EUROPEAN ACADEMIC RESEARCH
Vol. IV, Issue 6/ September 2016

Impact Factor: 3.4546 (UIF)
DRJI Value: 5.9 (B+)

ISSN 2286-4822
www.euacademic.org

Effect of Plant Growth Promoting Rhizobacteria (PGPR) on growth and yield Components of tomato (*Lycopersicon esculentum*)

FALIH H. SAEED[1], PhD
USAMA A. ALWAN, PhD
QASSIM M. ZAMIL, MSc
ABED AL-RAHMAN SUHAIL, MSc
Ministry of Science and Technology, Agric. Research director.
Baghdad, Iraq

Abstract:

A greenhouse experiment was conducted to evaluate the effects of two PGPR (Pseudomonas, Azotobacter) and combination on growth and yield Components of tomato plant (Lycopersicon esculentum c.v Wijdan).

Results showed that highest plant length and leaves number were observed with P. fluoresces + A. chroococcum and A.chroococum treatments (230cm and 42 leaves) and (224cm and 39leaves) respectively which significantly differed from other treatments, Maximum level of shoot dry weight and Relative Chlorophyll was achieved in P. fluoresces + A. chroococcum, treatment (246 g. Plant^{-1} and 46 spad unit) Respectively, which significantly differed from other bio-fertilizer treatments, While the control treatment recorded less values (162 g. Plant^{-1} and 33 spad unit).

The results also showed the Maximum level of number of clusters per plant, Fruits Number per plant, Plant yield and total yield per plastic house were achieved on P. fluoresces + A.chroococcum treatment (13 clusters.plant^{-1}, 77fruits.plant^{-1}, 9333Kg.plant^{-1} and 4469.8 kg. plastic house^{-1}) Respectively, While the control

[1] Corresponding author : falihss@yahoo.com

treatment recorded less values (7 clusters.plant^{-1}, 55 fruits.plant^{-1}, 6050 Kg.plant^{-1} and 2722.5 kg. plastic house^{-1}) .

Key words: Plant Growth Promoting Rhizobacteria (PGPR), growth and yield Components of tomato (*Lycopersicon esculentum*)

INTRODUCTION

Tomato (*Lycopersicum esculentum* L.) is one of the most popular garden vegetable in the world. Tomatoes have high values in Vitamin A and C and are naturally low in calories, it is a savory, typically red, edible fruit, as well as the plant which bears it. Originating in South America, the tomato was spread around the world following the Spanish colonization of the Americas, and its many varieties are now widely grown, often in greenhouses in cooler climates [1]

Tomato, according to FAO, is the second most cultivated vegetable in the world, after potato with an annual production of nearly 108 t of fresh tomato in 3.7 × 106 ha worldwide, while China, USA and Turkey are the leading producers[2] .

Studies have shown that high consumption of tomato is consistently correlated with a reduced risk of some types of cancer [3].

Plant growth promoting rhizobacteria (PGPR) help plants through different mechanisms, for example (i) the production of secondary metabolites such as antibiotics, cyanide, and hormone like substances; (ii) the production of siderophores; (iii) antagonism to soil borne root pathogens; and (iv) phosphate solubilization [4,5,6]. These organisms possessing one or more of these characteristics are interesting since it may influence plant growth. Improvement of phosphorus (P) nutrition is one of the factors involved in plant growth promotion by PGPR. These bacteria may improve plant P acquisition by solubilizing organic and inorganic phosphate sources through phosphatase synthesis or by lowering the pH of the soil [7,8]. In the present experiment, we studied the impact of *Pseudomonas fluoresces* and *Azotobacter chroococcum* alone or in combination on tomato growth and yield components of Wijdan tomato variety .

MATERIALS AND METHODS

This study carried out in greenhouse in an area of 500 m^2 during 2016 to study the impact of *Pseudomonas fluoresces* and *Azotobacter chroococcum* bacteria alone or in combination on growth and yield compounds of of Wijdan tomato variation.

The plant growth promoting rhizobacteria (PGPR) were obtained from the culture collection of the Agric. Research directorate / Ministry of Science and Technology - Baghdad – Iraq.

PGPR contained *P. fluoresces, A. chroococcum*. PGPR concentration was adjusted to 1×10^9 (CFU/G) in all inoculants in Gore tomato seedlings planting.

Three PGPR treatments were considered (*P. fluoresces*, *A. chroococcum* and *P. fluoresces* + *A. chroococcum*. The experiment was laid out in Randomized Completely Block Design(RCBD) with three replicate and with drip irrigation. N, P and K fertilizer was added to all the treatments according to the soil test, growth indicator (plant height, leaves number , dry weight of shoot system and relative chlorophyll) and yield compound indicator (number of clusters per plant , number of fruits per plant , Plant yield and Total yield per plastic house) .

Table 1 . Physical and Chemical properties of the soil test

Character	Sandy ($g.kg^{-1}$)	Silts ($g.kg^{-1}$)	Clay ($g.kg^{-1}$)	pH	EC s/cm	availability elements % N	(ppm) P	K	Fe	Mn	Zn
Value	870	74	56	7.02	2.40	39	28	157	2.3	1.2	1.3

DATA ANALYSIS

Data were statistically analysed using the analysis of variance (ANOVA) procedure using Genstat program to assess the effects of different treatments. Means were compared using the least significant difference (LSD) at ($P \leq 0.05$).

RESULTS AND DISCUSSION

The highest plant length was observed in *P. fluoresces* + *A. chroococcum* (230 g.plant^{-1}), and *A. chroococcum* (224 cm.plant^{1}) treatments which significantly differed from other bio-fertilizer treatments, the lowest value in control treatment(190 cm.plant^{1}).

The maximum level leaf number was achieved in *P. fluoresces* + *A. chroococcum* (42 leaf. Plant^{-1}) and *Azotobacter* (39 leaf.plant^{-1}) treatments which significantly differed from other treatments, while the control treatment recorded less values (26 leaf.plant^{-1}).

Maximum level of shoot dry weight was shown on *P. fluoresces* + *A. chroococcum* (246 g.plant) treatments which significantly differed from others treatment. , While the control treatment recorded less values (162 g. Plant^{-1}).

The highest relative Chlorophyll was achieved on *P. fluoresces* + *A. chroococcum* (46 spad) treatments which significantly differed from other bio-fertilizer and cotrol treatments (Table 2).

Table 2. Effect of Plant growth-promoting rhizobacteria on some tomato growth parameters

Treatments	Plant Length (cm)	Number of Leaves	shoot dry weight (g. Plant^{-1})	Relative Chlorophyll
T.1	**190**	**26**	**162**	**33**
T.2	**212**	**35**	**213**	**41**
T.3	**224**	**39**	**228**	**44**
T.4	**230**	**42**	**246**	**46**
L.S.D	7.462	**3.172**	**11.15**	**1.332**

T1=control, T.2= *P. fluoresces*, T.3= *A. chroococcum*, T4= *P. fluoresces* + *A. chroococcum*

Data illustrated significantly difference between inoculum tomato plant usages *P. fluoresces* + *A. chroococcum* and *P. fluoresces* or *A. chroococcum* treatments on same tomato indicator yield and yield compound (Table 3).

The highest number of clusters per plant was observed in *P. fluoresces* + *A. chroococcum* (13 clusters.plant^{-1}) treatment which significantly differed from other rhizobacteria inoculums treatments, , the lowest value in control treatment (7 clusters.plant^{-1}) .

The maximum Fruits number per plant was achieved in *P. fluoresces* + *A. chroococcum* (77 fruits. Plant^{-1}) treatment which significantly differed from other bio-fertilizer treatments and control treatment (which had non-inoculated by PGPR) which record (55 fruits. Plant^{-1}) .

Maximum Plant yield was shown on *P. fluoresces* + *A. chroococcum* (9933 g.plant^{-1}) treatments which significantly differed from others treatment.

The highest Total yield per plastic house was shown on *P. fluoresces* + *A. chroococcum* (4469.8 kg) treatments which significantly superiority differed from other bio-fertilizer (rhizobacteria) and control treatments (which had non-inoculated by PGPR) which recorded (2722.5 Kg) (Table 2).

Table 3.Effect Plant growth-promoting rhizobacteria on some tomatoyield parameters

Treatment	Number of clusters.plant^{-1}	Fruits Number.plant^{-1}	Plant yield (g.plant^{-1})	Total yield (kg. plastic house^{-1})
T.1	**7**	**55**	**6050**	**2722.5**
T.2	**10**	**67**	**8710**	**3919.5**
T.3	**11**	**71**	**8875**	**3993.7**
T.4	**13**	**77**	**9933**	**4469.8**
L.S.D	**1.881**	**4.22**	**543**	**477**

T1=control, T.2= *P. fluoresces*, T.3= A. *chroococcum* , T4= *P. fluoresces* + *A. chroococcum*

Increased growth and yield by tomato plants inoculated with plant-growth promoting bacteria has been attributed to the production of plant growth regulators at the root interface, which stimulated root development and resulted in better absorption of water and nutrients from the soil [9,10] .

PGPR can improve plant growth, plant nutrition, root growth pattern, plant competitiveness and responses to external stress factors. PGPR have also been shown to induce systematic resistance (ISR) to fungal, bacterial, and viral pathogens in various crops such as bean, tomato, radish, and tobacco [6,11].

Different PGPR including associative bacteria such as Azospirillum, Bacillus, Pseudomonas and Azotobacter have been used for their beneficial effects on plant growth [12 , 13] .

The results indicated that PGPR affect the growth and nutrients uptake. In the impact of root inoculation with beneficial rhizosphere microorganisms on some quality parameters is being explored [11, 14]

Facilitating plant nutrition could be the mechanism by which PGPR enhance crop yield, since the nutritional plants status is enhanced by increasing the availability of nutrients in the rhizosphere [6 , 8].

Phytohormones produced by PGPR, are believed to be changing assimilate partitioning patterns in plants altering growth in roots, the fructification process and development of the fruit under production conditions [4 , 5, 15]

This work supports that tomato root inoculation with PGPR enhances growth and yield under greenhouse conditions. However, field experiments should be carried out to ensure that positive effects are maintained under conventional production systems.

REFERENCES

1- Ordookhani, K., K. Khavazi., A. Moezzi and F. Rejali, (2010). Influence of PGPR and AMF on antioxidant activity, lycopene and potassium contents in tomato. African Journal of Agricultural Research, 5(10): 1108-1116.

2- F A O., Crop Description and Climate, (2004). Available: http://www.fao.org/ag/agl/aglw/cropwater/tomato.stm#- descrip 24 January 2005].

3- Franceschi, S., E. Bidoli, C. La Vecchia, R. Talamini, B. D'Avanzo and E. Negri, (1994). Tomatoes and risk of digestive-tract cancers. Int. J.Cancer, 59: 181-184.

4- Ahmad, F. ; I. Ahmad and M.S. Khan. (2005). Indole acetic acid production by the indigenous isolates of *Azotobacter* and *Fluorescent Pseudomonas* in the presence and absence of tryptophan. Turk. J. .Biol. (29) : 29-34.

5- Gupt A, and M Gopal. (2008). siderophore production by plant growth promoting rhizobacteria. Indian J. Agric. Res. 42 (2) : 153 -156

6- Jnawali, A. D., R. B. Ojha and S. Marahatta. (2015). Role of *Azotobacter* in Soil Fertility and Sustainability–A Review . Adv Plants Agric Res 2015, 2(6): 00069

7- Saharan, B. and V. Nehra. (2011). Plant growth promoting rhizobacteria: A critical review, Life Sciences and Medicine Research, Volume 2011 -21 , http://astonjournals. com/lsmr

8- Sharafzadeh S. (2012). Effects of PGPR on growth and nutrients uptake of tomato. International Journal of Advances in Engineering & Technology. 2: 27-31.

9- Hayat, R.; S, Ali; U. Amara; R. Khalid and I, Ahmed. 2010. Soil beneficial bacteria and their role in plant growth promotion: a review, Ann Microbiol, Springer – Verlag and the University of Milan, Page 1-20.

10- Awasth, R., R, Tewari and H, Nayyar. 2011. Synergy between Plants and P-Solubilizing microbes in soils: effects on growth and physiology of crops, International Research Journal of Microbiology (IRJM) 2(12): 484-503.

11- Bhardwaj, D., M. W. Ansari, R. K. Sahoo and N. Tuteja. 2014**.** Biofertilizers function as key player in sustainable agriculture by improving soil fertility, plant tolerance and crop productivity. Microb Cell Fact.; 13: 66

12- Naseri, R.; Azadi, S.; Rahimi, M. J.; Maleki, A.; Mirzaei. 2013. Effects of inoculation with *Azotobacter chroococcum* and *Pseudomonas putida* on yield and some of the important agronomic traits in barley (*Hordeum vulgar* L.). International Journal of Agronomy and Plant Production Vol. 4 No. 7

13- Srivastava, A. K., S K Malhotra and N. K. Krishna KUMAR.2015. Exploiting nutrient-microbe synergy in unlocking productivity potential of perennial fruits : A revie. *Indian Journal of Agricultural Sciences* **85** (4): 459–81

14- Ahemad, M. and M. Kibret.2014. Mechanisms and applications of plant growth promoting rhizobacteria: Current perspective. Journal of King Saud University – Science 26, 1–20.

15- Karnwal, A. 2009. Production of indole acetic acid by fluorescent *pseudomonas* in the presence of l-tryptophan and rice root exudates. Journal of Plant Pathology . 91 (1): 61-63**.**