

Research Article

Effect of Different Levels of P and Liquid Biofertilizers on Growth, Yield Attributes and Yield of Maize

A. P. Sivamurugan^{1*}, R. Ravikesavan¹, A.K. Singh² and S.L. Jat²

¹Department of Millets, Tamil Nadu Agricultural University, Coimbatore, Tamilnadu, India

²Indian Institute of Maize Research, Ludhiana, India

Abstract

Field experiment was carried out at Department of Millets, Tamil Nadu Agricultural University, Coimbatore during *Kharif*, 2016 in sandy clay loam soil to study the effect of different levels of P with varied liquid biofertilizers on growth, yield attributes and yield of maize. Based on the results, it is concluded that 60 kg P₂O₅/ha + NPK consortia are the optimum level of P and suitable liquid biofertilizer for obtaining higher grain yield (5308 kg ha⁻¹), net return (Rs. 44,834/ha) and B: C ratio (2.02).

Keywords: Maize, phosphorus, liquid biofertilizers, growth and yield

*Correspondence

Author: A.P. Sivamurugan

Email: apacsivamurugan@gmail.com

Introduction

Maize (*Zea mays* L.) is the third most important cereal crop in India after rice and wheat and it is cultivated in 8.40 million ha. with a production of 19.9 million tonnes having an average productivity of 2345 kg ha⁻¹. The low productivity is attributed to multivarious problems *viz.*, drought, improper planting density, environmental factors, imbalanced nutrient management practices, etc. Among these, nutrient management plays a pivotal role in influencing the yield as maize being an exhaustive crop requires a large quantity of nutrients during different growth periods. Balanced and optimum use of nitrogen, phosphorus and potassic fertilizers plays a significant role in increasing the yield of maize [1] and their contribution is 40 - 45 per cent.

The escalating cost of inorganic fertilizers, environmental hazards associated with them and failure in sustaining yields have given way for integrated use of organic and inorganic sources of nutrients, which will help to mitigate the abeyance state of soil thus improving biological power of the soil. Sustainable yield levels could be achieved only by the usage of organic sources of nutrients and chemical fertilizers [2, 3]. In respect of organic sources of nutrients, biofertilizers form an integral part of nutrient supply system. Liquid biofertilizer is a special formulation containing high number of desired microorganism with high shelf life and zero contamination. They are cost effective and as a source of plant nutrients to supplement inorganic fertilizers. These microbial inoculants help in increasing crop productivity through increased biological nitrogen fixation, increased availability or uptake of nutrients by plants through solubilization or increased absorption, stimulation of plant growth through hormonal action or antibiosis etc. Keeping in view the above facts, the present experimentation was conducted to study the effect of different levels of P with varied liquid biofertilizers on growth, yield attributes and yield of maize.

Materials and Methods

Field experiment was carried out at Department of Millets, Tamil Nadu Agricultural University, Coimbatore during *Kharif*, 2016 to study the effect of different levels of P with varied liquid biofertilizers on growth, yield attributes and yield of maize. The soil was sandy clay loam and low in available N, medium in available P and high in available K with a pH of 8.30. The experiment was laid out in a Randomized Complete Block Design (RCBD) with the following treatments *viz.*, T₁ - Control (Recommended N - 250 kg/ha and K - 75 kg/ha), T₂ - PSB I, T₃ - PSB II, T₄ - NPK consortia, T₅ - 60 kg P₂O₅/ha, T₆ - 30 kg P₂O₅/ha + PSB I, T₇ - 60 kg P₂O₅/ha + PSB I, T₈ - 30 kg P₂O₅/ha + PSB II, T₉ - 60 kg P₂O₅/ha + PSB II, T₁₀ - 30 kg P₂O₅/ha + NPK consortia, T₁₁ - 60 kg P₂O₅/ha + NPK consortia and T₁₂ - 90 kg P₂O₅/ha and replicated thrice. The liquid biofertilizers were treated with the seeds at 50ml/8 kg(1acre). Observations on plant height, 50% tasseling, yield attributes and yield were recorded (**Figure 1**).

Results and Discussion

Effect of different levels of P with varied liquid biofertilizers on growth and yield attributes of maize

Experimental results revealed that different levels of P and various liquid biofertilizers evinced no significant influence on plant height at harvest (**Table 1**). Nevertheless, T₁ - control (Recommended N and K) recorded

significantly the higher plant height (222.3 cm) at harvest which was followed by T₁₁ - 60 kg P₂O₅/ha + NPK consortia (210.4cm). This might be due to prolonged vegetative growth which increased the plant height. These results are in agreement with Khalil *et al.*, 1988 [4] who reported that plant height increased with increase in nitrogen and potassium rates. With respect to 50% tasseling and 50% silking, the treatments failed to exert any significant influence. There was no significant influence on yield attributes by the different treatments. However, T₁ - control (Recommended N and K) registered higher cob length (19.3 cm), cob girth (14.7 cm), no. of grain rows/cob(14.3), no. of grains/row (36.3) and 100 seed weight (38.7 g). The result confirms the findings of Sharar *et al.* 2003 [5], who reported that the yield attributes increased with increased levels of fertilizer. (**Figure 2**)



Figure 1 Seed treatment with Liquid biofertilizers

Among the different levels of P and liquid biofertilizers, T₁₁ - 60 kg P₂O₅/ha + NPK consortia recorded higher cob length (17.2 cm), cob girth (14.4 cm), no. of grain rows/cob (13.7), no. of grains/row (34.7) and 100 seed weight(37.6 g) and it was comparable with T₁₀ (30 kg P₂O₅/ha + NPK consortia), T₉ (60 kg P₂O₅/ha + PSB II) and T₇ (60 kg P₂O₅/ha + PSB I). This might be due to solubilization of bound form of soil minerals and enhanced availability of nutrients in the soil for plant growth and development by the liquid biofertilizers. The results are in accordance with the findings of Sheraz Mahdi *et al.*2010 and Gomathy *et al.* (2007) [6, 7]. (**Figure 3**)

Table 1 Effect of different levels of P and liquid biofertilizers on growth and yield attributes of maize

Treatments	Plant height (cm)	Days to 50% tasseling	Days to 50% silking	Cob length (cm)	Cob girth (cm)	Grain rows/cob	Grains/row	100-seed weight (g)
T ₁	222.3	53.3	57.0	19.3	14.7	14.3	36.3	38.7
T ₂	197.3	50.3	54.3	15.3	13.4	13.0	32.2	36.0
T ₃	198.1	50.3	54.3	15.3	13.4	13.0	32.5	36.0
T ₄	199.7	50.3	54.0	15.4	13.7	13.0	32.7	36.3
T ₅	193.3	49.7	53.3	14.8	13.2	12.4	32.0	35.7
T ₆	202.4	50.7	54.7	15.9	13.9	13.5	33.1	36.3
T ₇	204.9	51.0	55.3	16.4	14.1	13.5	34.0	37.0
T ₈	203.6	50.7	54.3	16.1	14.0	13.5	33.3	36.7
T ₉	205.7	51.0	55.0	16.5	14.1	13.6	34.3	37.3
T ₁₀	207.2	51.3	55.7	16.8	14.2	13.7	34.3	37.3
T ₁₁	210.4	51.7	55.7	17.2	14.4	13.7	34.7	37.6
T ₁₂	195.2	49.7	53.7	14.9	13.2	12.4	32.0	35.7
CD	NS	NS	NS	NS	NS	NS	NS	NS

Effect of different levels of P and liquid biofertilizers on yield and economics of maize

In respect of grain yield, T₁ - Control (Recommended N and K) recorded the highest grain yield of 6523 kg ha⁻¹ and it was significantly superior to T₁₁ - 60 kg P₂O₅/ha + NPK consortia. This might be due to higher levels of N and K favoured adequate supply of nutrients to the plant resulting in better growth which in turn led to better physiological process and movement of photosynthates to sink. The results are in accordance with the findings of Paramasivan *et al.* (2011) [8]. Among the different levels of P and liquid biofertilizers, T₁₁ - 60 kg P₂O₅/ha + NPK consortia recorded higher grain yield of 5308 kg ha⁻¹, which was comparable with T₁₀, T₉, T₇ and T₈. This was ascribed to increased microbial activity in the rhizosphere which resulted in solubilization of unavailable form of nutrients and production of growth promoting substances by the liquid biofertilizers thus leading to improved seedling germination, vigour,

emergence and productivity. The results confirm the findings of Kanimoli *et al.*, 2004, Yadav *et al.*, 2011, El-Kholy *et al.*, 2005 and Puenete *et al.*, 2009 [9-12]. The highest stover yield was recorded in T₁ (11185 kg ha⁻¹) which was significantly superior to T₁₁.

Regarding economics, the highest net return (Rs. 63,292/ha) and BC ratio (2.38) were registered in T₁. In respect of different levels of P and liquid biofertilizers, application of 60 kg P₂O₅/ha + NPK consortia registered the highest net return (Rs. 44,834/ha) and BC ratio (2.02) (**Table 2**).



Figure 2 Growth and development of maize influenced by 60 kg P₂O₅/ha + NPK consortia (T₁₁)

Table 2 Effect of different levels of P and liquid biofertilizers on yield and economics of maize

Treatments	Grain yield (kg/ha)	Stover yield (kg/ha)	Net returns (Rs./ha)	BC ratio
T ₁	6523	11185	63292	2.38
T ₂	4461	7718	33629	1.82
T ₃	4493	7873	34264	1.84
T ₄	4552	7975	35251	1.86
T ₅	4363	7548	29189	1.67
T ₆	4691	8105	35826	1.84
T ₇	4896	8471	37842	1.86
T ₈	4785	8278	37409	1.88
T ₉	4967	8593	39029	1.88
T ₁₀	5092	8809	42540	2.00
T ₁₁	5308	9283	44834	2.02
T ₁₂	4394	7702	28388	1.63
CD	821	1843	13101	0.30



Figure 3 Yield of maize as influenced by seed treatment with biofertilizers and levels of P. T₁-Recommended N & K; T₁₁ - 60 kg P₂O₅/ha + NPK consortia ; T₁₀- 30 kg P₂O₅/ha + NPK consortia; T₉- 60 kg P₂O₅/ha + PSB II

Conclusion

From the experimental results, it could be concluded that application of 60 kg P₂O₅/ha + NPK consortia are the optimum level of P and suitable liquid biofertilizer for obtaining higher grain yield (5308 kg ha⁻¹), net return (Rs. 44,834/ha) and B: C ratio (2.02).

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