

Efficacy of Biofertilizers on Phenological Traits in Budded *Aonla* Plants under Sub-tropical Conditions of India

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Abstract:

The efficacy of biofertilizers on phenological traits of budded plants had shown that treatment of biofertilizers with various combinations showed their drastical effects. The combination of AMF + Azospirillum enhances higher phenological growth behaviour than other combinations. The AMF + Azospirillum applied budded plants produce more leaves and shoot length which could have increased the rate of photosynthesis. These combinations also have more roots per plant than other combination. This improvement in plant growth could be attributing to the enhancement of the plant to absorb more nutrients. AMF also protect roots from soil pathogen and thereby increase root growth, shoot biomass and root biomass

Key words: Biofertilizers, phenological growth, AMF, Azospirillum and PSB

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Introduction

The Indian gooseberry (*Emblica officinalis* Gaertn.; Euphorbiaceae), native to tropical South-East Asia, particularly Central and South India. It is considered to be the second richest source of vitamin-C, 600 mg/100g next to barbedose cherry and it also contains high amount of minerals, i.e. iron, calcium and phosphorus. A number of value added processed fruit products, herbal and cosmetic products are manufactured from the fruits. The cultivation of aonla is widely distributed all over the country varying from rainfed drought prone areas, arid and semi-arid tropical and subtropical regions. Besides India, it widely grows in China and Srilanka. Aonla is considered to be high tolerance potential fruit species which is most suited to grow under salt-affected and wasteland/ravine lands and foothills with little investments and high economic returns. The maximum area under aonla cultivation is distributed in Uttar Pradesh, but a large area of aonla cultivation expanded during the last one decade in various part of country, particularly in Maharashtra, Madhya Pradesh, Chhattisgarh, Rajasthan, Gujrat, Karnataka, Andhra Pradesh, Orissa, Himanchal Pradesh, Delhi, Haryana and Punjab. *Aonla* seeds are shown in raised bed or polybags, subsequently, after 10-12 months, when seedling attains the lead pencil thickness then it is allowed for vegetative propagation. It takes more time for maturity of seedling for grafts. This time taking period may be shortened due to treatment of AMF because AMF can help uptake of macro and micro nutrients; thereby improve vegetative growth. In recent years, several studies have been conducted in different fruit plants regarding utilization of biofertilizers for improved plant growth and survival, particularly in nursery **(Krishna et al. 2006)**. However, very meager information is available in *aonla* on exploitation of biofertilizer / AMF for increased seedling growth.

Materials and Methods

The two months old seedling planting material of uniform height and girth was selected from nursery and budded plants were used. These planting materials are healthy and free from insect pest and diseases. Besides, planting materials there were four biofertilizers *AMF*, *Trichoderma*, *PSB* and *Azospirillum* alone as well as in combination are used. In this experiment contain eight treatment combinations, experimental unit was taken four and total ninety four seedlings are used in three replications. The soil media used in experiment was prepared by soil and FYM with the ratio of 1: 1. The measured quantity of biofertilizers was mixed properly in soil media. The biofertilizers used in above experiments for filling in the pots was as 30 gm in single biofertilizers and in combination of two biofertilizers was 60 gm (30gm each). The above biofertilizers in single or in combination was mixed with soil media and left over a night. In next day pots were filled with the mixture of soil media and biofertilizers and also in same day transplanting of seedling was done. The plant height and shoot diameter was measured in the interval of 30, 60 and 90 days after transplanting by using the measuring tape. The root length, root numbers, root collar girth, shoot biomass and root biomass measured after 120 days. The experiment was laid out in factorial RBD with three replications. The data was analysis as per method suggested by **(Panse and Sukhatme, 1985)**. Least significant differences at 5% level were used for finding the significance difference among the treatments.

Results and Discussion

The result obtained from the experiment, indicate that different combination of biofertilizer (Table-1 and 2) was significant as compared to non treatments of plants. The highest budded plant growth was recorded by using of *AMF* + *Azospirillum*

followed by *PSB* and *AMF+PSB* respectively. It could be due to enhance inorganic nutrient absorption and greater rates of photosynthesis. The *Azospirillum* and *AMF* are known to affect both the uptake and accumulation of nutrients so it acts as important biological factors that contribute to efficiency of both nutrient absorption and use.

Table-1 Efficacy of Bio fertilizers on Plant height (cm) of *Aonla* budded Plants.

Treatments	2011			2012		
	30days	60days	90 days	30 days	60days	90 days
Control	33.33	39.13	41.43	33.56	38.80	45.33
AMF	49.56	51.00	51.23	49.93	51.30	54.56
Azospirillum	51.43	52.13	53.66	49.96	51.36	54.90
Trichoderma	43.30	45.10	48.06	39.53	44.63	46.20
PSB	61.66	63.10	71.16	57.70	60.60	80.70
AMF+Azospirillum	77.10	84.83	94.66	75.03	78.13	89.60
AMF+ PSB	56.06	56.50	58.66	56.00	59.26	68.96
AMF+Trichoderma	53.86	54.46	55.23	51.90	54.10	55.53
Factor	A	B	A x B	A	B	AXB
SEm±	1.1409	1.8630	3.2269	1.7134	2.7979	4.8462
P=0.05	3.2448	5.2987	9.178	4.8731	7.9578	13.783

Table-2 Efficacy of Bio fertilizers on Shoot diameter (cm) of *aonla* budded Plants.

Treatments	2011			2012		
	30days	60days	90 days	30 days	60days	90 days
Control	0.903	0.935	0.966	0.87	0.93	0.98
AMF	1.062	1.083	1.104	1.03	1.05	1.06
Azospirillum	1.126	1.146	1.170	1.11	1.12	1.13
Trichoderma	0.976	1.030	1.040	1.01	1.02	1.03
PSB	1.317	1.348	1.401	1.24	1.43	1.50
AMF+Azospirillum	1.443	1.518	1.688	1.70	2.62	4.10
AMF+ PSB	1.263	1.277	1.292	1.22	1.27	1.29
AMF+Trichoderma	1.206	1.221	1.231	1.12	1.25	1.27
Factor	A	B	AXB	A	B	AXB
SEm±	0.0231	0.0377	0.0653	0.2920	0.4768	0.8258
P=0.05	0.0657	0.1072	0.186	NS	NS	NS

Table-3 Efficacy of Bio fertilizers on phenological growth Performance (cm) of Aonla budded Plants.

Treatments	Root Length(cm)		Root Number(cm)		Root Collor diameter(cm)		Shoot Biomass(g)		Root Biomass(g)	
	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
control	11.700	11.600	15.000	14.000	0.668	0.689	4.833	4.900	5.367	5.467
AMF	14.367	14.167	22.000	22.667	0.881	0.880	6.467	6.700	6.200	6.300
Azospirillum	16.200	16.000	23.000	24.000	0.902	0.902	6.833	6.900	6.300	6.433
Trichoderma	14.133	14.133	20.333	20.000	0.743	0.753	5.467	6.333	5.900	5.967
PSB	23.667	23.433	44.667	46.000	1.157	1.146	9.433	9.533	7.233	7.267
AMF+Azospirillum	26.500	26.100	55.333	57.667	1.316	1.316	11.167	11.333	8.433	8.433
AMF+ PSB	22.967	22.867	41.000	42.333	1.093	1.093	8.800	8.800	6.833	6.900
AMF+ Trichoderma	17.633	17.267	27.000	27.333	0.934	0.912	7.100	7.233	6.500	6.567
SEM±	1.001	0.943	1.414	1.546	0.034	0.035	0.289	0.250	0.201	0.221
P=0.05	3.026	2.850	4.276	4.674	0.103	0.105	0.875	0.757	0.609	0.668

As (Table -3) revealed that different combination of biofertilizers using in aonla budded plants for the observation of root length, root numbers, root collar diameters, shoot biomass, root biomass were recorded highest by using of *AMF* + *Azospirillum* than *PSB* and *PSB* + *AMF* respectively . The root length and root numbers increase might be due to absorption of more nutrient especially phosphorous. It increases in the absorbing surface area. This turn could have enhanced a higher plant growth rate resulting to more root per plant and higher length of roots. The similar result also been reported in Papaaya cv Sunset Solo (**Manjunathan et al., 2002**), in Banana cv. Barjahaye (**Gogoi et al., 2004**), in Pecan seedling (**Joolka et al., 2004**), in Senna Spectabilis (**Kunj'u, 2004**) in Alphonso (**Patel and Patel, 2008**) in Marigold cv. Pusa Narangi (**Kumar and Srivastava, 2006**) in Gallardia (**Deshmukh, et al., 2006**) and in Trifoliolate orange (**Yao et al., 2009**).

The mycorrhiza colonization also protect the roots from the soil pathogen so it could have led to increase in not only root growth and numbers but also help in survival.

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