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Effects of Humic Acid, Vermiwash, and Biofertilizer on Seedling Growth of Soursop (*Annona muricata* L)

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ABSTRACT: The study on effect of humic acid, vermiwash and biofertilizer on growth and establishment of soursop was conducted under open condition during 2020-21 at College of Horticulture, Dept. of Fruit Science, Bengaluru. Seedlings were raised in polythene bags of 12 × 24cm, then single seed was sown into every polybags containing media mixtures of Soil, FYM (1:1) treated with humic acid, vermiwash and biofertilizers as per treatment and these bags were kept under open condition. A total of twelve treatments were tested in three replications. The results showed that the inoculation of combination of humic acid (3%), vermiwash (1%) and three bio-fertilizers; *Azospirillum*, spp. *Pseudomonas fluorescence* and *AM* fungi (2g/ seedling) had produced significantly highest seedling height (39.00 cm), seedling girth (5.98 mm), number of leaves (25.20 no.), leaf area (49.00 cm^2), fresh and dry Weight of shoot (30.66 and 8.10 g respectively) in T_{12} treatment the findings are similar with that of Peters et al., 2001.The maximum fresh and dry weight of root (19.40 and 2.80 g), number of primary roots (33.00), length of primary root (25.00 cm) and root volume (5.20 cm^3) was also recorded in the T_{12} treatment at the end of 120 days in the nursery.

Keywords: Soursop, humic acid and vermiwash, biofertilizer, *Annona muricata*.

INTRODUCTION

Soursop/Lakshman Phal (*Annona muricata*) belongs to the family Annonaceae, having diploid chromosome number 2n=14. It is wide spread in the tropics and frost free subtropics of the world (Samson, 1980). The soursop plant is cultivated mainly in home gardens. The eachtree yields up to 10 tons/ha with average each fruit weighs 0.5 to 2 kg. The fruit is compound in and covered with reticulated, leathery appearing but tender, inedible bitter skin from which protrude few or many stubby, or more elongated and curved soft, pliable "spines". The skin is dark-green in the immature fruit, becoming slightly yellowish-green before the mature fruit is soft to the touch. In aroma, the pulp is somewhat pineapple-like, but its musky, subacid to acid flavor is unique (Schultes and Raffauf 1990). It is indigenous to most of the warmest tropical areas in South and North America including Amazon, it has become naturalized in many countries, and now has a wide distribution throughout tropical and subtropical parts of the world. The fruit makes an excellent drink or ice cream after straining. All parts of the tree are used in natural medicine in the tropics including the bark, leaves, root and fruit-seeds. The crushed seeds are used as an anthelmintic against internal and external parasitic worms. The bark leaves and roots are considered sedative, antispasmodic, hypoglycemic, hypotensive, smooth muscle relaxant and nervine and a tea is made for various disorders for those purposes (Holdsworth, 1990). Many bioactive compounds and phytochemicals have been found in plants and its various uses in natural medicine have been scientifically validated by many researchers (Heinrich, 1992; Sundarrao, 1993). Generally, the fruit and fruit juice is taken for worms and parasites, to cool fevers, to increase mother's milk after childbirth (lactagogue), and as an astringent for diarrhea and dysentery. Soursop contains antibacterial, antiviral and antifungal properties. So this is a good source of medicine the juice of ripe fruit is said to be a diuretic, while a decoction of powdered immature fruits is used for dysentery remedy.

In India, the average productivity of soursop is roughly 25-40 kg per plant. Soursop is only grown in small

scale in the southern Indian states of Tamil Nadu, Karnataka, Andhra Pradesh, and Kerala. Soursop has a high economic value, it is widely cultivated and consumed as edible food. White fibrous juicy segments surround an extended receptacle in the fruit pulp. It could be used as a raw material for purees, juices, jams, jellies, powdered fruit bars, and flakes. The pulp can be used to make nectar (Peters *et al*., 2001). Soursop contains antibacterial, antiviral and antifungal properties. So this is a good source of medicine. The juice of ripe fruit is said to be a diuretic, while a decoction of powdered immature fruits is used for dysentery remedy.

MATERIAL AND METHODS

The present study on effect of humic acid, vermiwash and biofertilizer on growth and establishment of soursop was conducted under open condition during 2020-21 at Fruit Science Dept. College of Horticulture, Bengaluru. Seedlings were raised in polythene bags of 12 × 24 cm, then single seed was sown into every polybags containing media mixtures of Soil, FYM (1:1) ratio treated with humic acid, vermiwash and biofertilizers per treatment and these bags were kept under open condition. The design RBD was used for the experiment, there were twelve treatments with three replications.

RESULT AND DISCUSSION

The results showed that the inoculation of combination of humic acid, vermiwash and three bio-fertilizers; *Azospirillum*, spp. *Pseudomonas fluorescence* and *AM* fungi had produced significantly highest seedling height (39.00 cm), seedling girth (5.98 mm), number of leaves (25.20 no.), leaf area (49.00 cm^2), fresh and dry Weight of shoot (30.66 and 8.10 g respectively) in the treatment T_{12}: [Humic Acid (3%) + Vermiwash (1%) + *Azospirillum* spp (2g / seedling) + *Pseudomonas fluorescence* (2g / seedling) + *AM Fungi* (2g / seedling)]. And the maximum fresh and dry weight of root (19.40 and 2.80 g), number of primary roots (33.00), length of primary root (25.00 cm) and root volume (5.20 cm^3) was also recorded in the treatment T_{12}: [Humic Acid (3%) + Vermiwash (1%) + *Azospirillum* spp (2g / seedling) + *Pseudomonas fluorescence* (2g / seedling) + *AM Fungi* (2g / seedling)] at the end of 120 days in nursery.

Table 1: Effects of humic acid, vermiwash, and biofertilizer on soursop seedling growth (*Annona muricata* L).

Treatments	Seedling height (cm)	Seedling girth (mm)	Number of leaves	Leaf area $(cm)^2$	Fresh weight of shoot (g)	Dry weight of shoot (g)
T_1: Water sprays (Control)	22.00	4.83	18.03	34.00	23.00	4.90
T_2: GA_3 (250 ppm)	35.80	5.23	20.40	46.00	27.00	6.50
T_3: Humic Acid (3%) + *Azospirillum* spp (2g/ seedling)	31.50	5.03	19.03	41.00	26.00	5.33
T_4: Humic Acid (3%) + *Pseudomonas fluorescence* (2g/ seedling)	31.00	5.16	20.60	42.00	24.00	6.00
T_5 : Humic Acid (3%) + AM Fungi (2g/ seedling)	32.00	5.06	18.23	41.00	26.00	5.93
T_6: Humic Acid (3%) + *Azospirillum* spp (2g/ seedling)+ *Pseudomonas fluorescence* (2g/ seedling)	31.20	5.40	22.90	37.00	25.00	5.50
T_7: Humic Acid (3%) + *Azospirillum* s pp (2g/ seedling) + AM Fungi (2g/ seedling) + *Pseudomonas fluorescence* (2g/ seedling)	32.33	5.53	20.36	40.00	26.00	7.00
T_8: Vermiwash (1%) + *Azospirillum* spp (2g/ seedling)	31.50	5.40	22.13	45.00	28.00	7.20
T_9: Vermiwash (1%) + *Pseudomonas fluorescence* (2g/ seedling)	35.50	5.60	18.93	43.00	25.00	7.20
T_{10} : Vermiwash (1%) + AM Fungi (2g/ seedling)	36.33	5.53	23.20	48.00	28.00	7.00
T_{11}: Vermiwash (1%) + *Azospirillum* spp (2g/ seedling) + *Pseudomonas fluorescence* (2g/ seedling)+ AM Fungi (2g/ seedling)	37.00	5.83	24.20	48.00	29.53	7.46
T_{12}: Humic Acid (3%) + Vermiwash (1%) + *Azospirillum* spp (2g/seedling) + *Pseudomonas fluorescence* (2g/seedling) + AM Fungi (2g/ seedling).	39.00	5.98	25.20	49.00	30.66	8.10
S.Em±	1.25	0.12	0.10	0.85	0.12	0.14
CD at 5%	3.66	0.34	0.30	2.48	0.35	0.40

Table 2: Effects of humic acid, vermiwash, and biofertilizer on soursop root growth (*Annona muricata* L).

Treatments	Fresh weight of root (g)	Dry weight of root (g)	Number of primary roots	Length of primary root (cm)	Root volume (cm3)
T_1: Water sprays (Control).	13.60	1.50	26.00	20.00	2.30
T_2: GA_3 (250 ppm)	17.10	2.30	29.00	22.00	4.10
T_3: Humic Acid (3%) + *Azospirillum* spp (2g/ seedling)	14.00	2.00	31.00	21.00	3.10
T_4: Humic Acid (3%) + *Pseudomonas fluorescence* (2g/ seedling)	15.73	2.20	30.00	22.00	4.00
T_5 : Humic Acid (3%) + *AM Fungi* (2g/ seedling)	14.50	1.90	29.00	22.00	3.50
T_6: Humic Acid (3%) +*Azospirillum* spp (2g/ seedling)+ *Pseudomonas fluorescence* (2g/ seedling)	14.40	1.80	28.00	23.00	3.00
T_7: Humic Acid (3%) + *Azospirillum* spp (2g/ seedling)+ *AM Fungi* (2g/ seedling)+ *Pseudomonas fluorescence* (2g/ seedling)	14.60	2.00	30.00	21.00	4.10
T_8: Vermiwash (1%) + *Azospirillum* spp (2g/ seedling)	14.40	2.10	29.00	22.00	4.20
T_9: Vermiwash (1%) + *Pseudomonas fluorescence* (2g/ seedling)	14.13	1.60	30.00	22.00	4.40
T_{10} : Vermiwash (1%) + *AM Fungi* (2g/ seedling)	17.50	2.20	32.00	23.00	5.00
T_{11}: Vermiwash (1%) + *Azospirillum* spp (2g/ seedling)+ *Pseudomonas fluorescence* (2g/ seedling)+ *AM Fungi* (2g/ seedling)	18.30	2.40	33.00	24.00	5.15
T_{12}: Humic Acid (3%) + Vermiwash (1%) + *Azospirillum* spp (2g/seedling) + *Pseudomonas fluorescence* (2g/seedling) + *AM Fungi* (2g/ seedling).	19.40	2.80	33.00	25.00	5.20
S.Em±	0.14	0.12	0.17	0.16	0.10
CD at 5%	0.42	0.36	0.51	0.47	0.30

CONCLUSION

Humic acid is a naturally occurring mixture of organic macromolecular molecules that can be found in all soils. It's an organically charged bio-stimulant that boosts crop output by influencing plant growth and development owing to their distinct physiological characteristics, it has been thoroughly studied (Quaggiotti *et al*., 2004). Vermiwash is a rich source of vitamins, hormones, enzymes, macronutrients and micronutrients when applied to plants help in efficient growth Nath *et al*, (2009). Bio-fertilizers are microbial preparations containing living cells of different microorganisms which have the ability to mobilize plant nutrients in soil from unusable to usable form through biological process and they are environmental friendly and play significant role in crop production. *Azospirillum* is a non-symbiotic micro aerophilic bacterium commonly found in association with roots of horticultural crops. *Pseudomonas fluorescens* is a ubiquitous bacterium that help in the maintenance of soil health and are metabolically and functionally most diverse. The treatment (T_{12}) was found best with respect to the parameters like Seedling height, Seedling girth, Number of leaves, Leaf area, Fresh weight of shoot, Dry weight of shoot, Fresh weight of root, Dry weight of root, Number of primary roots, Length of primary root and Root volume over other treatments.

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Conflict of Interest. None.

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