鉴定。盆栽论文是在干旱区研究中心 D.I.Khan 进行的。结果表明，接种根瘤菌菌株的处理地块表明，株高在统计学上大于对照（36.66cm），而地上部鲜重和干重显着大于其他处理。其中显示出更大的重量 (37.66g) (7.00 g)。研究发现，经过根际细菌菌株处理的地块显着

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促进了鹰嘴豆作物的生长。因此，这种组合增加了根际细菌菌株 T4 处理过的鹰嘴豆盆的处理地块中氮和磷的吸收。因此，PGPR 的组合增加了土壤中的氮和磷含量。结果表明，利用PGPR根瘤菌和恶臭假单胞菌对土壤养分的吸收和鹰嘴豆的发育起着至关重要的作用。

关键词.鹰嘴豆, 生长, 根际细菌,

INTRODUCTION

Chickpea is legume crop which is grown all over the world. It offers nutritional benefits because to the high 25–28 percent protein content. Legume crops are the second utmost important food crop subsequently after cereals. Poor countries contribute for 74% of legume productions, whereas developed countries contribute for the majority of pluses.

Chickpea is legume crop that supports and fix atmospheric nitrogen, through root nodulation**.**Rhizobacteria are a type of bacteria t hat live in the rhizosphere of plants and help to Cycle nutrients from soil particles to soil solutio n and plants. Rhizosphere microbial colonies known for nutrient absorption and growth improvement but they have become more visible in recent years (Glick, 1994).The discovery and subsequent efforts to produce rhizobacteria that enhance plant development through the use of such rhizospheric bacteria resulted in significant and beneficial outcomes. Rhizobacteria can change the nutrients availability in the soil and work as a growth regulators for plant growth. Plant growth-promoting rhizobacteria (PGPR) is a broad term for a variety of soil bacteria that aid plant growth. (PGPR) are also vital to the crop's success.

Plant growth promoting rhizobacteria are utilized all over the world to boost agricultural productivity while also being environmentally friendly. Bio fertilizer plays an important role in improving plant development and yield in order to increase crop production (Wani and Khan, 2010). Biological nitrogen fixation (BNF) accounts for two-thirds of worldwide N2 conversion whereas N chemically contributes to the remaining one-third. Pseudomonas is inoculated when used as bacterial strains, to different ecologically, PGPR is a soil biota that offers nutrient supply enhances soil physical Properties, and it is beneficial in phosphate solvents. The Agriculture experts and farmer are utilizing synthetic or chemical fertilizers to combat the nutrient deficiency.

The use of chemical fertilizer is not only put negative impact on soil as well as environment. The alternative of chemical fertilizer is bio fertilizer which not only improve soil health but also increase nutrient absorption from soil, especially Nitrogen and Phosphorus absorption from soil.

MATERIALS AND METHODS

Pot Experiment

A pot experiment was conducted at the Arid Zone Research Centre in Dera Ismail Khan.

Isolation of Microorganisms

Five Rhizobacterial strains (S1, S2, S3, S4, S5,) isolated form (lentil, mungbean and chickpea)

Screening of Rhizobacterial strains

Three healthy plants were uprooted from the fields of different legumes (Berseem, Lentil,

Mung bean, Chickpea) grown at the Arid Zone Research Center, Pakistan Agricultural Research Council, Dera Ismail Khan, during the flowering season.

Broth culture media preparation

These chemically sterilized pink and large-sized nodules were punctured with a sterilized needle and streaked for 72 hours on media plates of yeast extract mannitol agar (YMA) and incubated at 28 °C. After 72 hours, growth on Petri dish were visually observed and well-grown colonies were streaked over and over again until pure, fine and uniform colonies were obtained. Phylogenetic identification of five rhizobacterial strains was done from MicroGen® korea

Table- Rhizobacterial strains were identified as follows:

S. No	Plant growth promoting traits	Gram Reaction	Cultural Characteristics on Nutrient agar	Isolated Organism	Reference
1.	Indole Acetic Acid (IAA), Siderophores, ammonia, exo-polysaccharides, phosphate solubilization	Gram negative	Bluish	Enterobacter asburae	Ahmed and Khan (2010)
2.	ACC deaminase, IAA, siderophore, phosphate solubilization	Gram negative	White to cream	Enterobacter mori	Kumar et al. (2008)
3.	phosphate solubilization, IAA, exo-polysaccharides,ammonia siderophores, HCN	Gram negative	Cream, yellow to greenish	Pseudomonas areoginosa	Ahemad and Khan (2012)
4.	Antifungal activity, siderophore, HCN, phosphate solubilization	Gram negative	Round transparent, smooth colonies	Pseudomonas putida	Pandey et al. (2006)
5	Able to form symbiosis with chickpea produce penalate-type sidosphere in response to iron deficiency	Gram negative	Pink to red Rod shape	Mesorhizobium ceceri	Behrao et al (1997)

Seed Inoculation

Seeds variety of Desi Chickpea Nifa - 2005 was obtained from AZRC D.I.KHAN and inoculated with five rhizobacterial strains.

The soil was collected from the AZRC D.I.Khan area and sieved with a 2 mm sieve. The pots contained 20 kg of soil, and the Nifa 2005 variety was sown in them.Growth parameters of Chickpea crop were as under:

Agronomic parameters of Chickpea.

Plant height cm

Plant height was measured at crop maturity with help of meter rod.

Shoot wet and dry weight (g)

The shoot weight was determined using an electric balance. The dry weight of the shoot was measured before it was dried in an oven at 65 degrees for two days.

Root wet and dry weight (g)

The weight of chickpea shoots was determined using an electric balance. The root dry weight was sun dried before being placed in the oven. Following that, the electric balance was weighed.

Treatment details of the experiment

T1 control	**T2 Mesorhizobium ceceri**	**T3 Enterobactor asburiea**
T4 Enterobactor mori	**T5 pseudomonas aeruginosa**	**T6 pseudomonas putida**

Statistical Analysis

The soil and agronomic data were analyzed from Statistix 8.1 software. The Least Significance Difference (LSD) test was used at a 5% probability level for mean comparison (Steel, Torrie & Deekey, 1997).

RESULTS AND DISCUSSION

Plant Height (cm)

The results indicated that in comparison of PGPR treatments with the control, the treatments demonstrated a significant response of inoculated seeds. In terms of chickpea plant height, the (T2 Rhizobium ceceri) gave highest plant height while lowest plant height was observed in the (T1control) (28 cm) (Figure 3.1). Janardan et al. (2010) found that PGPR are beneficial rhizobacterai for chickpea growth.

Nodule Count

Nodule count data showed non-significant response to several rhizobacterial strains inoculation However, T5 (Pseudomonas aeruginosa) had the maximum number of nodules (14.33), while T6 (Pseudomonas putida) had the lowest value 11.66. (Figure 3.2). Katy 2009. Found that the genotype more extensive showed non-significant results of Nodule count.

Shoot fresh weight (g)

The results of shoot fresh weight revealed that (Figure 3.3) depicts the various inoculants The inoculants had a substantial impact on the shoot wet weight (P0.05). T2 Rhizobium ciceri showed the highest wet weight of 36.66 g, which was higher than T3, T4, and T5, while T1 Control had the lowest dry weight (26.66g). According to Kanwal et al. (2012), the majority of isolates result in Cicer arietinum seedlings.

Shoot dry weight (g)

The data regarding root dry weight showed significant response (P 0.05). When the means were compared with control treatment. It was discovered that T2 Rhizobium ciceri had the highest dry weight (17.33g). The least value recorded in T1 control (Figure 3.4). Kanwal et al. (2012) investigated that PGPR strains showed a considerable rise in dry weight of shoot (Cicer arietinum L) shoot and root.

Root Fresh weight (g)

The data regarding root fresh weight showed significant response. The maximum value was observed in (Treatment T2 Rhizobium ciceri) which was 13.66g.while the least value found in T1, which was (8.00) (Figure 3.5).

According to Yadav et al. (2010), rhizobia inoculated with (Cicer arietinum) showed rise in growth and shoot and root dry weight under various environmental regions.

Root dry weight (g)

Dry weight of Chickpea showed significant response. The usage of various inoculants has a considerable impact. In Treatment (T2 Rhizobium ciceri) (6.00g) had the highest root weight was found in T1 when compared to control (Figure 4.6). According to Fatima et al. (2008), a substantial increase in root dry weight of Cicer arietinum was found in inoculation treatments.

Soil Available N, P and Organic matter %

Soil phosphorus content absorption in soil showed increase in inoculation treatment (Figure 1.6). The highest soil Phosphorus content was

recorded in Rhizobium ceceri treated treatment, that was followed by (Enterobacter mori) treated treatment while the least value was recorded in T1(control). According to various researchers (Orhan et al.), rhizobacterial strains play a substantial effect in the availability of soil phosphorus. They found that inoculating Rhizobacterial strains increased phosphate solubilization, resulting in increased soil phosphorus availability. The nitrogen content of the soil was significantly affected by the results obtained after the crop was harvested. The maximum value for soil nitrogen was found in Rhizobium ceceri (T2) treatment, whereas the lowest was found in untreated soil.(Figure 1.7). Ma et al. (2011) published a similar finding, stating that rhizobacteria greatly boost soil nitrogen. Inoculants had a significant effect on soil organic matter content (P0.05), according to the data. Rhizobium cecri, Enterobacter asburiae, and Pseusomonas aeruginosa had the greatest organic matter level of 0.9 percent (Figure 1.8). It was statistically similar to the finding of Shahbaz et al. (2014). The application of rhizobacterial strains resulted in an increase in soil organic matter content and also improve uptake of plant nutrients. The soil organic matter content was significantly higher in the PGPR treated areas soil.

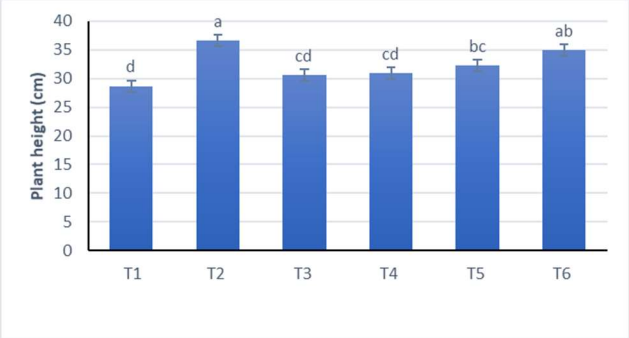
CONCLUSION

The current study revealed that the use of Inoculant of Rhizobium ceceri treatments plants showed significant response on Chickpea growth, plant height and shoot dry weight and root dry weight, as compared to control over inoculation plants,. The application of PGPR isolates considerably increases the percentage of plant growth of chickpea in arid conditions.

Table No-1. Effect of Rhizobacterial strains on Plant Height, Shoot fresh weight and Shoot dry weight of Chickpea grown in pots.

Treatments	Plant Height (cm)	Shoot fresh weight (g)	Shoot dry weight (g)
T1	28.667d	26.667 c	10.000 c
T2	36.667a	40.667 a	17.333 a
T3	30.667cd	34.333 b	14.667 b
T4	31.000 cd	29.667 c	12.667 bc
T5	32.333bc	35.000 a	14.333 b
T6	35.000 ab	38.000 ab	16.667 ab
LSD	3.5082	4.1298	2.8747

Figure 1.1 Plant height affected by Rhizobacterial strains



1.2 Figure:1.2 Nodule count affected by Rhizobacterial strains

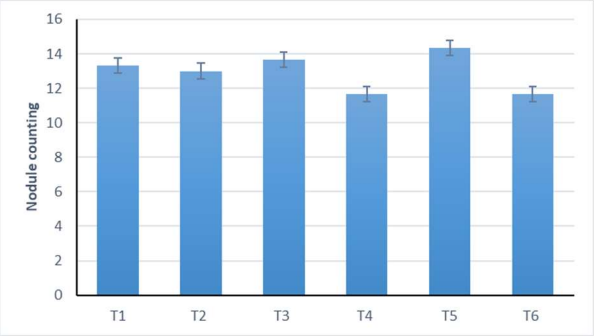


Figure: **1.3 Fresh weight of shoot affected by Rhizobacterial strain**

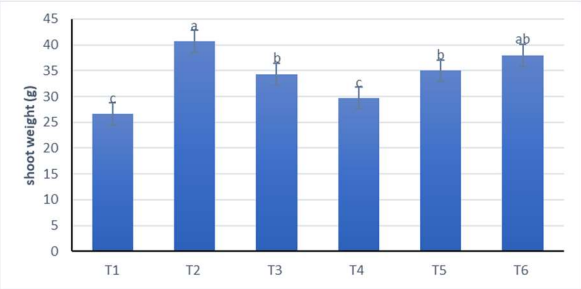


Figure: 1.4 Dry weight of shoot affected by Rhizobacterial strains

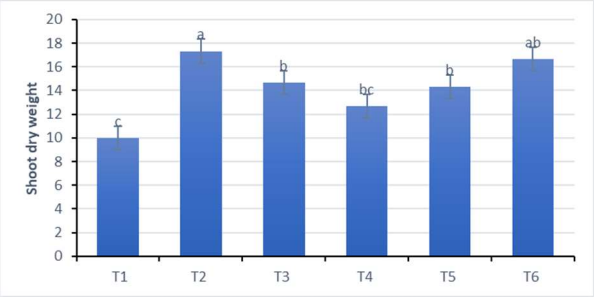


Figure: **1. 5 Root weight of Shoot as affected by Rhizobacterial strains**

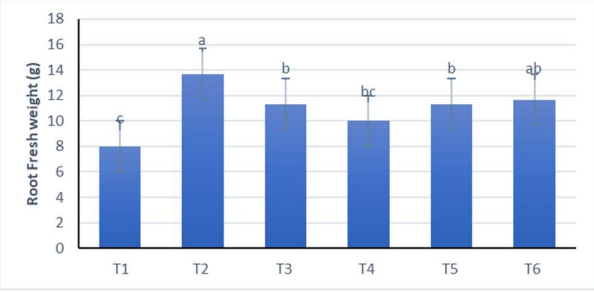


Figure 1.6 Soil phosphorus affected by Rhizobacterial strains

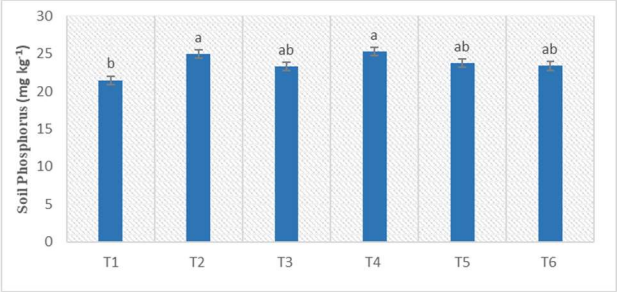


Figure 1.7 Soil Nitrogen affected by Rhizobacterial strains

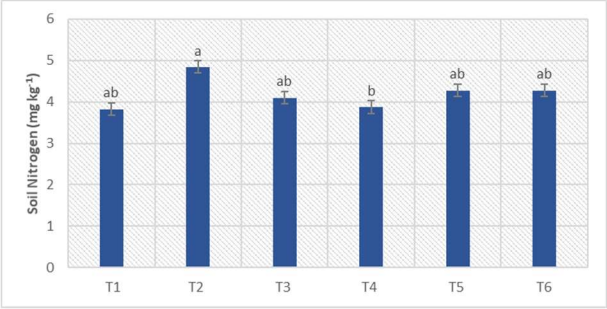
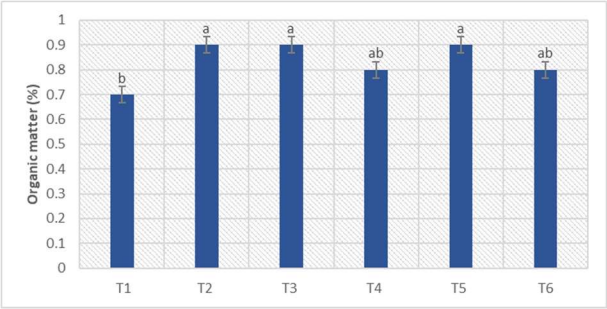


Figure 1. 9 Organic matter (%) affected by Rhizobacterial strains



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- for nutrient absorption increase in soil which improve
  plant growth and development,