International Journal of Innovative Horticulture. 7(1):46-49, 2018 **Original Article**

Effect of Azophos (50:50), a biofertilizer formulation on cardamom (*Elettaria cardamomum* L. Maton) in primary nursery

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ABSTRACT

An experiment was conducted in sandy clay loam soil to determine the influence of *Azospirillum, Azotobacter,* phosphobacteria (PSB), azophos (50:50) either individually or in combination, on growth and development of cardamom. Rate of germination and growth attributes such as shoot length, root length, number of leaves, chlorophyll pigments, plant fresh and dry weight were quantified. The results revealed that in general, earliness of germination was recorded in all biofertilizer treatments and germination percentage was higher in combined inoculation of *Azospirillum, Azotobacter* and phosphobacteria. This treatment improved shoot length, root length, number of leaves, plant biomass and chlorophyll content. Increment in growth attributes was lower in azophos (50:50) treatment in comparison with combined inoculation of *Azotobacter, Azospirillum and* phosphobacteria. However, growth attributes were on par when azophos (50:50) was combined with *Azotobacter* with that of *Azospirillum, Azotobacter,* phosphobacteria combinations.

Keywords: Azophos, biofertilizer, cardamom, seed germination.

INTRODUCTION

Cardamom (*Elettaria cardamomum* L. Maton) popularly known as "Queen of spices" is an export oriented spice crop of India. The Indian cardamom industry faces stiff competition from other countries in the world market and it has to sustain productively with superior quality of produce. To achieve success in cardamom plantation programme, promotion of seed germination and establishment of seedling is one of the important phases because propagation through seed is highly preferred as does not transmit the 'Katte', a viral disease. In order to make the seeds germinate, they must be placed under favourable environmental conditions. Seed treatment often improves germination through control of seed surface mold; it provide good insurance against disease, soil borne organisms etc., it affords protection to weak seeds and make them produce healthy seedlings. In cardamom attempts have been reported on hastening of germination of seeds through the application of gibberellin (Kalavathy and Ranganayaki, 1993). However, there are no comprehensive reports on the efficacy of biofertilizers on seed germination and growth in cardamom. Thus, the present study was undertaken to throw light on the influence of biofertilizers *viz., Azospirillum, Azotobacter* and phosphobacteria on growth and development of cardamom.

MATERIALS AND METHODS

Cardamom (cv. Malabar) seeds were obtained from mother plants from Pandiyan Estastes (P) Ltd., Vellimalai (+1090m above MSL), Tamil Nadu, from the selected uniformly ripened capsules. Native efficient acid tolerant isolates of *Azospirillum,* phosphobacteria (PSB), *Azotobacter*, obtained from the Vellimalai cardamom plantations were used in the present study. *Azospirillum, Azotobacter* and phosphobacteria were loaded in sterilized rice husk ash as carrier. Azophos (50:50) formulation was developed by mechanical mixing of the individual broths sterilized rice husk ash in equal ratio on volume basis after attain the sufficient growth (Premalatha, 2000). These rice husk ash based bacterial inoculants were treated with seeds @ 2 g per 10 g of seeds.

Following treatments were included in the present study

T_1 : *Azospirillum*; T_2: PSB; T_3 : *Azotobacter*; T_4 : *Azospirillum* + PSB; T_5 : *Azotobacter* + PSB; T_6 : *Azospirillum* + *Azotobacter* + PSB; T_7 : Azophos (50:50); T_8 : Azophos (50:50) + *Azotobacter* and T_9 : Control

One hundred and twenty seeds (3.0 g) were sown separately in each treatment in lines. The recommended nursery management practices were followed for the production of elite seedlings. The observations such as germination ercentage, shoot length, root length, number of leaves, lant bio-mass and plant dry weight were recorded at various ıtervals. Chlorophyll a, b and total chlorophyll were uantified following the method of Mahadevan and Sridar 1986).

ЯESULTS AND DISCUSSION

ffect of biofertilizers on seed germination

'he germination of seeds differed significantly due to the noculation of biofertilizers (Fig. 1) both in Madurai and /ellimalai locations. In general early germination was ›bserved (on 25 DAS) in the seeds inoculated with ›iofertilizers. Combined inoculation of *Azospirillum*, *1zotobacter* and PSB registered highest seed germination ›er cent of 65.8 and 86.7 when compared to 20 and 68.7% ;ermination in control at Madurai and Vellimalai locations, 'espectively on 65th days after sowing. Enhanced seed ;ermination due to co-inoculation of *Azospirillum* and ›hosphobacteria and combined inoculation of *Azotobacter*, ?SB, SSB and ZSB observed in the present study ;orroborates with earlier report in coffee (Raghu, 2000). *4zotobacter* treatment either individually or in combination with other biofertilizers was found to augment germination. Our results were in agreement with those reported in coffee (Glory Swarupa *et al.*, 1997) and in chilli (Bhat and Alagawadi, 1998). Azophos (50:50) treatment recorded relatively lesser seed germination when compare with combined inoculation of *Azospirillum and* phosphobacteria. On the other hand, azophos (50:50) in combination with *Azotobacter* improved seed germination percentage on par to that of *Azospirillum, Azotobacter*, phosphobacteria

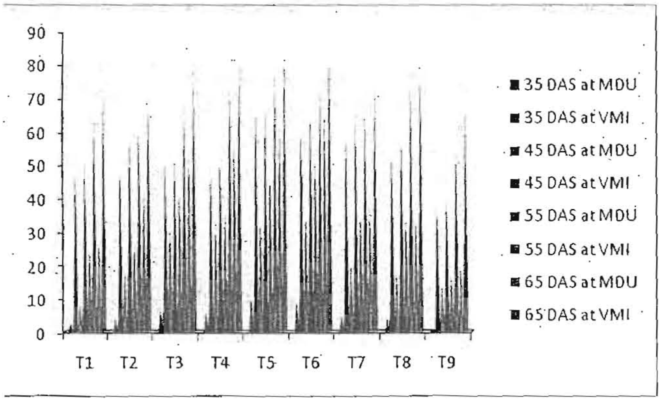

Fig. 1. Effect of biofertilizers on germination percentage in cardamom. Field experiment was conducted at Madurai (MDU) and Vellimalai (VMI) locations and rate of seed germination (%) after 35, 45, 55 and 65 days of sowing was represented.

combination (T6). The increased seed germination might be due to auxin and other growth promoting substances released by these organisms. Earlier, Bottini *et al.* (1989) reported the production of gibberellic acid by *Azospirillum* whereas Barea *et al.* (1976) reported the production of gibberellic acid by phosphobacteria. Martinez-Toledo *et al.* (1988) reported the production of auxin, gibberellin and cytokinins by *Azotobacter choroccum.*

Effect of biofertilizers on shoot length, root length, number of leaves and plant biomass

In the present investigation, all the treatments irrespective of the inoculants resulted in vigorous growth of seedlings with increased root length, shoot length, number of leaves and plant biomass in comparison with control (Tables 1 and 2). Irrespective of location the combined inoculation of *Azospirillum, Azotobacter* and phosphobacteria had recorded highest shoot and root length, number of leaves and plant biomass when compared to the other treatments and un-inoculated control. Similar positive influence of biofertilizers on growth attributes were reported by Rajagopal and Ramarethinam (1997) and Glory Swarupa (1996) in coffee. Azophos (50:50) treatment recorded relatively lesser plant growth parameter values when compare with combined inoculation of *Azospirillum and* phosphobacteria which is in contrary to the findings of Premalatha (2000) who reported improved growth and development in rice as compared to inoculation of *Azospirillum and* phosphobacteria. This deviation may be positively due to the rhizosphere effect/ niche-ecosystems difference between the crops supported by the views of Roberts *et al.* (1992) that inoculants may differ in their ability to colonize different plants. The interactions inoculated microorganisms with other components of the soil biota have not been well characterized but will have a profound effect on the ability of the inoculant to establish in soil and on roots. The vast majority of seed exudates (sugars, sugar alcohols, amino acids, organic acids, and various volatiles and enzymes) released during germination would stimulate the proliferation of the diverse microbial community present on the surface of seeds.

The enhancement in growth parameters registered with combined inoculation of biofertilizers was possibly due to the accumulation or uptake of nitrogen by *Azospirillum* or *Azotobacter*; uptake of phosphorous owing to phosphobacteria and also through the production of growth promoting substances like phyto-hormomes, vitamins and antibiotic substances by the inoculants.

Table 1: Effect biofertilizer inoculation on growth and development of cardamom in primary nursery at Madurai location

Treatments	Root length (cm)		Shoot length (cm)		No. of leaves		Plant biomass (g plant^{-1})		Plant dry weight (g plant^{-1})	
	DAS		DAS		DAS		DAS		DAS	
	100	125	100	125	100	125	100	125	100	125
T_1	2.0	4.1	6.4	6.5	2.0	3.0	0.527	0.733	0.400	0.053
T_2	2.3	3.5	6.1	6.9	2.0	3.0	0.560	0.693	0.043	0.050
T_3	2.6	4.3	6.6	7.4	2.3	3.0	0.673	0.827	0.050	0.057
T_4	2.5	4.3	6.3	7.2	2.0	3.0	0.713	1.067	0.050	0.073
T_5	2.7	4.8	6.7	7.6	2.3	3.3	0.760	1.207	0.053	0.087
T_6	2.8	6.4	6.7	7.7	3.0	4.0	0.847	1.747	0.060	0.120
T_7	3.3	4.0	6.0	7.1	2.0	3.0	0.660	0.973	0.047	0.063
T_8	2.9	4.9	6.5	7.4	2.3	3.7	0.787	1.603	0.057	0.113
T_9	1.7	2.5	5.2	6.3	2.0	2.3	0.427	0.587	0.030	0.040
SEd	0.119	0.367	0.145	0.137	0.236	0.272	0.012	0.023	0.014	0.006
CD (0.05%)	0.245	0.758	0.300	0.284	0.487	0.562	0.026	0.047	0.030	0.040

DAS – Days after sowing

Table 2. Effect biofertilizer inoculation on growth and development of cardamom in primary nursery at Vellimalai location

Treatments	Shoot length (cm)		Root length (cm)		No. of leaves		Plant biomass (g plant^{-1})		Plant dry weight (g plant^{-1})		Chlorophyll content (mg g^{-1}) at 155 DAS		
	100 DAS	155 DAS	100 DAS	155 DAS	100 DAS	155 DAS	100 DAS	155 DAS	100 DAS	155 DAS	Chl- a	Chl-b	Total
T_1	2.7	8.3	3.5	7.8	3.0	4.0	0.640	1.367	0.053	0.143	0.76	0.82	1.57
T_2	2.4	8.5	3.5	9.5	3.0	4.3	0.820	2.037	0.067	0.210	0.69	0.84	1.53
T_3	2.8	9.3	3.9	11.5	3.0	4.7	0.953	2.453	0.080	0.257	0.81	0.91	1.71
T_4	3.0	10.0	3.9	11.6	3.0	5.3	1.050	2.873	0.087	0.300	0.91	1.09	1.99
T_5	3.2	11.9	4.2	12.5	3.3	5.7	1.140	3.807	0.093	0.420	0.84	1.11	1.96
T_6	3.3	12.7	4.3	13.3	3.3	6.0	1.530	4.400	0.107	0.450	0.94	1.30	2.24
T_7	3.0	9.2	3.9	8.3	3.3	4.70	0.917	2.603	0.073	0.267	0.74	0.93	1.67
T_8	3.1	12.0	3.8	12.3	3.3	5.3	1.187	3.433	0.093	0.373	0.78	1.14	1.92
T_9	2.1	5.8	2.8	4.0	2.3	4.0	0.453	0.973	0.033	0.100	0.49	0.48	0.97
SEd	0.14	0.38	0.21	0.87	0.41	0.41	0.019	0.055	0.003	0.006	0.03	0.04	0.07
CD (0.05%)	0.28	0.78	0.43	1.80	0.84	0.83	0.038	0.112	0.005	0.013	0.07	0.09	0.15

DAS – Days after sowing

Effect of biofertilizers on chlorophyll content

The results revealed that chlorophyll content of inoculated seedlings recorded a marked increase as compared to un-inoculated control (Table 4). Combined inoculation of *Azospirillum, Azotobacter* and phosphobacteria recorded a higher total chlorophyll (2.2 mg g^{-1}) and chlorophyll - b (1.3 mg g^{-1}) at 155 DAS and the un-inoculated control recorded least total chlorophyll (0.97 mg g^{-1}) and chlorophyll - b (0.48 mg g^{-1}).The increase in chlorophyll – b content was relatively higher than chlorophyll - a. Our results were in agreement with those observed in coffee by Raghu (2000).

CONCLUSION

The results of the present study clearly indicate that combined inoculation of biofertilizers will be simple, less expensive and a promising technology for hastening germination of seeds and production of vigorous seedlings which can be transplanted to secondary nursery with in a short period in primary nursery. Study also standardized the ratio of the mixed formulation of biofertilizers with respect to germination, growth and development in cardamom.

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