

Influence of organic-inorganic and biofertilizers and their interactions on number of fruits per tree and average weight of fruit of sweet orange (*Citrus sinensis* Osbeck L.)

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ABSTRACT

Sweet orange trees were treated with recommended doses of fertilizers along with *Azospirillum* (10 g) and PSB (10 g) by mixing with FYM. The application of biofertilizers significantly increases the number of fruits per tree and average weight of fruit. The interactions were also found to have significant influence on number of fruits per tree and average weight of fruit. The results have shown positive response to soil inoculation of *Azospirillum* and PSB by increasing nitrogen fixation and nutrition status, respectively. The flowers increase with increasing fertility status and organic matter content of soil.

Key words : *Azospirillum*, Phosphate solubilizing bacteria (PSB) R.D.F., N, P, K content, Sweet orange, Citrus

INTRODUCTION

Sweet orange is important fruit crop. India endowed with varied agro climatic condition where wide range of citrus species can be grown on commercial scale (Shyam Singh *et al.*, 1996). So there is need to increase sweet orange production. Balanced fertilizer application is one of important factors for getting maximum yield and quality fruits. Large scale use of chemical fertilizers cause problems of ground water and environmental pollution through leaching of volatization, respectively. The disproportionate use of fertilizer has widened soil imbalance in terms of NPK ratio. A national assessment of nutrient efficiency reveals that nitrogen deficiency is universal and will continue. In future nearly 49 and 29 per cent of Indian soils are deficient in phosphorus and potassium, respectively. It has now been realized that use of chemical fertilizers must be integrated through more economic, renewable and environmental friendly organic fertilizer and biofertilizers. Sweet orange responds very well to nutrient management.

MATERIALS AND METHODS

Experiment was conducted on eight years old sweet orange (variety Nuceller) on Jambheri root stock trees of uniform growth. They were spaced at 6 x 6 meters. An experiment was started in Mrig bahar (April - May) in year 2003 a subsequent second trial was conducted in Mrig bahar (April - May) in year 2004. The design of experiment was Factorial Randomized Block Design with ten treatments and was replicated thrice. The plot unit for each treatment consists of one tree.

- Recommended doses of inorganic fertilizer @ 800: 400: 400 NPK gm / tree
- Recommended dose of FYM @ 50 kg /tree
- Applied dose of bio fertilizers @ *Azospirillum* @ 10 gm / tree, PSB @ 10 gm / tree

Well rotten FYM was applied to the respective plot as per treatment at beginning. Half dose of nitrogen and full doses of phosphorus and potassium were applied in the form of urea single super phosphate and murate of potash in the month of June 2001 and June 2002 remaining half dose of nitrogen was given one and half month after.

Treatment details (I)			
	Sr. No	Symbol	Treatments
Factors – 1	1	F ₀	No application of NPK
A. Organic and inorganic fertilizers	2	F ₁	25% of recommended dose of NPK&FYM
	3	F ₂	50% of recommended dose of NPK&FYM
	4	F ₃	75% of recommended dose of NPK&FYM
	5	F ₄	Recommended dose of NPK&FYM
	Factor – 2	1	B ₀
B. Bio fertilizer	2	B ₁	Application of the <i>Azospirillum</i> & PSB (Soil inoculation)

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Treatment details (II)			
Sr. No.	Treatment No.	Treatment combinations	Treatment detail
1.	T ₁	F ₀ B ₀	No application of fertilizers
2.	T ₂	F ₀ B ₁	Application 10 gm <i>Azospirillum</i> + 10 gm PSB
3.	T ₃	F ₁ B ₀	200:100:100 NPK: and 12.5kg FYM
4.	T ₄	F ₁ B ₁	200:100:100 NPK: and 12.5 kg FYM + 10 gm <i>Azospirillum</i> + 10gm PSB
5.	T ₅	F ₂ B ₀	400:200:200 NPK and 25kg FYM
6.	T ₆	F ₀ B ₁	400:200:200 NPK, 25kg FYM + 10gm <i>Azospirillum</i> + 10 gm PSB
7.	T ₇	F ₃ B ₀	600:300:300 NPK + 37.5 kg FYM
8.	T ₈	F ₃ B ₁	600:300:300 NPK + 37.5 kg FYM + 10gm <i>Azospirillum</i> +10 gm PSB
9.	T ₉	F ₄ B ₀	800:400:400gm NPK + 50kg FYM (Control)
10.	T ₁₀	F ₄ B ₁	800:400:400gm NPK + 50kg FYM +10gm <i>Azospirillum</i> +10 gm PSB

Bio fertilizers such as *Azospirillum* and PSB were given both through soil inoculation. For Number of fruit harvesting was carried out. yield in respect of Number of fruits per tree was calculated. Five randomly selected fruits were weighed from each treatment and average weight of fruit (g) was computed.

RESULTS AND DISCUSSION

In the present investigation significant influence of organic and inorganic fertilizer was observed (Table 1). The levels of fertilizers in regard to number of fruits per tree and average weight of fruits indicated that trees without fertilizers or supplied with lower dose of fertilizer produced less number of fruits per tree and average weight of fruits as compared to trees receiving full dose of RDF (*i.e.* 800g: 400 g: 400 g + 50 kg FYM) per trees per year. Number of fruits per tree and average weight of fruits significantly increased with the increasing levels of organic and inorganic fertilizers (Table 1 and 2). The average weight of fruits was observed to be increased significantly

due to application of RDF (800g: 400g: 400g + 50 kg FYM). The least number of fruits and lowest weight was observed in trees without fertilizers. These finding are in accordance with Sharma and Azad (1991) who reported that, Max fruit weight and number of fruits were recorded with increasing levels of fertilizers. In citrus Gawande *et al.* (1998) also reported that application of inorganic fertilizers (NPK) at recommended rate produced highest on of fruits per tree and highest weight of fruits.

The application of bio fertilizers also recorded significant increase in no of fruits and average weight of fruits as compared the trees without bio fertilizers. Number of fruits per tree and average weight of fruits was higher when *Azospirillum* @ 10g and PSB @ 10g were applied. This is in similar line with findings of Sankarnarayana *et al.* (1995) in okra. They reported that application of recommended 'N' with *Azospirillum* produced highest number of fruits per plant.

The interaction effect was also significantly increased number of fruits and average weight of fruit (Table 2 and 3). This indicated that when recommended

Table 1 : Influence of organic, inorganic and biofertilizers on number of fruits / tree

Treatments symbol	2001-02	2002-03	Pooled
F ₀	456.00	466.67	461.33
F ₁	484.33	592.50	488.42
F ₂	554.67	568.33	561.50
F ₃	628.50	633.33	630.92
F ₄	621.67	631.67	626.67
Mean	549.03	558.50	553.76
S.E. ±	5.094	5.183	3.78
C.D. (P=0.05)	15.11*	15.37*	11.23*
B ₀	527.27	513.33	532.80
B ₁	570.80	538.33	574.73
Mean	549.03	578.67	553.76
S.E. ±	3.222	3.278	2.39
C.D. (P=0.05)	9.55*	9.82*	7.10*

* indicates significance of value at P=0.05

Table 2 : Influence of organic, inorganic and Bio-fertilizers average wt. of fruit (g)

Treatment symbol	2001-02	2002-03	Pooled
F ₀	124.47	129.47	126.97
F ₁	134.23	139.23	136.73
F ₂	142.77	150.60	146.68
F ₃	163.57	167.57	165.57
F ₄	167.20	171.70	169.45
Mean	146.45	151.71	149.07
S.E.±	1.69	1.33	1.106
C.D. (P=0.05)	5.03*	3.96*	3.28*
B ₀	144.70	150.17	147.43
B ₁	148.19	153.26	150.72
Mean	146.45	151.71	149.07
S.E.±	1.07	8.45	0.70
C.D. (P=0.05)	3.18*	2.50*	2.07*

* indicates significance of value at P=0.05

Table 3 : Influence of interactions on number of fruits / tree

Treatments symbol	2001-02	2002-03	Pooled
F ₀ B ₀	440.00	453.33	446.67
F ₀ B ₁	472.00	480.00	476.00
F ₁ B ₀	467.00	475.00	471.00
F ₁ B ₁	501.67	510.00	505.83
F ₂ B ₀	530.67	546.00	538.67
F ₂ B ₁	578.67	590.00	587.33
F ₃ B ₀	588.67	596.67	592.67
F ₃ B ₁	668.33	670.00	669.17
F ₄ B ₀	610.00	620.00	615.00
F ₄ B ₁	633.33	643.00	638.33
Mean	549.03	558.50	553.76
S.E.±	7.20	7.33	5.35
C.D. (P=0.05)	21.37*	21.74	15.89*

* indicates significance of value at P=0.05

Table 4 : Influence of interactions on average wt. of fruit (g)

Treatment symbol	2001-02	2002-03	Pooled
F ₀ B ₀	124.70	128.70	126.70
F ₀ B ₁	124.23	130.23	127.23
F ₁ B ₀	131.70	136.70	134.20
F ₁ B ₁	136.77	141.77	139.27
F ₂ B ₀	140.63	149.97	145.30
F ₂ B ₁	144.90	151.23	148.07
F ₃ B ₀	156.87	161.87	159.37
F ₃ B ₁	170.27	173.27	171.77
F ₄ B ₀	169.60	173.60	171.60
F ₄ B ₁	164.80	169.80	167.30
Mean	146.45	151.71	149.07
S.E.±	2.40	1.88	1.59
C.D. (P=0.05)	7.12*	5.60	4.65

* indicates significance of value at P=0.05

dose of fertilizer applied along with biofertilizers (*Azospirillum* and PSB) resulted in increased number of fruits and average weight of fruit. Numbers of fruits per tree, and fruit weight increased with application of biofertilizers. The increased in number of flowers and

fruit set was also noticed by Sankarnaryana *et al.* (1995) and Parvatham *et al.* (1989) in okra due to application of biofertilizers. The reason behind, the increase in number of fruits and average fruit weight may be due to increased nutrient availability from FYM, the organic phosphorus through phospho bacteria and IAA from *Azospirillum* which may have increased various endogenous hormonal levels in plant tissue which might be responsible for enhancing flowering, pollen germination and pollen tube which might have ultimately increased fruit set (Rajgopal and Rao, 1974).

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