



Influence of Bio-Priming on Field Performance and Yield in Maize Hybrid

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Abstract

A field experiment was conducted during kharif 2014 at the Main Agricultural Research Station, UAS, Dharwad to study the influence of bio-priming on field performance and yield in maize hybrid GH-0727. The treatments imposed are Control, KH_2PO_4 (1%), *Azospirillum brasilense* (10%), *Azospirillum brasilense* (20%), *Pseudomonas striata* (10%), *Pseudomonas striata* (20%), *Azospirillum brasilense* (10%) + KH_2PO_4 (1%), *Azospirillum brasilense* (20%) + KH_2PO_4 (1%), *Pseudomonas striata* (10%) + KH_2PO_4 (1%) and *Pseudomonas striata* (20%) + KH_2PO_4 (1%). The results of the investigation revealed that among the bio-priming treatments *Azospirillum brasilense* (20%) recorded significantly higher field emergence (96.3%), plant height at harvest (210 cm), minimum number of days to 50 percent tasseling and silking (53 and 57.33 respectively) and yield (68.28 q/ha). The yield parameters like cob length, cob girth, number of rows per cob, number of seeds per row and yield per plant were higher with *Azospirillum brasilense* (20%), which was on par with *Pseudomonas striata* (20%) and minimum was recorded with non primed control. The study indicated that seed bio-priming with *Azospirillum brasilense* (20%) significantly enhanced the crop growth, performance and yield as compared to control. The study indicated that the bio-priming with *Azospirillum brasilense* (20%) increased the yield by 22.8 per cent which was on par with *Pseudomonas striata* (20%).

Keywords: Bio-priming; Hybrid; Maize; *Azospirillum brasilense*; *Pseudomonas striata*; KH_2PO_4

Introduction

Maize (*Zea mays L.*) is one of the important cereal crop in the world. As it has higher yield potential than any other cereals hence it is referred to as "miracle crop" or the "queen" of cereals. Maize is being a C_4 plant has the higher potential for synthesis of carbohydrates. Dr. Norman E. Borlaug believes that maize has the highest yield potential among the cereals. In the last two decades there was a revolution in rice and wheat and the next few decades will be known as maize era. By 2020 AD the requirement of maize in various sectors will be around 100 million tons of which the poultry sector demand alone will be 31 million tons. The only option is to increase the maize productivity or selection of good genotypes and application of proper production management techniques.

The seed bio-priming is an effective seed treatment to increase the rate, uniformity of emergence and crop establishment

in most of the crops especially in advanced countries in last two decades. It integrates the biological and physiological aspects of enhancing growth, disease control and increase in yield, which involves coating the seed with biological agents and incubating the seed under warm, moist conditions. Excessive and continuous use of chemical fertilizers coupled with pesticides and fungicides have damaged the cultivation and productivity. Now a days the chemical fertilizers are replaced by environment friendly bio-fertilizers.

The actual yield of maize is affected by many things that are insufficient nutrients would decrease 10-22 per cent of maize yield [1]. Germination is the first step in the plant growth, which is one of the critical stages in the life cycle of plants and it is a key process in germination [2]. Germination ability of seeds in unfavorable conditions, the more chance of establishment of the plant and will lead to higher density, which is resulting in increased performance [3]. The rapid and uniform field emergences are two essential pre-requisites to in-

crease yield, quality, and ultimately profits in crops. Uniformity and percentage of seedling emergence of direct-seeded crops have a major impact on final yield and quality. Slow emergence results in smaller plants and seedlings, which are more vulnerable to soil-borne diseases. Hence, an attempt has been made to determine the "Influence of bio-priming on field performance and yield in maize hybrid.

Materials and Methods

The field experiment was carried out at the Main Agricultural Research Station UAS, Dharwad during kharif 2014 to evaluate the influence of bio-priming on field performance and yield in maize hybrid GH-0727. The experiment was laid out in randomized complete block design with ten treatments viz., (T1) Control, (T2) KH_2PO_4 (1%), (T3) *Azospirillum brasilense* (10%), (T4) *Azospirillum brasilense* (20%), (T5) *Pseudomonas striata* (10%), (T6) *Pseudomonas striata* (20%), (T7) *Azospirillum brasilense* (10%) + KH_2PO_4 (1%), (T8) *Azospirillum brasilense* (20%) + KH_2PO_4 (1%), (T9) *Pseudomonas striata* (10%) + KH_2PO_4 (1%) and (T10) *Pseudomonas striata* (20%) + KH_2PO_4 (1%) and replicated thrice. The seeds of maize hybrid GH-0727 collected from the National Seed Project, UAS, Dharwad. The seeds were soaked for 12 hrs in bio-priming solutions which were prepared by dissolving the bio-agents in the distilled water as per the concentration. Later seeds were dried back to their original moisture content under the shade and sown in the field for the further evaluation. The five tagged plants from the net plot were used to record the observations. Observations on growth parameters like plant height at harvest (cm), flowering parameters like days to 50 per cent flowering and yield parameters like cob length (cm), cob girth (cm), number of rows per cob, number of seeds per row, grain yield plant⁻¹ and grain yield (q ha⁻¹). The data recorded were subjected to the statistical analysis as per Panse and Sukhatme. (1967) [4].

Results and Discussion

Perceptible differences were observed with regard to growth, flowering and yield parameters among the bio-priming seed treatments. The growth parameters like field emergence and plant height at harvest showed significant variation due to bio-priming seed treatments (Table 1). Among the bio-priming treatments *Azospirillum brasilense* (20%) recorded the highest field emergence (96.3%) and plant height at harvest (210 cm), which were on par with *Pseudomonas striata* (20%) (96% and 209 cm respectively), where as lowest field emergence and plant

height noticed with control (81.5%, 191 cm). The seed bio-priming with *Azospirillum brasilense* might have stimulated the hypocotyl and epicotyls growth as induces cell elongation by inducing secretion of GA3 resulting in rapid emergence. Similar observations were made by Senthil Kumar and Panneerselvam. (2012) [5] in rice and Shirin mokari., *et al.* (2012) [6] in corn. They suggested that *Azospirillum brasilense* treatment may be a valid strategy to shorten the emergence time and to improve plant stand. The beneficial effect of exogenous application of *Azospirillum brasilense* to seeds might be due to the translocation of GA3 to the aerial part of plants and this perhaps occurs to an extent that is enough to increase epicotyl size and the consequent increase in first node height which is sufficient to positively affect plant height. The enhanced plant height may also be due to the improved and faster plant emergence in bio-primed seeds which might have created nitrogen fixation by the plant, phosphorous solubilization and also cooperative competition among the plants for light and resulted in taller plants. The results are in agreement with the findings of the Kamran shaukat., *et al.* (2006) [7].

A progressive decrease in the number of days to 50 per cent flowering was noticed because of bio-priming seed treatments (Table 1). The least number of days for 50 per cent tasseling was noticed with *Azospirillum brasilense* @ 20 per cent (53) as well as *Pseudomonas striata* @ 20 per cent (53), where as more number of days taken by the control (57.39). Similar to days to 50 per cent tasseling the days for 50 per cent silking also showed significant variation due to bio-priming seed treatments. Among the treatments the bio-priming with *Azospirillum brasilense* (20%) or *Pseudomonas striata* (20%) recorded least number of days (57.33) and more number of days taken by the control (61.67). The days required to attain 50 per cent flowering was reduced with bio-priming treatments. The *Azospirillum brasilense* @ 20 per cent and *Pseudomonas striata* @ 20 per cent induced tasseling early by 3.69 days and the same treatments induced early silking by 4.34 days over untreated control. The increased rate of emergence could be correlated with early flowering and early harvest observed in the present study. Similar observations in advancement of flowering were also reported by Niranjana Raj., *et al.* (2004) [8] in pearl millet. Meysam Beigzade., *et al.* (2013) [9] also reported that seed bio-priming in maize resulted in faster emergence, more vigorous plant population, earlier flowering.

The seed bio-priming treatments showed significant increase in the yield of maize hybrid GH-0727 by recording significantly higher yield parameters as compared to control (Table 2). The bio-priming seed treatment with *Azospirillum brasilense* (20%) recorded higher

Treatments	Field emergence (%)	Plant height at Harvest (cm)	Days to 50% Tasseling	Days to 50% Silking
T ₁ : Control	81.5 (64.5)*	191	57.39	61.67
T ₂ : KH ₂ PO ₄ @ 1%	92.3 (73.8)	204	55.00	58.33
T ₃ : Azospirillum brasilense @ 10%	91.7 (73.2)	202	55.33	59.00
T ₄ : Azospirillum brasilense @ 20%	96.3 (78.9)	210	53.00	57.33
T ₅ : Pseudomonas striata @ 10%	92.0 (73.5)	202	54.67	58.67
T ₆ : Pseudomonas striata @ 20%	96.0 (78.5)	209	53.00	57.33
T ₇ : Azospirillum brasilense @ 10%+ KH ₂ PO ₄ @ 1%	92.9 (74.5)	203	53.67	58.00
T ₈ : Azospirillum brasilense @ 20%+ KH ₂ PO ₄ @ 1%	95.4 (76.7)	209	53.33	57.67
T ₉ : Pseudomonas striata @ 10%+ KH ₂ PO ₄ @ 1%	92.9 (74.5)	203	54.00	58.33
T ₁₀ : Pseudomonas striata @ 20% + KH ₂ PO ₄ @ 1%	95.4 (76.7)	209	53.33	57.67
Mean	92.5 (74.5)	204.2	54.3	58.40
S.Em ±	0.59	2.55	0.29	0.29
CD (0.05)	1.76	7.57	0.87	0.86

*Figures in the parenthesis indicate arcsine values.

Table 1: Field emergence (%), plant height (cm) and days to 50% tasseling and silking as influenced by bio-priming in maize hybrid.

yield parameters viz., cob length (18.83 cm), cob girth (15.17), number of rows per cob (14.67), number of seeds per row (33.73), yield per plant (118.33g) and yield per hectare (68.28q ha⁻¹) and minimum was recorded with control (16.37 cm, 13.66 cm, 12.67, 29.27, 110.12g and 55.58q ha⁻¹ respectively). The increase in the yield of bio-primed seeds may be attributed to increase in the yield contributing parameters cob length, cob girth, number of rows per cob, number of grains per row, and yield per plant seems to be the important components closely related to yield per ha. Among the treatments the highest percent increase in the grain yield per hectare was recorded to the tune of 22.8 per cent by *Azospirillum brasilense* @ 20 per cent. This influence of bio-fertilizers on the grain yield might be through their effect

on actively growing regions in such a way that they encourage nitrogen fixation, phosphorous solubilization and mobilize the nutrients absorbed elsewhere towards the shoot resulting in better vegetative growth and subsequent yield [10] and Nezarat and Gholami (2009) [11]; the results of which, duly agree with the findings of the present investigation.

Conclusion

The present investigation revealed that the seed bio-priming with *Azospirillum brasilense* (20%) enhanced the seed quality and grain yield by 22.8 per cent which was on par with *Pseudomonas striata* (20%) 21.4 per cent as compared to control.

Treatments	Cob length (cm)	Cob girth (cm)	No. of rows/Cob	No. of grains/row	Grain yield/plant (g)	Grain yield (q/ha)
T ₁ : Control	16.37	13.66	12.67	29.27	110.12	55.58
T ₂ : KH ₂ PO ₄ @ 1%	18.25	14.34	13.87	31.07	114.31	58.23
T ₃ : Azospirillum brasilense @ 10%	17.90	14.09	13.47	30.67	113.30	57.43
T ₄ : Azospirillum brasilense @ 20%	18.83	15.17	14.67	33.73	118.33	68.28
T ₅ : Pseudomonas striata @ 10%	18.27	14.37	13.60	30.80	113.60	57.96
T ₆ : Pseudomonas striata @ 20%	18.79	15.13	14.40	33.53	117.83	67.49
T ₇ : Azospirillum brasilense @ 10%+ KH ₂ PO ₄ @ 1%	18.35	14.21	13.60	31.47	114.87	59.29

T ₈ : Azospirillum brasilense @ 20%+ KH ₂ PO ₄ @ 1%	18.61	14.87	14.13	32.60	116.00	63.26
T ₉ : Pseudomonas striata @ 10%+ KH ₂ PO ₄ @ 1%	18.35	14.25	13.87	31.40	114.80	59.02
T ₁₀ : Pseudomonas striata @ 20% + KH ₂ PO ₄ @ 1%	18.56	14.72	14.00	32.60	115.83	62.99
Mean	18.23	14.48	13.83	31.71	114.90	60.95
S.Em ±	0.13	0.11	0.21	0.40	0.75	0.56
CD (0.05)	0.39	0.32	0.62	1.20	2.23	1.67

Table 2: Yield and yield attributing parameters as influenced by bio-priming in maize hybrid GH-0727.

Bibliography

- Subedi K and Ma B. "Assessment of some major yield limiting factors on maize production in a humid temperate environment". *Field Crop Research* 110 (2009): 21-26.
- De Villiers AJ, *et al.* "Germination of three Namaqualand pioneer species, as influenced by salinity, temperature and light". *Seed Science and Technology* 22 (1994): 427-433.
- Baalbaki RZ., *et al.* "Germination and seedling development of drought tolerant and susceptible wheat under moisture stress". *Seed Science and Technology* 27 (1999): 291-302.
- Panse VG and Sukhatme PV. "Statistical Methods for Agricultural Workers, ICAR Publication, New Delhi (India), (1967): 167-174.
- Senthil Kumar R and Panneerselvam A. "Studies on the effect of different native strains of Azospirillum on paddy (*Oryza sativa* L.)". *Journal of Microbiology and Biotechnology Research* 2.6 (2012): 888-893.
- Shirin Mokari F, *et al.* "Effect of seed inoculation with bio-fertilizer on germination and early growth of corn". *International Re-search Journal of Applied and Basic Sciences* 3.5 (2012): 1097-1102.
- Kamran Shaukat, *et al.* "Growth responses of Helianthus annuus to plant growth promoting rhizobacteria used as a biofertilizers". *International Journal of Agricultural Research* 1.6 (2006): 573-581.
- Niranjan Raj S., *et al.* "Seed bio-priming with Pseudomonas striata fluorescens isolates enhances growth of pearl millet plants and induces resistance against downy mildew". *International Journal of Pest Management* 50.1 (2004): 41-48.
- Meysam Beigzade., *et al.* "Effect of combined application of phosphate fertilizers and phosphate solubilizing bacteria on yield and yield components of maize single cross 704". *International Journal of Agriculture and Crop Sciences* 6.17 (2013): 1179-1185.
- Mohammad Yazdani., *et al.* "Effect of phosphate solubilization microorganisms (PSM) and plant growth promoting rhizobacteria (PGPR) on yield and yield components of corn (*Zea mays* L.)". *World Academy of Science, Engineering and Technology* 3 (2009): 01-26.
- Nezarat S and Gholami A. "Screening plant growth promoting rhizobacteria for improving seed germination, seedling growth and yield of maize". *Pakistan Journal of Biological Sciences* 12.1 (2009): 26-32.

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