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Effect of integrated nutrient management on yield and economics of lablab bean (*Lablab purpureus* L.) in lateritic soil of Konkan region of Maharashtra

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Abstract
A field experiment was conducted at the agronomy farm of College of Agriculture, Dr Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra to study the effect of integrated nutrient management (INM) on yield and economics of lablab bean in lateritic soil of Konkan region of Maharashtra. The experiment was laid out in Split Plot Design (SPD) comprising fifteen treatment combinations replicated thrice with an absolute control which was laid out of experimental plot to study the effect of integrated nutrient management on yield and economics of lablab bean as a test crop during *Rabi* season of 2020-21 and 2021-22. The result of the present investigation indicated that for getting maximum yield of lablab bean and fetching highest net returns as well as for improving the soil health, the equal integration of RDN through fertilizers and RDN through poultry manure (PM) with a blend of seed inoculations of phosphorus solubilizing bacteria (PSB) @ 5 mL kg^{-1} and vesicular arbuscular mycorrhiza (VAM) @ 10 g kg^{-1} seed (F_5B_3) was found to be beneficial in lateritic soils of Konkan during *Rabi* season.

Keywords: Integrated nutrient management, biofertilizers, phosphorus solubilizing bacteria, vesicular arbuscular mycorrhiza, yield and economics

Introduction
Lablab bean (*Lablab purpureus* L.) is believed to have originated in India and belongs to the family *Fabaceae*. It is popularly recognized as "Wal" in Maharashtra state. Hot and humid climatic conditions of Konkan region during *Rabi* season are suitable for production of lablab bean. In India, lablab bean is grown as a field crop in Madhya Pradesh, Maharashtra, Andhra Pradesh and Tamil Nadu. It is popularly known as 'Wal' in Konkan region accounting 80 percent of total area under lablab bean in Maharashtra which is about 60,000 ha. Lablab bean is grown in all the districts of Konkan region of Maharashtra *viz*., Thane, Palghar, Raigad, Ratnagiri and Sindhudurg with gram, lentil, horse gram with an average productivity of 537 kg ha^{-1} (Anonymous 2016). The proximate and mineral composition of lablab bean shows that the protein content ranged from 20.46 to 25.47 percent, crude lipid 2.69 to 4.17 percent, ash 3.97 to 4.48 percent and carbohydrates 60.63 to 66.32 percent (Davari *et al.* 2018) [14].
Lablab bean (Wal) is one of the important pulse crop grown in Konkan region of Maharashtra especially for seed purpose. The crop is mostly grown on residual moisture. So, mostly zero tillage is followed in Maharashtra for the cultivation of lablab bean. In Konkan region farmers apply only urea for rice, in rice-based cropping system and the pulse crops are grown on residual moisture after harvest of *Kharif* rice without application of fertilizer or manure. This leads to a great imbalance of plant nutrients, not only resulting in low yield but also degrading the soil to a great extent. To boost up the production on such low fertile soil, efficient use of applied nutrients and maintenance of soil fertility at sustainable level of production is needed. This can only be achieved through integrated use of different sources of nutrients-organics, chemical fertilizers and biofertilizers. This type of technology in lablab bean has not been evaluated widely in farmer's field. Hence, present study was undertaken with the objective to compare yield and economics of lablab bean under integrated nutrient management.

Materials and Methods
Details of experimental site and treatment combinations
A field experiment was conducted at Department of Agronomy, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra to study the effect of integrated nutrient

management (INM) on yield and economics of lablab bean as a test crop in lateritic soil of Konkan region of Maharashtra during *Rabi* season of 2020-21 and 2021-22. The experiment was laid out in in Split Plot Design (SPD) comprising fifteen treatment combinations replicated thrice with an absolute control which was laid out of experimental plot. The main plot treatment was manures and fertilizers consisted of 100% RDF through Fertilizers (F_1), 100% RDN through Vermicompost (F_2), 100% RDN through Poultry manure (F_3), 50% RDN through Fertilizers + 50% RDN through Vermicompost (F_4) and 50% RDN through Fertilizers + 50% RDN through Poultry manure (F_5). While the sub plot treatments were three biofertilizers combinations, consisted of Phosphorus solubilizing bacteria (B_1), Vesicular arbuscular mycorrhiza (B_2) and Phosphorus solubilizing bacteria + Vesicular arbuscular mycorrhiza (B_3).

Yield observation

Seed yield (q ha^{-1})

After each picking, the mature pods obtained from each net plot were dried in the sun, threshed and then it was recorded as dry seed yield and expressed as seed yield q ha^{-1} plot^{-1}.

Stover yield (q ha^{-1})

After harvest of the pods from the plants, stover yield of each net plot was recorded after complete sun drying. Similarly, stover yield was also expressed as stover yield q ha^{-1} plot^{-1}.

Statistical analysis

The experimental data was analyzed statistically by the technique of Analysis of Variance as applicable to Factorial Randomized block design. The significance of treatment difference was tested by 'F' (Variance ratio) test. Critical difference (CD) at 5 percent level of probability was worked out for comparison and statistical interpretation of the treatment means (Panse and Sukhatme 1967) [9].

Benefit: Cost Ratio

Total cost of cultivation was calculated on the basis of cost of inputs used. Gross monetary returns were calculated by multiplying the dry pod yield per hectare (q) with existing market price of lablab bean. Net monetary returns were calculated by deducting the cost of cultivation from gross returns for each treatment. Benefit cost ratio was calculated by using the formula.

$$\text{Benefit cost ratio} = \frac{\text{Net returns (Rs.ha}^{-1})}{\text{Cost of cultivation (Rs.ha}^{-1})}$$

Results and discussion

Effect of Integrated Nutrient Management (INM) on seed yield (q ha^{-1}) of lablab bean

The data presented in Table 1 indicated that the seed yield of lablab bean was significantly influenced by the application of manures and fertilizers with a blend of biofertilizers.

Effect of manures and fertilizers

The data presented in Table 1 when studied revealed that the seed yield of lablab bean as influenced by manures and fertilizers application showed variation from 9.46 to 11.67 and 9.64 to 12.04 q ha^{-1} during the years 2020-21 and 2021-22, respectively. The significantly highest seed yield (11.67 and 12.04 q ha^{-1}) of lablab bean was recorded as a result of the F_5 treatment receiving the equal integration of fertilizers and poultry manure and it was found to be statistically at par with F_3 and F_4 treatments during both the years of investigation.

The response to manures and fertilizers application was significantly evident in seed yield of lablab bean which can be mainly ascribed due to improvement in yield attributes.

Effect of biofertilizers

The data on effect of biofertilizers presented in Table 1 indicated that the seed inoculation of biofertilizers significantly influenced the seed yield of lablab bean and it varied from 9.55 to 11.73 and 9.80 to 12.03 q ha^{-1} during the years 2020-21 and 2021-22, respectively. Statistically significant and the highest seed yield (11.73 q ha^{-1}) of lablab bean was noticed by seed inoculation of phosphorus solubilizing bacteria @ 5 mL kg^{-1} and vesicular arbuscular mycorrhiza @ 10 g kg^{-1} seed (B_3) over rest of the treatments except seed inoculation of phosphorus solubilizing bacteria @ 10 mL kg^{-1} seed (B_1) which was statistically at par with B_3 treatment during the year 2020-21. During the year 2021-22, the application of B_3 treatment recorded statistically significant and the highest seed yield (12.03 q ha^{-1}) of lablab bean over rest of the treatments.

PSB and VAM inoculation showed it's significance on seed yield of lablab bean, which may be attributed to it's phosphate solubilizing ability. PSB and VAM solubilize the fixed native P in soil by production of organic acids in micro environment around the root. Organic acids solubilize more P than inorganic acids at same pH due to the chelating effect of the former. Further, production of CO_2 by soil microorganisms and plant roots leads to formation of carbonic acid which also encourages solubilization of insoluble P (Somani 2002) [14]. These results are in close conformity with the findings reported by several researchers (Subba Rao and Tilak 1984; Ahmad and Jha 1982; Algawadi and Gaur 1988; Vaidya 2005 and Shinde 2013) [15, 1, 2, 16, 12].

Table 1: Effect of Integrated Nutrient Management (INM) on seed, stover and biological yield (q ha^{-1}) of lablab bean

Treat. No.	2020-21			2021-22		
	Seed yield	Stover yield	Biological yield	Seed yield	Stover yield	Biological yield
Effect of manures and fertilizers						
F_1	09.46	20.94	30.40	09.64	22.01	31.65
F_2	10.59	21.22	31.81	10.62	22.66	33.28
F_3	11.10	24.32	35.42	11.40	25.21	36.61
F_4	11.53	25.09	36.62	11.78	26.09	37.87
F_5	11.67	26.23	37.90	12.04	27.12	39.16
S.E. ±	0.22	0.59	0.75	0.23	0.44	0.55
C.D. at 5%	0.71	1.93	2.44	0.75	1.42	1.79
Effect of biofertilizers						
B_1	11.33	23.65	34.98	11.46	24.89	36.35
B_2	09.55	22.50	32.05	09.80	23.56	33.36
B_3	11.73	24.53	36.26	12.03	25.40	37.43
S.E. ±	0.14	0.31	0.35	0.15	0.34	0.30
C.D. at 5%	0.42	0.93	1.02	0.44	1.01	0.90
Interaction Effect (F X B)						
S.E. ±	0.32	0.70	0.77	0.34	0.76	0.68
C.D. at 5%	0.93	2.07	2.28	0.99	2.25	2.00
General mean	10.87	23.56	34.43	11.09	24.62	35.71
Absolute control	10.25	22.64	32.89	10.96	23.59	34.55

Interaction effect

From the above results presented in Table 2, the interaction of manures and fertilizers along with biofertilizers significantly influenced the seed yield of lablab bean and it ranged from 8.40 to 13.40 and 8.97 to 13.21 q ha^{-1} during the years 2020-21 and 2021-22, respectively. It was evident that significantly superior seed yield (13.40 q ha^{-1}) of lablab bean was noticed by the interaction of F_5B_3 comprizing 50% RDN through fertilizers and 50% RDN through poultry manure (PM) with the blend of seed inoculation of phosphorus solubilizing bacteria @ 5 mL kg^{-1} and vesicular arbuscular mycorrhiza @ 10 g kg^{-1} seed in the year 2020-21. Similarly, during the year 2021-22, interaction effect of F_5B_3 recorded the significantly highest seed yield (13.21 q ha^{-1}) of lablab bean however it remained statistically at par with the interaction of F_4B_3 and F_5B_1.

Table 2: Interaction effect of manures and fertilizers and biofertilizers on seed yield (q ha^{-1}) of lablab bean

Treat. No.	2020- 2021					2021-2022				
	F_1	F_2	F_3	F_4	F_5	F_1	F_2	F_3	F_4	F_5
B_1	09.93	11.05	11.47	11.90	12.29	9.41	10.76	11.94	12.06	13.10
B_2	08.40	09.47	10.02	10.52	09.33	08.97	09.42	10.16	10.66	09.80
B_3	10.05	11.25	11.79	12.17	13.40	10.52	11.69	12.10	12.63	13.21
S.E. ±	0.32					0.34				
C.D. at 5%	0.93					0.99				

The beneficial effect of super imposition of P over integrated use of chemical and organic N sources is evident through significant increase in seed yield of lablab bean crop. These responses were expected since the soil has poor initial available P status accompanied with high P fixing capacity of Alfisols (Dongale and Kadrekar 1991) [5]. Improvement in seed yield with increase in P levels has also been observed by Panwar *et al.* (1976) [10] and Gaidhani (2008) [6].

In general, equal integration of urea and poultry manure (F_5) showed significant increase in seed yield whereas inoculation of phosphorus solubilizing bacteria and vesicular arbuscular mycorrhiza (B_3) significantly enhanced the seed, stover and biological yield of lablab bean. While equal integration of urea and poultry manure with a blend of biofertilizers (PSB+VAM) also caused significant increase in seed, stover and biological yield of lablab bean. This suggest that a 50 percent saving in fertilizers of RDF could be possible in case of lablab bean when 50 percent N of RDF is applied through integration of urea with poultry manure in equal proportion and super imposition of PSB and VAM inoculation to solubilize native as well as applied phosphorus.

Effect of Integrated Nutrient Management (INM) on stover yield (q ha^{-1}) of lablab bean

The data presented in Table 1 reported that the stover yield of lablab bean was significantly influenced by the application of manures and fertilizers in conjunction with biofertilizers.

Effect of manures and fertilizers

Stover yield of lablab bean represents the total biomass excluding seed yield. Influence of manures and fertilizers application on stover yield of lablab bean showed variation from 20.94 to 26.23 and 22.01 to 27.12 q ha^{-1} during the years 2020-21 and 2021-22, respectively. The application of 50% RDN through fertilizers and 50% RDN through poultry manure (F_5) recorded significantly highest stover yield (26.23 q ha^{-1}) of lablab bean and it was statistically at par with F_3 and F_4 treatments during the year 2020-21. The same treatment F_5 caused significantly highest stover yield (27.12 q ha^{-1}) of lablab bean and it was found to be significantly superior over F_1, F_2 and F_3 treatments, whereas, it was statistically at par with F_4 treatment during the year 2021-22.

Effect of biofertilizers

The variation in stover yield of lablab bean in different treatments by the inoculation of biofertilizers was observed from 22.50 to 24.53 and 23.56 to 25.40 q ha^{-1} during the years 2020-21 and 2021-22, respectively. The significantly superior stover yield (24.53 and 25.40 q ha^{-1}) of lablab bean was observed by the seed inoculation of phosphorus solubilizing bacteria @ 5 mL kg^{-1} and vesicular arbuscular mycorrhiza @ 10 g kg^{-1} seed (B_3) however it remained statistically at par with B_1 treatment during both the years of investigation.

Interaction effect

The data presented in Table 3, regarding the interaction effect between manures and fertilizers and biofertilizers was found to be significant in respect of stover yield of lablab bean and it ranged from 20.72 to 28.73 and 21.72 to 29.07 q ha^{-1} during the years 2020-21 and 2021-22, respectively. It was evident that significantly superior stover yield (28.73 q ha^{-1}) of lablab bean was noticed by the interaction of F_5B_3 comprizing 50% RDN through fertilizers and 50% RDN through poultry manure (PM) with the seed inoculation of phosphorus solubilizing bacteria @ 5 mL kg^{-1} and vesicular arbuscular mycorrhiza @ 10 g kg^{-1} seed and it was statistically at par with F_4B_3 during the year 2020-21. Similarly, during the year 2021-22, interaction effect of F_5B_3 combination recorded the significantly highest stover yield (29.07 q ha^{-1}) of lablab bean and it was statistically at par with the interaction of F_4B_3 and F_5B_1.

Such an improvement in yield of lablab bean crop could be attributed to increased supply of nutrients making a congenial environment for growth in the rhizosphere. The yield of lablab bean recorded in the treatment F_5B_3 consisting of 50% RDN through fertilizers and 50% RDN through poultry manure (PM) with the seed inoculation of phosphorus solubilizing bacteria @ 5 mL kg^{-1} and vesicular arbuscular mycorrhiza @10 g kg^{-1} seed caused statistically highest stover yield during both years of investigation with exception of F_4B_3 and F_5B_1 in the year 2021-22 (Table 3).

Table 3: Interaction effect of manures and fertilizers and biofertilizers on stover yield (q ha^{-1}) of lablab bean

Treat. No.	2020- 2021					2021-2022				
	F_1	F_2	F_3	F_4	F_5	F_1	F_2	F_3	F_4	F_5
B_1	21.05	21.52	24.47	24.92	26.29	22.25	22.52	25.47	26.59	27.63
B_2	21.06	20.88	23.36	23.52	23.66	22.06	23.21	24.02	23.85	24.66
B_3	20.72	21.25	25.13	26.82	28.73	21.72	22.25	26.13	27.82	29.07
S.E. ±	0.70					0.76				
C.D. at 5%	2.07					2.25				

Effect of Integrated Nutrient Management (INM) on biological yield (q ha^{-1}) of lablab bean

Biological yield of lablab bean represents the total of seed yield and stover yield. The data presented in Table 1 reported that the biological yield of lablab bean was significantly influenced by the application of manures and fertilizers along with biofertilizers during the years 2020-21 and 2021-22, respectively.

Effect of manures and fertilizers

Influence of manures and fertilizers application on biological yield of lablab bean showed variation from 30.40 to 37.90 and 31.65 to 39.16 q ha^{-1} during the years 2020-21 and 2021-22, respectively. The application of 50% RDN through fertilizers and 50% RDN through poultry manure (F_5) recorded significantly highest biological yield (37.90 and 39.16 q ha^{-1}) of lablab bean and it was statistically at par with F_4 treatment during both the years of investigation.

Effect of biofertilizers

The variation in biological yield of lablab bean caused by the seed inoculation of biofertilizers in different treatments was observed from 32.05 to 36.26 and 33.36 to 37.43 q ha^{-1} during the years 2020-21 and 2021-22, respectively. The significant and highest values of biological yield (36.26 and 37.43 q ha^{-1}) of lablab bean was observed by the seed inoculation of phosphorus solubilizing bacteria @ 5 mL kg^{-1} and vesicular arbuscular mycorrhiza @10 g kg^{-1} seed (B_3) during the years 2020-21 and 2021-22, respectively.

Interaction effect

The data presented in Table 4 regarding the interaction effect between manures and fertilizers with a blend of biofertilizers was found to be significant in respect of biological yield of lablab bean during both the years of investigation and it ranged from 29.46 to 42.14 and 31.03 to 42.27 q ha^{-1} during the years 2020-21 and 2021-22, respectively. It was evident that the significantly superior biological yield (42.14 q ha^{-1}) of lablab bean was noticed due to the interaction of F_5B_3 consisting of 50% RDN through fertilizers and 50% RDN through poultry manure (PM) with the seed inoculation of phosphorus solubilizing bacteria @ 5 mL kg^{-1} and vesicular arbuscular mycorrhiza @10 g kg^{-1} seed through seed treatment during the year 2020-21. Similarly, interaction effect of F_5B_3 combination recorded the significantly highest biological yield (42.27 q ha^{-1}) of lablab bean however it remained statistically at par with the interactions F_4B_3 and F_5B_1 during the year 2021-22.

The significant increase in seed, stover and biological yield was found as a consequence of poultry manure, single super phosphate, phosphorus solubilizing bacteria and vesicular arbuscular mycorrhiza inoculation. The beneficial effect of PSB and VAM had also reported by Pandey *et al.* (1998) [8], Tarafdar and Rao (2001) [17], Khan *et al.* (2009) [7], Premi *et al.* (2012) [11] and Sodavadia *et al.* (2017) [13]. The reason for increase in nutrient content with inoculation of PSB could be attributed to proliferation of roots resulting into effective nutrient absorption and thereby higher dry matter accumulation and subsequently better yield (Vaidya, 2005 and Gaidhani, 2008) [16, 6].

Table 4: Interaction effect of manures and fertilizers and biofertilizers on biological yield (q ha^{-1}) of lablab bean

Treat. No.	2020- 2021					2021-2022				
	F_1	**F_2**	**F_3**	**F_4**	**F_5**	**F_1**	**F_2**	**F_3**	**F_4**	**F_5**
B_1	30.98	32.57	35.94	36.82	38.59	31.67	33.28	37.41	38.65	40.73
B_2	29.46	30.35	33.38	34.04	32.99	31.03	32.63	34.19	34.51	34.46
B_3	30.77	32.51	36.92	38.99	42.14	32.24	33.94	38.23	40.45	42.27
S.E. ±	0.77					0.68				
C.D. at 5%	2.28					2.00				

Effect of Integrated Nutrient Management (INM) on economics of Lablab bean

The interaction effect of manures and fertilizers in conjunction with biofertilizers inoculation on yield of lablab bean was found to be effective. However, the adoption of any technology by the farmers depends upon its cost effectiveness. The same principle was considered while deciding lablab bean crop. Therefore, while arriving at any conclusion and deriving any inference, a detail economic analysis is necessary. The data pertaining to the cost of cultivation, gross returns, net returns and B:C ratio as influenced by different interactions is presented in Table 5.

Table 5: Effect of Integrated Nutrient Management (INM) on economics of lablab bean

Tr. No.	Symbol	Total Cost (ha^{-1})		Gross Returns (ha^{-1})		Net Returns (ha^{-1})		B:C ratio	
		2020-21	**2021-22**	**2020-21**	**2021-22**	**2020-21**	**2021-22**	**2020-21**	**2021-22**
T_1	F_1B_1	34982	33370	99300	94133	64318	60763	2.84	2.82
T_2	F_1B_2	31872	33370	83967	89700	52095	56330	2.63	2.69
T_3	F_1B_3	31802	33440	100500	105233	68698	71793	3.16	3.15
T_4	F_2B_1	44773	48301	110500	107600	65727	59299	2.47	2.23
T_5	F_2B_2	44913	48441	94667	94200	49754	45759	2.11	1.94
T_6	F_2B_3	44843	48371	112533	116867	67691	68495	2.51	2.42
T_7	F_3B_1	35061	36222	114700	119433	79639	83212	3.27	3.30
T_8	F_3B_2	35201	36362	100233	101633	65033	65272	2.85	2.80
T_9	F_3B_3	35131	36292	117933	121000	82803	84708	3.36	3.33
T_{10}	F_4B_1	38252	40550	119000	120633	80748	80083	3.11	2.97
T_{11}	F_4B_2	38392	40690	105200	106600	66808	65910	2.74	2.62
T_{12}	F_4B_3	38322	40620	121667	126267	83344	85646	3.17	3.11
T_{13}	F_5B_1	33396	34510	122933	131000	89537	96490	3.68	3.80
T_{14}	F_5B_2	33536	34650	93267	98000	59730	63350	2.78	2.83
T_{15}	F_5B_3	33466	34580	134033	132067	100567	97486	4.01	3.82
T_{16}	Absolute control	28304	29684	62500	59600	34196	29916	2.21	2.01

The data presented in Table 5 when studied revealed that the highest cost of cultivation (Rs. 44913/- ha^{-1} and Rs. 48441/- ha^{-1}) was recorded under the interaction of 100% RDN through vermicompost in conjunction with seed inoculation of vesicular arbuscular mycorrhiza @ 25 g kg^{-1} seed (F_2B_2) during the years 2020-21 and 2021-22, respectively. While, the lowest cost of cultivation (Rs. 28304/- ha^{-1} and Rs. 29684/- ha^{-1}) was observed in the absolute control in the year 2020-21 and 2021-22, respectively.

The data presented in Table 5 when studied revealed that the higher gross returns (Rs. 134033/- ha^{-1} and Rs. 132067/- ha^{-1}) and net returns (Rs. 100567/- ha^{-1} and Rs. 97486/- ha^{-1}) of

lablab bean were recorded due to the interaction of F_5B_3 receiving the application of 50% RDN through fertilizers and 50% RDN through poultry manure with a blend of seed inoculation of phosphorus solubilizing bacteria @ 5 mL kg^{-1} and vesicular arbuscular mycorrhiza @ 10 g kg^{-1} seed during the years 2020-21 and 2021-22, respectively. However, the absolute control recorded the lowest net return (Rs. 34196/- ha^{-1} and Rs. 29916/- ha^{-1}) of lablab bean during the years 2020-21 and 2021-22, respectively. The highest B:C ratios (4.01 and 3.82) of lablab bean were observed as a result of the interaction of F5B3 receiving the application of 50% RDN through fertilizers and 50% RDN through poultry manure with conjunction of seed inoculation of phosphorus solubilizing bacteria @ 5 mL kg-1 and vesicular arbuscular mycorrhiza @ 10 g kg^{-1} seed during the year 2020-21 and 2021-22, respectively. However, the lowest B:C ratios (2.11 and 1.94) were observed in the interaction of F_2B_2 receiving the application of 100% RDN through vermicompost in conjunction with the seed inoculation of vesicular arbuscular mycorrhiza @ 25 g kg^{-1} seed during both the years of investigation. It is observed that the equal integration of fertilizers and poultry manure with a blend of seed inoculation of phosphorus solubilizing bacteria @ 5 mL kg^{-1} and vesicular arbuscular mycorrhiza @ 10 g kg^{-1} seed is essential for obtaining higher yield and higher returns with optimum investment.

Conclusions

All manures, fertilizers and biofertilizers treatments showed significant influence on lablab bean crop. For getting maximum yield of lablab bean and fetching highest net returns, the equal integration of RDN through fertilizers and RDN through poultry manure (PM) with a blend of seed inoculations of phosphorus solubilizing bacteria (PSB) @ 5 mL kg^{-1} and vesicular arbuscular mycorrhiza (VAM) @10 g kg^{-1} seed (F_5B_3) was found to be beneficial in lateritic soils of Konkan during *Rabi* season.

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