

Original Research Article

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## Comparative Efficiency of Bio-phos and Phosphate Solubilizing Bacteria on Castor Yield at Different Levels of Phosphorus Fertilizer under Rainfed Conditions

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### ABSTRACT

Field experiments were conducted during 2014-15, 2015-16 and 2016-17 at Zonal Agricultural and Horticultural Research Station, Babbur farm, Hiriya, Karnataka, India to study the efficiency of bio-phos and phosphate solubilizing bacteria on castor yield at different levels of phosphorus fertilizer under rainfed conditions. The experiment was laid out in randomized block design with three replication and nine treatments. Three years pooled results indicated that there was a linear response of seed yield (1620 kg/ha) and higher economics like gross return (Rs. 54320/ha), net return (Rs. 35135/ha) and B:C ratio (2.6) due to application of 40 kg P<sub>2</sub>O<sub>5</sub>/ha + PSB 20g/kg castor seed has compared to control and seed treatment with biophos alone, respectively. Further in the farmer's field yield of Rangappa s/o Badagi (1627 kg/ha), Palanna s/o Kamaiah (1748 kg/ha) and Prahalada s/o Obalajja (1695 kg/ha) was recorded in the improved practice treatment as compared to farmer practice. The average yield of three demos was (1690 kg/ha), gross return (Rs. 60840), net return (Rs. 36259) and B:C ratio (2.46) showed highest in the improved practice as compared to farmer practice.

#### Keywords

Biophos, PSB, Phosphorus, Castor, DCH-177

#### Article Info

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### Introduction

Castor is an important non-edible oilseed crop of the arid and semi-arid regions. It's yield is most useful and economically important plant oil having vast and varied industrial applications such as lubricants, surfactants, surface coating, cosmetics, plasticizers, resins, paints, pharmaceuticals, adhesives, waxes, polishes, varnishes, perfumes,

flavours, textile dyes, textile finishing agents, nylon etc. India is the world's largest producer of castor contributing to around 80 per cent of total world production and dominating the global trade with a share of more than 10 lakh tonnes of castor seed and around 5.5 lakh tonnes of castor oil, India meets more than 80 per cent demand of castor oil, thereby enjoying a dominant position in the world castor scenario (Shinde *et al.*,

2018). Phosphorus (P) is considered to be one of the most essential macro-elements required for growth and development of plants and it is associated with several key functions of the plants, which include development of roots, strengthening the stalks and stems, formation of flowers and seeds, crop maturity and quality of the production, nitrogen fixation in legumes and strengthening the plant against diseases (Saber *et al.*, 2005). Phosphorus is added in the form of phosphatic fertilizers, part of which is utilized by plants and the remainder converted into soluble fixed forms. To circumvent phosphorus deficiency, phosphate-solubilizing microorganisms (PSM) could play an important role in supplying phosphate to plants in a more environmentally-friendly and sustainable manner. Biophos (*Chaetomium globosum*) is a naturally occurring phosphorus mobilizing organisms when applied through seed treatment, release huge amount of phosphatases, phytase and organic acids which may help in mobilization of native unavailable phosphorus (Tarafdar and Gharu, 2006). In castor plant with an important aspect of its nutrition that will help in taking decision to improve its production and management. In view of above consideration the present investigation was carried out entitled comparative efficacy of phosphate solubilizing bacteria and bio-phos on castor yield at different levels of phosphorus fertilizer under rainfed conditions.

### **Materials and Methods**

The field experiment was conducted during rainy seasons of 2014-15, 2015-16 and 2016-17 at Zonal Agricultural and Horticultural Research Station, Babbur farm, Hiriyur, Karnataka, India under rainfed conditions. The soil of the experimental plot was block in texture and alkaline in reaction. The soil has an organic carbon content of 0.41 per cent and was low in available nitrogen 205 kg/ha, high

in phosphorus 23.0 kg/ha and potash 321 kg/ha. The experiment was laid out in randomized block design with three replications. The experiment consisted of nine treatment combinations of seed treatment with PSB inoculants @ 20g/ kg castor seed (cv. DCH 177) with different doses of phosphorus (20 kg, 40 kg and 60 kg/ha). Seed treatment with bio-phos@ 30g/50g of castor was done by sticking solution (jaggery solution @ 125g/liter water) on seeds and it was mixed thoroughly. Seeds were air dried in shade after treatment and then used for sowing. A recommended dose of nitrogen, potash and seed rate was applied. The crops were sown under rainy season but after cessation of monsoon five irrigations each of 50 mm depth were given to castor crop at an interval of 15 days. Pest and disease control measures were taken as and when required. Castor picked at 90, 120, 150 and 180 days after sowing. The total rainfall received during 2014-15, 2015-16 and 2016-17 was 852.4 mm, 784.8 mm and 312.2 mm, respectively.

Based on these treatment results, the best treatment of 40 kg P<sub>2</sub>O<sub>5</sub>/ha + PSB inoculants @ 20g /kg castor seed was carried to farmers trail and farmer practice as a check for comparative study. Three farmer fields with an area of one acre were selected at Gudihalli village, Talaku Hobli, Challakere Tq. Chitradurga District for validation of results and technology. The initial nutrient status of farmer fields were medium available nitrogen (280 kg/ha), phosphorus (22 kg/ha) and potassium (299 kg/ha) and low Zinc (0.25 ppm) content.

### **Results and Discussion**

#### **Growth and yield attributes**

Results presented in table 1 revealed that the growth and yield attributes significantly influenced by different treatments.

**Table.1** Effect of phosphate solubilizing bacteria, bio-phos and different levels of phosphorus on yield and economics of castor

Treatments	Seed yield (Kg/ha)				Plant height up to primary raceme (cm)	Number of branches /plant	Number of Spikes / plant	Primary spike length (cm)	Number of capsules per spike	Gross Returns (Rs./ ha)	Net Returns (Rs./ ha)	B : C Ratio
	2014	2015	2016	Pooled								
<b>T<sub>1</sub>- Bio-phos (30gm/50gm of seeds)</b>	1633	1803	597	1344	55	5.6	6.0	46.1	56.0	44287	25864	2.3
<b>T<sub>2</sub>- Control</b>	1511	1724	545	1260	49	5.2	5.5	40.4	49.5	40669	21805	2.1
<b>T<sub>3</sub>- Seed treatment with PSB (UAHS, Shivamogga)</b>	1630	1808	555	1331	52	5.2	5.9	46.8	54.1	43459	25272	2.3
<b>T<sub>4</sub>- 20 kg Phosphorus/ha</b>	1895	1886	558	1446	54	5.4	6.1	48.9	53.7	47696	30722	2.4
<b>T<sub>5</sub>- 20 kg Phosphorus/ha+ T<sub>3</sub></b>	1921	2073	546	1513	55	5.8	6.4	48.8	56.1	49907	31066	2.5
<b>T<sub>6</sub>- 40 kg Phosphorus/ha</b>	1968	2057	644	1556	59	6.0	7.0	49.6	60.4	51903	33096	2.5
<b>T<sub>7</sub>- 40 kg Phosphorus/ha+ T<sub>3</sub></b>	2034	2142	683	<b>1620</b>	60	6.3	7.2	51.5	66.1	54320	35135	2.6
<b>T<sub>8</sub>- 60 kg Phosphorus/ha</b>	1839	2022	582	1481	53	4.8	6.1	47.0	57.1	48981	28929	2.3
<b>T<sub>9</sub>- 60ckg Phosphorus/ha+ T<sub>3</sub></b>	1718	2000	562	1427	51	5.2	6.1	47.0	51.8	46672	25726	2.3
<b>SEm ±</b>	<b>272</b>	<b>61.0</b>	<b>23.3</b>	<b>50.5</b>	<b>1.6</b>	<b>0.4</b>	<b>0.33</b>	<b>1.12</b>	<b>2.25</b>			
<b>CD(P=0.05)</b>	<b>815</b>	<b>184</b>	<b>70.0</b>	<b>151</b>	<b>4.9</b>	<b>1.0</b>	<b>1.0</b>	<b>3.3</b>	<b>6.74</b>			

**Table.2** Castor yield and Economics as influenced by application of Biophos and PSB at different farmers of Challakere taluk

<b>On farm trial No.</b>	<b>Name and address of the farmer</b>	<b>Improved / farmers' practice</b>	<b>Seed yield (kg/ha)</b>	<b>Cost of cultivation</b>	<b>Gross Returns (Rs./ha)</b>	<b>Net returns (Rs./ha)</b>	<b>BCR</b>
<b>1.</b>	Rangappa s/o BadagiObanna, Gudihalli, TalakuHobli, ChallakereTq. Chitradurga District	<b>IP</b>	1627	24506	58572	34066	2.4
		<b>FP</b>	1435	22654	51660	29006	2.3
<b>2.</b>	Palanna s/o Kamaiah, Gudihalli, TalakuHobli, ChallakereTq. Chitradurga District	<b>IP</b>	1748	24961	62928	37967	2.5
		<b>FP</b>	1549	23000	55764	32764	2.4
<b>3.</b>	Prahallada s/o ObalajjaGudihalli, TalakuHobli, ChallakereTq. Chitradurga District	<b>IP</b>	1695	24276	61020	36744	2.5
		<b>FP</b>	1427	23704	51372	27668	2.2
<b>Average of 3 demos</b>		<b>IP</b>	<b>1690</b>	<b>24581</b>	<b>60840</b>	<b>36259</b>	<b>2.46</b>
		<b>FP</b>	<b>1470</b>	<b>23119</b>	<b>52932</b>	<b>29812</b>	<b>2.30</b>

The highest plant height (60 cm), number of branches per plant (6.3), number of spikes per plant (7.2), capsules per spikes (66.10) and length of main spike (51.50 cm) were significantly recorded by seed inoculation with PSB 20g /kg castor seed + 40 kg P<sub>2</sub>O<sub>5</sub>/ha and which is on par with the application of 40 kg Phosphorus/haplant height (59cm), number of branches per plant (6.0), number of spikes per plant (7.0), capsules per spikes (60.4) and length of main spike (49.6cm). Some of these bacteria increase P uptake by the plant belongs to the group of phosphate solubilizing bacteria and as biological fertilizers are used to increase plant growth and yield (Chen *et al.*, 2006). Rhizosphere microorganisms can interact positively in promoting plant growth similar finding was also reported by Tomar *et al.*, (2004).

### Seed yield and economics

Significantly higher seed yield (2034 kg/ha) was recorded when crop was fertilized with 40 kg P<sub>2</sub>O<sub>5</sub>/ha + PSB 20g /kg castor seed. But, it remained at par with 40 kg P<sub>2</sub>O<sub>5</sub>/ha (1968 kg/ha) during 2014-15. While during 2015-16 and 2016-17 the application of 40 kg P<sub>2</sub>O<sub>5</sub>/ha + PSB 20g/kg castor seed resulted in distinct improvement in seed yield (2142 and 683 kg/ha). Three years pooled results indicated that there was a linear response of seed yield (1620 kg/ha) due to application of 40 kg P<sub>2</sub>O<sub>5</sub>/ha + PSB 20g/kg castor seed has compared to control and seed treatment with biophos alone, respectively. Economics of different treatments are presented in table 1. Gross realization, cost of cultivation, net realization and B:C ratio of different treatments was worked out on the basis of current market prices of castor and inputs used. The results indicated that inoculation of 40 kg P<sub>2</sub>O<sub>5</sub>/ha + PSB was recorded higher gross return (Rs. 54320/ha), net return (Rs. 35135/ha) and B:C ratio (2.6) in pooled results

Further in the farmer's field, results were presented in the table-2. All the three farmers field yield of Rangappa s/o Badagi (1627 kg/ha), Palanna s/o Kamaiah (1748 kg/ha) and Prahalada s/o Obalajja (1695 kg/ha) was recorded in the improved practice treatment as compared to farmer practice. The average yield of three demos was (1690 kg/ha), gross return (Rs. 60840), net return (Rs. 36259) and B:C ratio (2.46) showed highest in the improved practice as compared to farmer practice.

This was due to increase P uptake by the plant belongs to the group of phosphate solubilizing bacteria and as biological fertilizers are used to increase plant growth and yield (Chen *et al.*, 2006). The PSB solubilize the fixed soil P and applied phosphates resulting in higher crop yields (Gull *et al.*, 2004). These findings are in the conformity with the result of Singh *et al.*, (2013) and Yadav and Yadav (2015).

From the three years experiments and farmers field data it is concluded that application of 40 kg P<sub>2</sub>O<sub>5</sub>/ha + PSB inoculants 20g/kg of castor seed was more productive and remunerative for castor under rainfed conditions in dry land areas has compared to control and seed treatment with biophos alone, respectively.

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