



## Effect of Bio-Fertilizers *Azotobacter chroococcum* and *Pseudomonas fluorescens* on Growth of Broccoli (*Brassica oleracea* L. var. *Italica*)

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### Abstract

A field experiment was carried out at the experimental farm of soil laboratory belong to Directorate of Diyala Agriculture, Iraq during 2017. The experiment comprises of different doses of biofertilizers (*Azotobacter chroococcum* and *Pseudomonas fluorescens*) 0.08, 0.14 and 0.28 g/plant to assess their performance on growth characteristics of broccoli. The experiment was laid out in randomized complete block design having four treatments with three replications. The data analysis revealed that the maximum of leaves numbers in the treatment of Biofertilizer, 0.28 (23.4) whereas the maximum area of bigger leaf and head diameter was recorded in all treatments of Biofertilizer 0.08, 0.14 and 0.28 (415.9, 340.3 and 373.9 cm) and (15.5,15.4 and 15.1cm) as compared with control (108.8 cm) and (3.0 cm) respectively.

**Key words:** Broccoli, *Azotobacter chroococcum*, *Pseudomonas fluorescens*.

Date of Publication: 2018-08-30

DOI: <https://doi.org/10.24297/jab.v11i1.7590>

ISSN: 2347-6893

Volume: 11 Issue: 01

Journal: Journal of Advances in Biology

Publisher: CIRWORLD

Website: <https://cirworld.com>



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## Introduction

The broccoli (*Brassica oleracea* var. *Italica*) belongs to the family Brassicaceae or Cruciferae, it is one of the most nutritious vegetables among the crops, it is considered food important due to its high nutritional value. Because it contains vitamin A and C, protein, carotenoids, fiber, calcium, folic acid and anti-carcinogenic compounds. Is richer source of sulforaphane, a compound reduce the risk of cancer in humans [1;2]. Potential of crop production is increases by synthetic fertilizers but excessive use of these fertilizers causes imbalance in soil environment, bio fertilizers have proven best for soil fertility and productivity [3]. Nutrient management is the main factor, which affects the productivity and quality of any crop, Bio fertilizers are improving quality and quantity of vegetable produce through they contain microorganisms which are capable of mobilizing nutrient elements from unavailable form to available form through different biological processes [ 4]. *Azotobacter* is aerobic bacteria and heterotrophic, it has the ability to fix nitrogen non-symbiotically and existed in soils and water [5; 6; 7; 8]. It has capability of synthesizing antibiotics, plant growth promotion substances, exopolysaccharides, vitamins and pigment production [9; 10; 11; 12; 13; 14]. It has the ability to solubilize phosphates in aquaculture systems and antagonist effect against pathogens [15; 16; 17; 18]. *Pseudomonas* is associated with the rhizosphere and is able to exert a beneficial effect on plant growth [19]. *Pseudomonas fluorescens* is considered to be the most promising group for plant growth [20]. This study was carried out to evaluate *Azotobacter chroococcum* and *Pseudomonas fluorescens* on the growth of broccoli.

## Materials and Methods

The present experiment was conducted at farm of soil laboratory belong to Directorate of Diyala Agriculture, Iraq during 2017. The Broccoli seedlings were obtained from nursery of Directorate of Diyala Agriculture and transplanted in the soil with Ec 0.81 dsm and PH 7.13 at 19\9\2017. Bio fertilizer (*Azotobacter chroococcum* & *Pseudomonas fluorescens*) as commercial formulation was obtained from a ministry of science and technology. DAP fertilizer (Diammonium phosphate) at the rate of 100 kg\ hectare was added at 29/9/2017 whereas bio fertilizers were added to each plant by drill the soil close the plant and deep 5 cm at 18/10/2017, the experiment included three levels of bio fertilizers 0.08, 0.14 and 0.28 g/plant with a treatment of control without adding with three replications, the distance between row to row and plant to plant was kept as 40 cm × 20 cm respectively, ten plants of each replicate were taken randomly for recording vegetative growth characteristics, (i.e., number of leaves, the area of the bigger leaf, length of head, a diameter of the head, length of a plant, head weight, plant weight, head weight ton/acre, plant weight ton/acre. The experiment was conducted under Randomized Block Design and watered as needed and the data was analyzed by one-way analysis of variance (ANOVA) [21].

## Results and Discussion

The data of growth characteristics viz., numbers of leaves, area of bigger leaf and diameter of head revealed that significant variations among the different treatments under study (Table 1). The maximum of leaves numbers was superior in the treatment of Biofertilizer, 0.28 (23.4) followed by Biofertilizer 0.08 (21.9) and Biofertilizer 0.14 (21.3) as compared with control (17.9). The maximum area of bigger leaf and head diameter was recorded in all treatments of Biofertilizer 0.08, 0.14 and 0.28 (415.9, 340.3 and 373.9 cm) and (15.5, 15.4 and 15.1 cm) with significant variations from control (108.8 cm) and (3.0 cm) respectively, whereas the other characteristics showed non-significant variation in spite of the yield of plant and head was high in all biofertilizers as compared with control.



The present findings are in agreement with the results of [22 ;23; 24] stated that application of biofertilizers (Azotobacter and Phosphorus solublising bacteria) with NPK led to the effective utilization of nutrients available in the soil which increased growth and activity of microbial saprophytes which influenced the yield of broccoli per hectare. [25] reported that application of biofertilizer such Azotobacter helps in secretion of substances of growth promotion which leads to uptake and decomposition of nutrients, transportation of water through root development. [26] reported that the increase in the number of broccoli leaves per plant due to the application biofertilizers (Azotobacter) with a combination of NPK might have increased the availability of nutrients through direct addition in the soil. phosphorus solubilizing bacteria (PSB) like *P. fluorescens* can be implemented for broccoli cultivation, *P. fluorescens* has the ability to increase growth, nutrient uptake, and yield of broccoli [ 27]. *P. fluorescens* has the ability to produce plant growth promoting substances and some secondary metabolites which enhance nutrient uptake and plant growth [28].

### Conclusion

The benefits of growth-promoting microbes such as *A. chroococcum* in combination with *P. fluorescens* in the present study was clearly demonstrated to be a promising factor for improved growth performance, nutrition, and increase in plants growth of broccoli and sustain yield.

### Conflict of Interest

The authors declare that they have no competing interests.

### Acknowledgements

Authors wish to thank Ministry of Agriculture, Directorate of Diyala Agriculture for awarding the opportunity to accomplish this work.

**Table 1. Effects of bio fertilizers on some characteristics of broccoli**

Treatments	Numbers of leaves	Area of bigger leaf (cm)	Head height (cm)	Diameter of head (cm)	plant height (cm)	Head weight (g)	Plant weight (g)	Head yield ton/acre	Plant yield ton/acre
Biofertilizer 0.08 g/plant	21.9	415.9	17.1	15.5	59.9	297.2	1028.6	2.477	8.571
Biofertilizer 0.14 g/plant	21.3	340.3	17.9	15.4	60.3	281.1	842.2	2.343	7.018
Biofertilizer 0.28 g/plant	23.4	373.9	17.9	15.1	58.5	283.5	890.7	2.362	7.422
Control	17.9	239.0	16.7	11.2	52.3	158.2	543.9	1.222	4.301
CD (0.05)	1.3	108.8	N.S	3.0	N.S	N.S	N.S	N.S	N.S



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