

## Comparative study on influence of Arbuscular Mycorrhizal Inoculum and Chemical Fertilizer on vegetative growth of Mango seedlings

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### ASBTRACT:

Mycorrhiza is a natural phenomenon of mutualism between roots of plants and a group of soil fungi. Of more interest are Arbuscular Mycorrhizal fungi to the field of agriculture and Forestry. AM fungi fulfil almost all the criteria of bio-fertilizers. Recently, their growth promoting potential has also been experimented on various plants like cereals, fruit crops, ornamental plants, vegetables and other economically important plants in different parts of the world as well as in India.

Mango (*Mangifera indica*) is a major fruit crop of Konkan region of Maharashtra state. The present work was carried out to study influence of AM fungi on the vegetative growth of mango seedlings. Seedlings of homozygous variety 'Villaicolumban' were subjected to eight different treatments including chemical fertilizer, AM bio-fertilizer and combinations of both. The effects of the treatments were recorded in terms of growth parameters like, Root and Shoot length (cm), Stem girth (cm), Number of leaves, Root and shoot fresh weight and dry Weight (g) at 30 days interval for 12 months.

Comparative study between Control (untreated) plants and plants under different treatments revealed that chemical and AM bio-fertilizer applied in combination were superior over Control and over individual treatments of chemical and AM bio-fertilizer alone.

### INTRODUCTION:

Out of total world production of mangoes, 39 percent is contributed by India (Singh, 2008). Thus with respect to mango production and export, India is the major competitor in the international market. However, the yield is actually at its lowest level. Among many reasons leading to low yield of mangoes two important reasons are lack of education about correct agronomic practices and poor management of orchards (Venkatraman, 2002).

For cultivation of fruit crops, in general, majority of the farmers depend more on chemical phosphatic fertilizers than bio-fertilizers due to their faster effect. However, the amount of fertilizer applied is not completely available to the plants as it accumulates in the soil forming insoluble complexes. This harms the soil health slowly rendering it non-fertile. Nowadays, the research is directed towards developing better alternatives to the traditional chemical fertilizers.



In recent years, the Arbuscular mycorrhizal (AM) fungi have gained attention of the researchers as potential bio-fertilizer to boost production in agriculture and horticulture. Mycorrhiza is a symbiotic relationship between a fungus (mycobiont) and the root system of the plant.

The AM fungi are obligate symbionts forming symbiotic association with roots of plants. This association is a common phenomenon in the nature wherein, over 90% of the plants harbour AM fungi in their root tissues. Of all the types the arbuscular mycorrhizal (AM) fungi are more preferable as bio-fertilizer because of their inherent properties such as, their ubiquitous occurrence in wild as well as cultivated plants, remarkable ability of mobilizing insoluble phosphates and capacity to absorb various macro- and micro-nutrients. They also enhance the ability of the host plants to produce PGRs, to withstand water stress and provide protection against soil borne pathogens (Manoharachary *et al.*, 2009). This has been confirmed experimentally by various researchers working with different types of test crops (Hazarika *et al.*, 1999; Rattiet *et al.*, 2002; Patil and Patil, 2005; Thakur *et al.*, 2005; Maitiet *et al.*, 2008;). Though studied well in variety of plants, the status of AM association in mango has been given less attention. A nursery experiment was set up to study the effect of AM Inoculum, Chemical fertilizer and their combinations on vegetative growth of mango seedlings, in present study.

## MATERIALS & METHODS:

### 1. The Test Crop: Mango (*Mangifera indica*), Variety: *Villaicolumban*

Mango is an economically important fruit crop of Konkan region of Maharashtra state, however, it has not been the subject of Mycorrhizal experiments as much as other types of plants.

*Villaicolumban* is a homozygous variety of mango, developed by Dr. BS Konkan Krishi Vidyapeeth, Dapoli and is commonly used as rootstock for grafting. The seeds are polyembryonic.

Seeds of the test crop were procured from Fruit Research Centre, Vengurle (Sindhudurg district). They were sown in cow dung: soil (1:3) mixture in polybags. The seeds were opened to separate the multiple seedlings germinated inside and transferred to experimental potting mixtures prepared in polybags.

### Treatments:

Table No. 01: Details of the fertilizer treatments

Sr. No.	Treatment Symbol	Composition
1.	T1	Un-inoculated Control
2.	T2	100% dose of SSP* (Chemical fertilizer Control)
3.	T3	50% dose of AM inoculum
4.	T4	100% dose of AM inoculum**
5.	T5	50% dose of AM inoculum + 50% dose of SSP
6.	T6	50% dose of AM inoculum + 100% dose of SSP
7.	T7	100% dose of AM inoculum + 50% dose of SSP
8.	T8	100% dose of AM inoculum + 100% dose of SSP



[\*100% dose of SSP- 20g/ 4kg soil; \*\*100% dose of AM inoculum - 40/ 4kg soil]

### 3. Experimental Set up:

- Number of Replications per treatment: **03**
- Number of plants per replication: **05**

**4. Growth parameters :** Growth parameters selected for study and the time period of observation are as follows-

Growth Parameter	Days of observation
Plant height (cm)	30 days interval
No. Of leaves	30 days interval
Stem girth (cm)	30 days interval
Root length (cm)	180 days interval
Root & Shoot fresh weight (g)	180 days interval
Root & Shoot Dry weight (g)	180ys interval

**Height of seedling (cm)**- Total height of main growing shoot from ground level up to the tip was measured in centimetres. Average height of plant was calculated by taking mean of the readings for all three replications (2 seedlings/ replication) i.e. total six seedlings per treatment.

**Number of leaves** -Total number of leaves per plant was counted for the marked seedlings and the average number of leaves per treatment was calculated.

**Stem girth (cm)**- Stem girths at collar region and first node were measured in centimeters for each seedling with the help of thread. The stem girth at collar region and first node were recorded and are presented separately which are mean values of three replications per treatment.

**Root length (cm)** -Length of main (primary) root was measured in centimetres per replication per treatment. Mean root length was determined by calculating the average of three replications.

**Root and shoot fresh weights (g)** - Root and shoot parts of up-rooted seedlings were cut apart and their fresh weights were taken separately. Average root and shoot fresh weights were then calculated for all the treatments.

**Root and shoot dry weights (g)** - Following fresh weight determination, root and shoot parts of the seedlings were subjected to oven drying at 60°C till constant reduced weights were observed. Mean values of root and shoot dry weights were worked out for each treatment.

**Mycorrhizal studies-**

**Root colonization:** Roots of up-rooted seedlings were washed thoroughly, under tap water and were processed using staining method given by Carol and Stribley (1991) to assess per-cent root colonization by AM fungi.



**AM spore density:** Density of AM fungal spores in rhizosphere soil, collected from each treatment was determined by 'Wet sieving and decanting' method (Gerdemann and Nicholson, 1963).

### OBSERVATION AND RESULTS:

#### 1. Plant height:

Plants treated with only chemical fertilizer (T2) showed maximum average height than the plants in rest of the treatments. However heights of seedlings in T5, T6 and T8 showed uniform increase throughout the period of experiment indicating the stable growth.

**Table No. 02: Effect of various AM treatments on the height of mango seedlings (in cm)**

Treatments	No. of Days												
	0	30	60	90	120	150	180	210	240	270	300	330	360
T1	18.26	18.72	19.73	21.1	22.01	22.91	23.84	<b>24.63</b>	<b>27.3</b>	27.4	27.44	27.89	28.25
T2	12.74	14.46	15.81	16.74	<b>18.4</b>	<b>24.68</b>	27.75	29.7	31.43	43.5	45.85	<b>50.9</b>	<b>56.55</b>
T3	12.3	12.83	13.06	13.6	14.2	16.68	18.22	19.48	20.78	21.67	<b>22.07</b>	<b>27.65</b>	27.85
T4	13.1	15.32	17.2	18.65	19.73	21	23.01	25.28	26.6	26.68	27.76	<b>29.52</b>	<b>32.95</b>
T5	12.78	15.38	<b>16.7</b>	<b>20.5</b>	22.2	<b>24.5</b>	<b>27.4</b>	30.75	32.93	34.37	35.06	37.03	<b>40.3</b>
T6	22.6	22.65	23.4	24.33	25.83	27.48	29.63	30.7	37	39.05	40.75	41.25	<b>44.65</b>
T7	17.9	18.48	19.76	21.02	22.04	23.24	25.08	28.03	31.1	36.05	37.5	38.25	<b>39.08</b>
T8	15.06	16.2	17.72	18.76	19.92	21.7	23.84	24.58	25.4	26.73	27.17	28.47	32.63
F test							S						S
C.D. (0.5%)							13.25						10.89

#### 2. Number of Leaves:

- Plants under T6 showed highest No. of leaves (13.33 & 25.67) at 180 days and 360 days respectively.
- Results of T6 were competitive to T2 i.e. treatment with only chemical fertilizer.
- The results are superior over control (T1).

**Table No. 03: Effect of various nutrient treatments on number of leaves per seedling.**

Treatments	No. of leaves per seedling		
	Zero DAS	180 DAS	360 DAS
T1	1.33	6.33	14
T2	2	11	21.67
T3	2.33	9.67	20.33
T4	2.67	12.33	21.33
T5	2.67	11.33	18
T6	3.67	13.33	25.67
T7	2.33	11.33	22.33
T8	1.33	10	24.33
F-test	S	S	S
C.D.(0.5%)	1.66	4.5571	2.80474



### 3. Stem Girth (cm):

With respect to stem girth at first node and collar region, treatment T5 (0.40 & 0.55) and T6 (0.40 & 0.60) were superior to verun-inoculated control T1 as well as chemical control T2.

**Table No. 04: Effect of various nutrient treatments on Mean stem girth (cm) at collar and first node region of the seedlings**

Treatment	First node			Collar region		
	Zero DAS	180 DAS	360 DAS	Zero DAS	180 days	360 dys
T1	0.22	0.30	0.55	0.31	0.45	0.6
T2	0.17	0.25	0.55	0.22	0.35	0.75
T3	0.14	0.25	0.35	0.2	0.40	0.45
T4	0.2	0.35	0.45	0.25	0.40	0.70
T5	0.25	0.40	0.55	0.25	0.45	0.80
T6	0.25	0.40	0.60	0.29	0.50	0.80
T7	0.18	0.30	0.50	0.18	0.35	0.75
T8	0.19	0.40	0.50	0.22	0.45	0.65
F-test		S	S		S	S
C.D. (0.5%)		0.06299	0.0839		0.06299	0.11972

### 4. Root length (cm):

- T7 exhibited better effect on root length (36 cm) at 360 days followed by T6 (26.45 cm & 31.45) at both 180 and 360 days, as compared to T2 i.e. treatment with only chemical fertilizer.
- In case of shoot length, plants in T6 showed highest values (29.5 cm & 43.8 cm) at 180 days as well as 360 days than any other AM treatment and also the treatment with chemical fertilizer at both 180 and 360 days intervals.

**Table No. 05: Effect of various nutrient treatments on Mean root length (cm) of the experimental seedlings**

Treatment	Root length (cm)	
	180 DAS	360 DAS
T1	18.05	25.15
T2	16	30.6
T3	15.6	23.4
T4	20	25.6
T5	16.95	29.45
T6	26.45	31.45
T7	16.1	36
T8	19.7	23.5



### 5. Fresh and Dry weight of shoot:

Fresh and dry weight (g) of shoot was determined separately by uprooting the plants from each treatment and calculating average.

- Over all, average shoot fresh weight of plants in T2 was found to be maximum (34.4g & 14.7g) at 180 days as well as 360 days. Shoot fresh wt. for plants in T8 was found to be increased at 360 days which is highest of all the treatments.
- However, shoot dry wt. was maximum (5.34g & 12.68g) for plants under T6 at both time intervals.

**Table No. 06: Effect of various nutrient treatments on Shoot Fresh and Dry weights (g) of the seedlings**

Treatment	Fresh wt (g)		Dry wt. (g)	
	180 DAS	360 DAS	180 DAS	360 DAS
T1	7	12.08	2.34	4.04
T2	8.1	34.4	3.46	14.7
T3	7	8.74	2.81	3.51
T4	7.13	18.09	2.98	7.9
T5	7.3	26.07	2.83	10.11
T6	9.85	23.38	5.34	12.68
T7	7.83	22.81	3.15	9.18
T8	11.2	36.98	2.78	9.18
F-test	S	S	S	S
C.D. (0.5%)	3.53133	4.06682	2.134849	1.28864

### 6. Fresh and Dry weight of root:

Fresh and dry weight (g) of root was determined separately by uprooting the plants from each treatment and calculating average.

Plants under treatment T6 showed overall highest root fresh&dry wt. (6.1g & 2.19g) at 180 DAS interval. However, Final maximum root fresh & dry wt. (29.78g & 8.34g) was determined for plants in treatment T7.

**Table No. 07: Effect of various nutrient treatments on Root fresh and Dry weight (g) of the seedlings**

Treatment	Fresh wt (g)		Dry wt (g)	
	180 DAS	360 DAS	180 DAS	360 DAS
T1	6	11.16	1.93	3.59
T2	5	14.74	1.93	5.69
T3	4.5	4.97	1.61	1.78
T4	4.2	13.11	1.25	3.9
T5	6.4	23.54	1.87	6.88
T6	6.1	11.56	2.19	4.15
T7	5.25	29.78	1.47	8.34
T8	4.5	11.68	1.66	4.31
F-test	S	S	S	S
C.D. (0.5%)	2.86498	4.909231	1.3177	0.9207



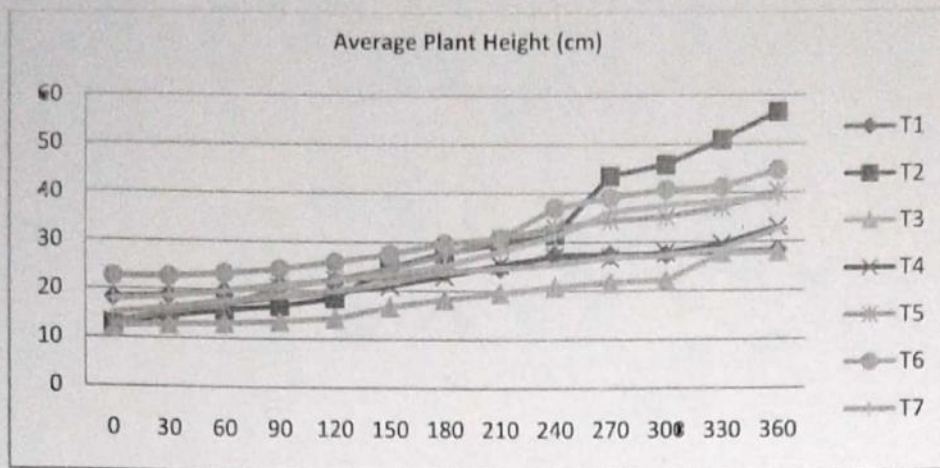


Fig. No.01. Average plant height at 30 days interval up to 360 days in all treatments

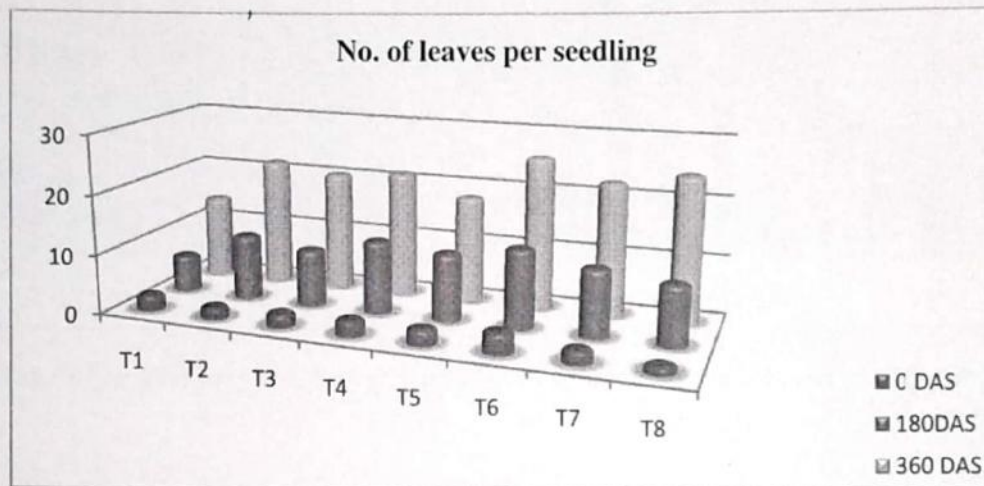


Fig. No. 02: Average No. of Leaves per seedling

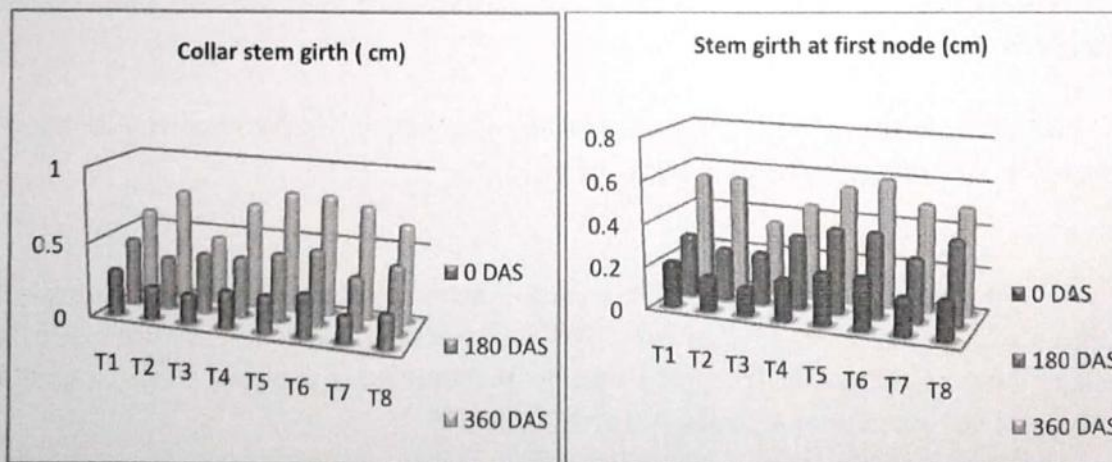


Fig.3a&b: Average Stem Girth (cm) per plant at collar region & First Node



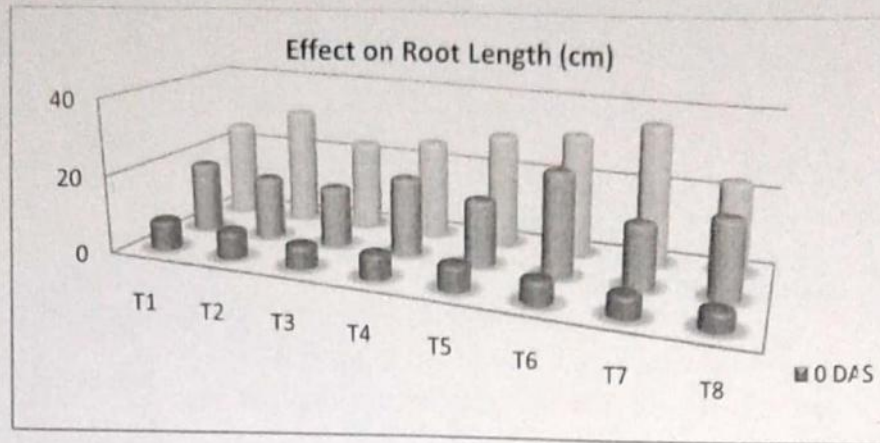


Fig. No. 04: Average length Root (cm) of seedling in all treatments

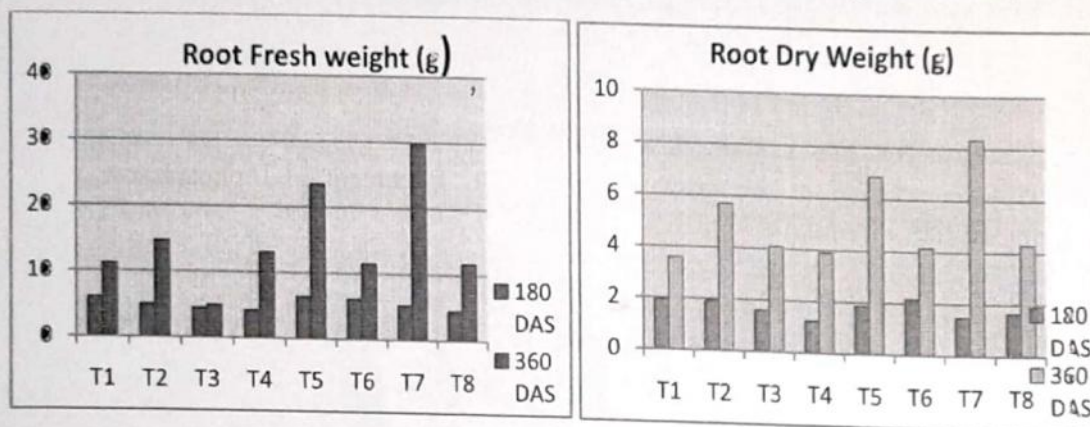


Fig. No. 05a & b: Average Fresh weight (g) and Dry weight (g) of root at 180 day and 360 days.

#### CONCLUSION:

- Treatment with only chemical fertilizer (T2) showed good influence on almost all the selected parameters of test plants.
- Effect of the treatments involving AM Inocula, especially in combination with chemical fertilizer was comparable with that of chemical fertilizer alone.
- Among the treatments including AM Inoculum, Treatment T6(100% chemical fertilizer + 50% dose of AM Inoculum), T7(50% chemical fertilizer + 100% dose of AM Inoculum) exhibited better potential of influencing growth of test plants. It suggests efficient mobilization of chemical fertilizer applied to plant which otherwise becomes insoluble and accumulates in the soil.



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