Original Research Article **Open Access**

Studies on the Effect of *Azospirillum brasilense* on Growth Parameters in *Zea mays* Linn

Subramanian G, Sowmiya R, Indhu M, Punitha S, Sasikala J and Jayanthi V

PG and Research Department of Botany, Arignar Anna Government Arts College, Namakkal – 637002, Tamilnadu, India.

Abstract

The influence of Azospirillum brasilense strain on morphometric characteristics of maize plants was studied and recorded. On 30 and 40 day, pot culture of Zea mays with Azospirillum brasilense showed higher shoot and root growth, leaf length and breadth than the control plant. This study has been found that inoculation of maize crops with an active strain of A. brasilense has a beneficial effect on maize vigour and yield under the identical climatic and soil conditions.

Keywords Azospirillum brasilense, Zea mays L., Biofertilizer, Pot culture.

INTRODUCTION

The term 'biofertilizers' denotes all the "nutrient inputs of biological origin for plant growth" [1]. In recent years, biofertilizers have been emerged as supplement to mineral fertilizers and hold a promise to improve the yields of crops. The biofertilizers are found to have positive contribution to soil fertility, resulting in an increase in crop yield without causing any type of environmental, water and soil hazards. Out of many microorganisms which were identified and included in the list of biofertilizers, *Azospirillum brasilense* has been recognized to play a unique role in nitrogen economy of many crops like cereals and grasses [2].

Bio-fertilizer is a material containing microorganisms added to a soil to directly or indirectly make certain essential elements available to plants for their nutrition. Various sources of bio-fertilizers include nitrogen fixers, phytostimulators, phosphate solubilizing bacteria, plant growth promoting *rhizobacteria*, etc,[3]. Application of bio-fertilizers became of great necessity to get a yield of high quality and to avoid the environmental pollution [4].

The three most important cereal crops are rice, wheat and maize in the world. Maize is high yielding, easy to process, readily digested and cheaper than other cereal crops. It is also a versatile crop, growing across a range of agro ecological zones. Every part of the maize plant has economic value, the grain, leaves, stalk, tassel and cob of the maize plant can all be used to produce a large variety of food and non food production. Corn is a very versatile grain that benefits mankind in many ways. Each year, 6 billion bushels of corn are used as feed for cattle, hogs and poultry in the United State. Another 2 billion bushels were exported, which are an integral part of this country's balance are converted to sweeteners, starch, flower cereal, liquor, animal feed, vegetable oil, alcohol for fuel and hundreds of other products[5].

The quantification of halophilic *Azospirillum brasilense* (*A. brasilense*) from mangroves was studied earlier, where the bacterial density was found higher in the roots of *Avicennia marina.* The percentage of germination in coastal crop plants increased by 70 % in black gram and 45% in rice with the inoculation of *A. brasilense* compared with control. The saline tolerant *A. brasilense* is recommended as bio-fertilizer for improving crop yield in coastal agricultural fields [6].

In field experiments, corn inoculated with *A. lipoferum* showed double the seeds per year, an increase in seed dry weight by 59 %, and a significant stimulation in root development at harvest time [7]. Increased root, shoot weight with dual inoculation in maize have been reported [8], while grain yields of the different maize genotypes treated with *A. brasilense.* Increasing yield was attributed to the plant growth promoting substances by root colonizing bacteria more than the biological nitrogen fixation, stated that yield increased due to promoting root growth which in turn enhancing nutrients and water uptake from the soil. There were positive and synergistic interactions between factors like interactions between mycorrhizal inoculation and phosphate bio-fertilizer on N concentration and phosphate bio-fertilizer and vermin-compost on P concentration [9]. For the highest seed yield in agriculture addition of both nitrogen and phosphate fertilizer is very important [10-12]. A pot culture experiment was conducted to study the effect of seed treatment of micronutrient supplemented *Azospirillum biofertilizer* strains (ACD-20 and ACD-L) on dry matter production, N content and yield of maize [13].

In recent years, use of microbial inoculants as a source of bio-fertilizers has become a hope for most of countries, as far as economical and environmental view points are concerned. Biologically fixed nitrogen is such a source which can supply an adequate amount of nitrogen to plants and other nutrients to some extent. It is a non-hazardous way of fertilization of field. Moreover, biologically fixed nitrogen consumes about 25 to 30 per cent less energy than normally done by chemical process. Therefore, in developing countries like India, it can solve the problem of high cost of fertilizers and help in saving the economy of the country.

The present investigation was carried out to study the efficacy of using *A. brasilense* biofertilizers on *Zea mays* for enhancing the growth rate.

MATERIALS AND METHODS

In this study, a commercial crop corn (Zea mays L.) was analyzed for the morphometric characters such as total height of the plant, leaf number, leaf length and breadth, shoot and root length.

Address Correspondence at PG and Research Department of Botany, Arignar Anna Government Arts College, Namakkal – 637 002, Tamil Nadu, India. Ph: 91-9943690123; E-mail: gslifesciencegs@gmail.com

The above parameters of normal and experimental maize plants were observed on 30th and 45th days. The experiment was laid out in order to evaluate the effects of *A. brasilense* as bio-fertilizers on growth morphometric characterization of corn (*Zea mays* L.).

Source of Plant

Zea mays Linn, was collected from Ladduvadi, Namakkal district, Tamilnadu, India. The botanical studies were at Indian literatures [14]. As a bio-fertilizer, the *A. brasilense* was obtained from, Agricultural Research Center, Namakkal district, Tamilnadu. *A. brasilense* is a bacterium[15]. Its type strain is sp 7 (ATCC 29145). It is nitrogen – fixing and is found in rhizospheres of several grasses [16].

Pot culture experiments

The experiment was carried out with 12 earthen pots. Each pot had a single test plant (*Zea mays* L.). Among the 12 pots, six were kept as control (black soil) and the remaining six were treated plants (black soil + *A. brasilense* (9:1 ratio) (Fig. 1 and 2). The maize seeds were sowed in each pot. After emergence of seedlings, the pots were kept in sunlight and irrigated with water regularly. The growth parameters of pot cultured plants were observed and the number of leaves, leaf length and breadth, shoot length and root length were recorded on 30 and 45 days after sowing (Fig - 1 & 2).

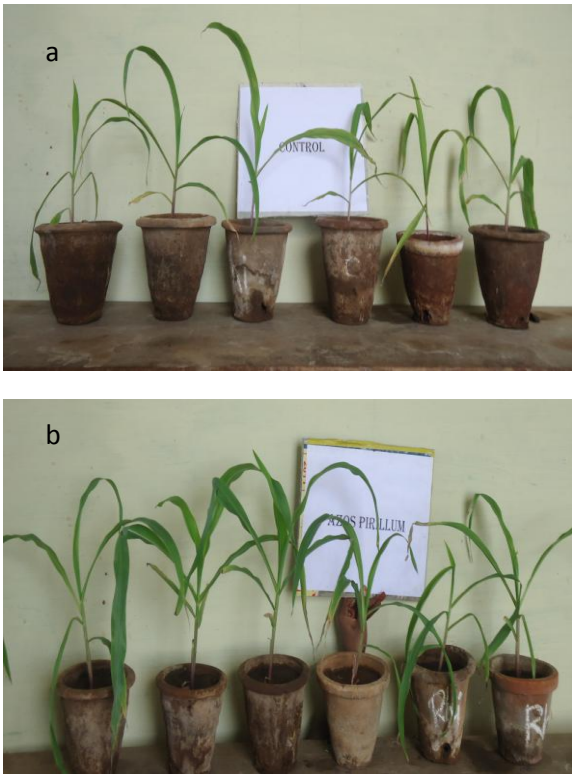

Figure.1: *Azospirillum brasilense* treated *Zea mays* plants on 30th day **(a)** Control Plants (Black soil) **(b)** Treated plants (Black soil + *Azospirillum brasilense)*

RESULT and DISCUSSION

The morphometric characters of *A. brasilense* treated maize plant were higher than the control plants. The maximum plant height was obtained with *A. brasilense* (20cm) when compared with control plants. More number of leaves was obtained in treated plants (6 numbers) and the maximum breadth of leaf (3.6cm) per plant was obtained with treated plant than control (2cm) (Table -1; Fig. 3).

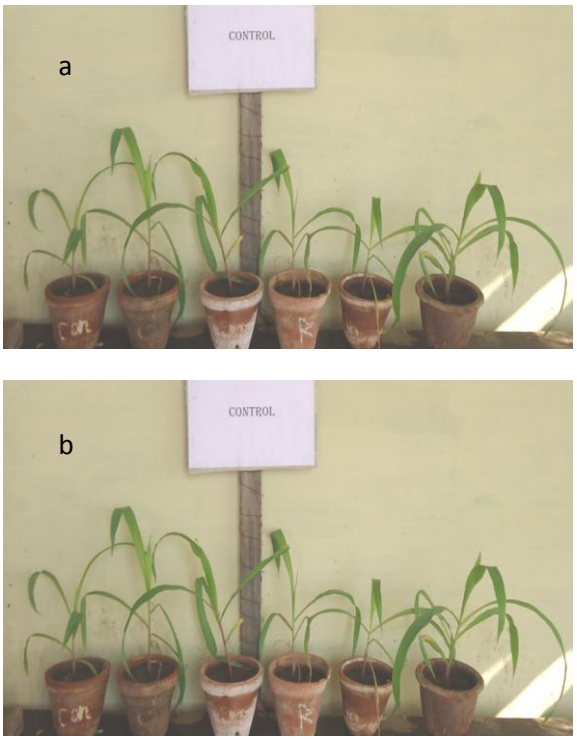

Figure.2 *Azospirillum brasilense* treated *Zea mays* plants on 45th day **(a)** Control Plants (Black soil) **(b)** Treated plants (Black soil + *Azospirillum brasilense)*

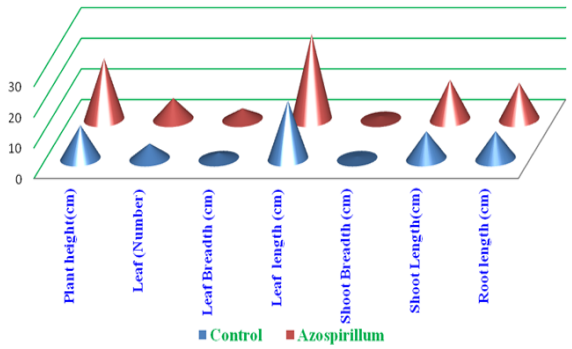

Figure.3: Effect of *Azospirillum brasilense* on *Zea mays* Linn. Pot growth culture (30 days) [Mean value in %]

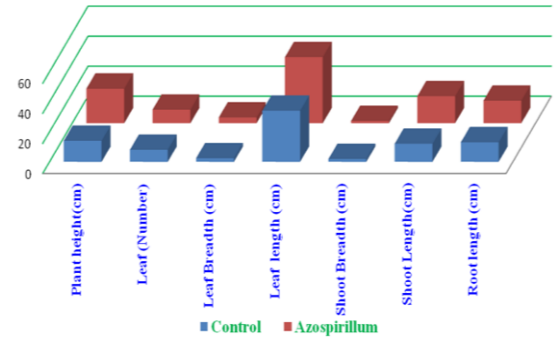

Figure.4: Effect of *Azospirillum brasilense* on *Zea mays* Linn. Pot growth culture (45 days) [Mean value in %]

Table.1: Effect of *Azospirillum brasilense* on *Zea mays* (30 and 45 days after experiment).

S.No.	Morphometric characters	Control plant (Mean value)		Treated with *Azospirillum* (Mean value)	
		30 days	45 days	30 days	45 days
1	Plant Height (cm)	11	14	20	23
2	Leaf in number	5	8	7	9
3	Length of leaf (cm)	29	34	38	44
4	Breadth of leaf (cm)	2	2.4	3.6	3.8
5	Shoot length (cm)	9	12	13	18
6	Shoot breadth (cm)	0.8	1.9	1.1	1.5
7	Root length(cm)	9	13	12	15

On 45th day, the experiment plant showed the maximum height (23cm), number of leaves (9 numbers), leaf length (44cm) and breadth (3.8cm), shoot length (18cm) and breadth (1.5cm) and root length (15cm) treated with *A. brasilense* than control plants (Table -1; Fig- 4). In the Azospirillum treated 30 and 45 days old *Zea mays* plant, the height increased (11cm), the number of leaves was increased (9 number), and leaf length mean value was higher than the control plants. Breadth of leaves of *Zea mays* L., were significantly increased when compared to control plant.

The shoot length was significantly increased (18cm) than control plant (13cm). The shoot breadth was increased 0.5cm more than the control plants. This experiment enhanced plant growth parameters with the application of bio-fertilizer *Azospirillum* was in accordance with Yadav *et al.*,[17].

CONCLUTION

The effect of *Azospirillum brasilense* on the maize plant revealed that the soil amendment of the bio-fertilizer has its own impact on the test plant growth parameters at two different ages.

ACKNOWLEDGEMENTS

The authors thank the Head, Department of Botany and Principal of Arignar Anna Government Arts College, Namakkal -637 002, for providing the necessary facilities to carry out this research work.

REFERENCES

[1] Subba Rao, NS (1982). Biofertilizers in agriculture 2nd edition (New Delhi: Oxford and IBH Publ. Co.).

[2]Chunchun K, Agrawal MM, and Gupta BR (1998) *Azospirillum* and its potential as biofertilizer. *Fertiliser. News*, 43(11):47, 49-50.

[3] Shekh BA (2006) Biotechnology and bio-fertilization: Key to sustainable agriculture. Scientific issue, (1) Das, K., R.Dang, T. N.

[4] Shevananda (2008) Influence of bio-fertilizers on the availability of nutrients (N, P and K) in soil in relation to growth and yield of Stevia rebaudiana grown in South India. *International Journal of Applied Research in Natural Products,* 1(1): 20-24.

[5]Audrac Erickson(2006) Changing the conversation about high fructose corn syrup. In: Corn refiners association, Washington, 4th edition.

[6]. Ravikumar. S., G. Ramanathan, N. Suba and L.Jeyaseeli, (2002). Quantification of halophilic *Azospirillum* from mangroves, *Indian J. Mar. Sci.,* 31(2):157-160.

[7]. Fulchieri. M. and L. Frioni. (1994). *Azospirillum* inculation on maize(*Zea mays*): Effect of yild in a field experiment in central Argentina.Soil. *Biol Biochem.*, 26: 921-924.

[8] Chabot R, Antoun H and Cescas MP (1993) Stimulation de la croissance du maïs et de la laitue romaine par des microorganismes dissolvant le phosphore inorganique. *Canadian J. Microbiol*., 39: 941–947.

[9] Darzi MT, Ghavaland A and Rajali F (2009) The effects of biofertilizers application on N, P, K assimilation and seed yield infennel (*Foeniculum vulgare* Mill. *Iranian J. medicinal and Aromatic plants*. (25),(1).

[10] Shaban M (2013a) Application of seed equilibrium moisture curves in agro physics. *International journal of Advanced Biological and Biomedical Research*. 1(9): 885-898

[11] Shaban M (2013b) Biochemical aspects of protein changes in seed physiology and germination. *International journal of Advanced Biological and Biomedical Research*. 1(8): 885-898

[12] Azimi SM, Farnia A, Shaban M and Lak M (2013) Effect of different biofertilizers on Seed yield of barley (*Hurdeom vulgar* L.), Bahman cultivar. *International journal of Advanced Biological and Biomedical Research*. 1(5): 538-546

[13] Mudenoor MG, Geeta Goudar and Savalgi VP (2007). Response of maize (*Zea mays* L.) to seed treatment of micronutrients supplemented *Azospirillum* biofertilizer. *Internat. J. Plant Sci.* 2(2): 197-201

[14] Kirtikar KR and Basu BD (1999). In: Indian Medicinal Plant, vol. III, International Book Distributors, Dehradun, India, pp.2262-2263.

[15] Tarrand Jeffrey J, Krieg, Noel R, Döbereiner Johanna (1978). "A taxonomic study of the *Spirillum lipoferum* group, with descriptions of a new genus, *Azospirillumgen*. nov. and two species, *Azospirillum lipoferum*(Beijerinck) comb. nov. and *Azospirillum brasilense* sp. nov.". *Canadian Journal of Microbiology* 24 (8): 967–980.

[16] Tien TM, Gaskins MH, Hubbell DH (May 1979). Plant growth substances produced by *Azospirillum brasilense* and their effect on the growth of Pearl Millet (*Pennisetum americanum* L.). *Applied and environmental microbiology* 37(5): 1016-24.

[17] Yadav BS, Gupta AK and Singh S (2005). Studies on the effect of Nitrogen, plant spacing and biofertilizers on growth parameters in tuberose cv. double , *Indian J.Horti. Sci.,*34(1-2):78-80.

Citation : Subramanian G, Sowmiya R, Indhu M, Punitha S, Sasikala J and Jayanthi V (2014) Studies on the Effect of Azospirillum brasilense on Growth Parameters in Zea mays Linn, Int J Adv Interdis Res, 1(9): 8-11.

Received : August 04,2014 | **Revised :** August 10,2014 | **Accepted :** August 18,2014 **| Published:** August 26,2014