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Effect of different bioinoculants on growth attributes of cashew grafts under nursery condition

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Abstract
The field experiment has been conducted for one year to study the effects of different bioinoculants on growth attributes of Cashew grafts. The combine effects of application of bioinoculants such as *Azotobacter* and Phosphate Solubilizing Bacteria (PSB) in a potting mixture significantly shows improvement in growth components such as graft survival, number of leaves, number of shoot, height and girth of the plant as well as root length of the cashew grafts. The microbial population such as bacterial population and fungal population was significantly higher in combine treatments of bioinoculants which may be involved in increase in growth attributes of the grafts. However the Actinomycetes population did not significantly influenced by different treatments. The treatments containing *Trichoderma* as a biocontrol agent also did not significantly control the Anthracnose disease of the mango grafts during the whole year.

Keywords: Mango grafts, bioinoculants, *Azotobacter*, PSB, *Trichoderma*, bacteria, fungi actinomycetes, anthracnose, growth attributes

Introduction
Cashewnut (*Anacardium occidentale* L.) is a tropical evergreen hardy tree crop originated from South and Central America. India is the major producer of cashewnut contributing around 60% of the world's cashewnut production. Cashew nut is presently grown in an area of 1124 thousand hectares with annual production of 691 thousand MT. In India cashew nut is grown mainly in Maharashtra, Goa, Karnataka and Kerala along west coast and Tamil Nadu, Andhra Pradesh, Orrisa, and West Bengal along the east coast. The agro climatic conditions of Konkan region of Maharashtra state are favourable for cashew production and hence it has been predominantly cashew zone in the state The beneficial use of nitrogen-fixing microorganisms, *viz*. *Azotobacter*, and phosphate-solubilizing bacteria as biofertilizers used as a supplementary source of plant nutrition on agricultural crops is well documented (Gajbhiye *et al*. 2003) [4]. Therefore, the study was carried out to see the effect of biofertilizers on the growth attributes of Cashew graft, microbes and nutrient content of the potting mixture under nursery condition.

Materials and Methods
A Field experiment was conducted on Cashew grafts for seventh months started from 2021-22 at the Regional Fruit Research Station, Vengurla, Dist. Sindhudurg. The experiment was laid in Randomized Block Design (RBD) with three replications and nine treatments. In Cashew fresh and dried seed nuts were sown in 6 x 8 inch filled with media treatments in the month of October and grafting was done in the month of November. After grafting, 100 successful grafts per treatment per replication were selected and for three replications total 2700 no. of grafts were selected for experimentation The uniform package of practices were followed for all treatments including fertilizer application through potting media with 19:19:19 @ 2 gm, plant protection measure and application of water, regular removal of sprouts below graft union etc. The biofertilizers such as *Azotobacter* and PSB biofertilizer is prepared by using local strain isolated from mango plant. The estimation of microbes and major nutrients at initial stage and final stage (After seventh months of cashew graft) has done by serial dilution plate count technique and soil standard techniques respectively.

Results and Discussion
The present study was conducted at RFRS, Vengurla for seventh months to know the effect of different bio- inoculants on growth of Cashew grafts.

Results of present research revealed that the combine application (T_5 and T_9) of biofertilizers such as *Azotobacter* and Phosphate Solubilizing Bacteria (PSB) in a potting mixture shows significant improvement in microbial population (Total bacterial and total fungal population), nutrient content (Total nitrogen and Total Phosphorous) and growth components (Graft survival, Number of leaves, Number of shoot, height and girth and root length of the plants) as compared to potting mixture (Control) after seventhes of the graft (Table no.2 & 3). The more addition of *Azotobacter* and PSB in the form of biofertilizers directly increases the total bacterial population and indirectly stimulates the fungal population. The additional population and native population of *Azotobacter* and PSB in the *rhizosphere* shows combine beneficial effect on growth attributes of Cashew graft in the (T_5 and T_9) treatments. The *Azotobacter* and PSB promotes the biochemical activities such as nitrogen fixation and phosphate solubilisation and increases the nitrogen and phosphorous content in potting mixture (Table no.3) which has been absorbed by the roots of the plant. The absorption of available nitrogen and available phosphorous further significantly improves the growth attributes of the mango grafts.

Table 1: Initial Microbial and Nutrients status of the potting mixture of Cashew graft

A. Microbial population (CFU)		
1	Total bacterial population	31 x 10^6
2	Total fungal population	1 x 10^4
3.	Total actinomycetes population	3 x 10^3
B. Nutrients		
1	pH	6.29
2	EC	0.57
3	Total Nitrogen (%)	1.16
4	Total Phosphorous (%)	0.86
5	Total Potassium (%)	1.34

Table 2: Effects of different bio-inoculants on growth parameters of the 7th month cashew grafts.

Tr. No.	Treatments	Percent Sprouting (%)	Grafts survival (%)	No. of leaves	No. of shoot	Height of the plant (cm)	Girth of the plant (cm)	Root length of the plant (cm)
T_1	Potting mixture alone	78.10	73.93	11.73	1.00	37.10	3.06	19.16
T_2	Potting mixture + *Azotobacter* 50 g	78.53	80.90	15.43	1.17	42.30	3.22	24.16
T_3	Potting mixture + PSB 50 g	82.43	79.67	13.12	1.07	41.18	3.29	26.25
T_4	Potting mixture + Talc based *Trichoderma* 50 g	83.77	76.63	11.13	1.00	38.67	3.07	19.32
T_5	Potting mixture + *Azotobacter* 50 g + PSB 50 g + Talc based *Trichoderma* 50 g	82.83	81.07	16.97	1.37	48.90	3.34	31.54
T_6	T_2 + Spraying of *Trichoderma* (Spore formulation) 3 times at 2 months interval @ 1 g/10 L	81.60	80.53	14.37	1.07	43.23	3.08	26.37
T_7	T_3 + Spraying of *Trichoderma* (Spore formulation) 3 times at 2 months interval @ 1 g/10 L	82.47	81.53	13.03	1.03	41.70	3.21	26.35
T_8	T_4 + Spraying of *Trichoderma* (Spore formulation) 3 times at 2 months interval @ 1 g/10 L	79.10	77.00	11.27	1.03	38.92	3.23	20.25
T_9	T_5 + Spraying of *Trichoderma* (Spore formulation) 3 times at 2 months interval @ 1 g/10 L	84.53	83.20	18.73	1.43	51.47	3.54	30.35
	SE.+-	1.33	1.04	1.00	0.05	1.10	0.06	1.32
	C.D.@5%	NS	3.13	3.01	0.15	3.32	0.18	3.96

Table 3: Effects of different bio-inoculants on microbial population and nutrient status of the 7th month cashew grafts.

Tr. No.	Treatments	Microbial population (CFU)			Nutrient Status		
		Bacteria X 10^6	Fungi X 10^4	Actinomycetes X 10^3	Total N (%)	Total P (%)	Total K (%)
T_1	Potting mixture alone	39	02	05	1.12	0.79	1.32
T_2	Potting mixture + *Azotobacter* 50 g	49	03	07	1.22	0.79	1.33
T_3	Potting mixture + PSB 50 g	47	03	07	1.12	0.88	1.33
T_4	Potting mixture + Talc based *Trichoderma* 50 g	44	05	05	1.12	0.79	1.32
T_5	Potting mixture + *Azotobacter* 50 g + PSB 50 g + Talc based *Trichoderma* 50 g	59	03	05	1.20	0.85	1.33
T_6	T_2 + Spraying of *Trichoderma* (Spore formulation) 3 times at 2 months interval @ 1 g/10 L	47	05	06	1.21	0.80	1.33
T_7	T_3 + Spraying of *Trichoderma* (Spore formulation) 3 times at 2 months interval @ 1 g/10 L	46	05	07	1.13	0.89	1.33
T_8	T_4 + Spraying of *Trichoderma* (Spore formulation) 3 times at 2 months interval @ 1 g/10 L	42	07	05	1.12	0.79	1.32
T_9	T_5 + Spraying of *Trichoderma* (Spore formulation) 3 times at 2 months interval @ 1 g/10 L	56	03	05	1.22	0.87	1.32
	SE.+-	1.72	0.83	1.20	0.02	0.07	0.02
	C.D.@5%	5.18	2.49	NS	0.07	0.05	NS

This has been supported by Kamil (2008) [5] who shown that the *Azotobacter* is capable of converting nitrogen to ammonia which in turn is taken up by the plants. The *Azotobacter* has been reported to contribute 15 Kg N ha^{-1} per year. It has been also observed that inoculation of soil or seed with *Azotobacter* causes increase in growth attributes of different crops (Sindhu *et al*. 2010) [8]. Whereas the phosphate-solubilizing bacteria active in solubilizing insoluble P improving growth attributes

of various crops. (Cattelan *et al*. 1999) [3]. These organisms solubilize the unavailable forms of inorganic P like tricalcium phosphate iron phosphate, aluminium phosphate and rock phosphates into soluble forms by release of a variety of organic acids like succinic, citric, malic, fumaric, glyoxylic and gluconic acids. (Venkateswarlu *et al*. 2008) [9]. The results were also in line up with that of Prabhu *et al*. (2003) [6] Asad *et al* (2017) [2] and Ritik Chawla and Ramesh Kumar Sadawarti (2020) [7]. They revealed that the application of bio fertilizer rate directly help in increasing plant height, Plant leaves which might be due to the nutrient uptake of plants, that is important to improved chlorophyll content, carbohydrate synthesis and increased the activity of hormones. Thus Bio-fertilizer increases overall development of vegetative growth parameters like in higher growth rates stem girth as compared to chemical fertilizer (Alam and Seth, 2014) [1]. However the Actinomycetes population did not significantly influenced by any of the treatment(table no.3) which may be due to lack of its application

Conclusion

It is thus concluded that the combine application of *Azotobacter* and PSB in the form of biofertilizers significantly add the microbial population in the form of biofertilizer and increases the nutrient content such as nitrogen and phosphorous of the potting mixture which further improve the growth attributes of Cashew grafts.

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