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Study the bio-efficacy and product impact of opteine on fruit set and yield in mango (*Mangifera indica*) cv. Alphonso

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Abstract

Alphonso is one of the choicest variety of mango grown in the Konkan region of Maharashtra. Fruit drop is the major problem in mango cv. Alphonso. In order to reduce fruit drop the present investigation entitled "Study the Bio-efficacy and product impact of opteine on fruit set and yield in mango (*Mangifera indica*) cv. Alphonso" was conducted at Regional Fruit Research Station, Vengurle. The foliar spray of opteine was carried out at three times viz., first at full bloom stage, second at 15 days and third at 30 days after first spraying. The experiment was carried out with Randomized Block Design with four replications and six treatments viz., 4ml, 5ml, 6ml, 7.5ml, 12.50 ml opteine/ 10 lit. of water and water as control. The mango tree sprayed with opteine 6ml/ 10 lit. of water concentration was recorded significantly the highest fruit set 12.41, 6.75 and 1.68 per cent fruit per panicle at pea nut stage, marble stage and at harvest, respectively. Significantly the highest fruit weight (270.75 gm), fruit per tree (319.84) and shelf life (15.50 days) was recorded in the treatment T₃ (opteine 6 ml/ 10 lit. of water). With regards to chemical composition, T.S.S., acidity, reducing, non reducing and total sugars at ripe stage were better in opteine treated fruits as compared to control. Sensory evaluation of Alphonso mango fruits indicated that T₃ treatment (opteine 6ml/10 lit. of water) was superior over control and better than other treated fruits.

Keywords: Fruit set, yield, opteine, chemical composition, shelf life, Alphonso

Introduction

Mango (*Mangifera indica* L.) is a typically tropical fruit and can be found throughout India. It has important participation in the Indian market of fresh fruits, especially when these are destined for export. Alphonso mango is one of the choicest varieties grown in the Konkan region of Maharashtra. More than 90% of area is under Alphonso mango in the Konkan on which economy of most of mango growers is dependent. Fruit drop is major problem in Alphonso mango. Opteine is seaweed (*Ascophyllum nodosum*) extract of organic and biodegradable in nature and it is considered as an important source of nutrition for sustainable agriculture. The extract of seaweeds has been reported to induce many positive changes in treated plants such as improved crop yield, increased nutrient uptake and resistance to frost and stress conditions (Cassan *et al.*, 1992) [3].

Owing to the fact that the world's population increases, demand for horticultural products is great. New insights and techniques are required in order to achieve sufficient and sustainable yields to meet global food demand and prevent world hunger. Therefore, Research in this field is strongly oriented towards searching and testing the effectiveness and efficiency of new products.

Seaweed extract (SWE) have been used for several decades to enhance plant growth and productivity; by the development of non-pollution organic biostimulants, which increase plant growth, vigour, crop yield and quality through increasing efficiency of nutrients and water uptake. Seaweed products exhibit growth stimulating activities, and the use of seaweed formulations as biostimulants in crop production is well established.

This study aimed to throw some light of the prospective on the use of a seaweed extract (SWE) product of opteine to promote the yield quantitatively and qualitatively of "Alphonso" mango trees.

Materials and methods

The present experiment was conducted on plot No. 17 of mango farm, Regional Fruit Research Station, Vengurle, under Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli (MS) during the year 2015-16. Total 60 Alphonso mango plants were selected at full bloom stage. The foliar spray of opteine was carried out at three times *viz.*, first at full bloom stage, second at 15 days after first spraying and third at 30 days after first spraying. The experiment was carried out with Randomized Block Design with four replications and six treatments *viz.*, 4ml, 5ml, 6ml, 7.5ml, 12.50 ml opteine/ 10 lit. of water and water as control. Twenty five inflorescence were selected for observation per tree. Observation on yield attributes were noted at peanut stage, marble stage and at harvest stage. Total number of fruits, fruit weight were recorded as per the treatment.

Alphonso mango fruits were harvested at 'B' stage of physiological maturity (85% maturity). After harvest, fruits were first pre-cooled in pre-cooling unit to remove field heat and then allow to ripe at ambient temperature. For quality assessment, fruit samples were used for physico-chemical parameters namely TSS (⁰Brix), acidity (%), reducing sugars (%), total sugars (%) and non reducing sugars (%) and sensory qualities.

Results and Discussion

Effect of opteine on Fruit set, yield attributing characters and shelf life of mango fruits cv. Alphonso

The data relevant to fruit set, yield attributing characters and shelf life are presented in Table No.1, indicated that fruit set at pea nut stage, marble stage, fruit at harvest and yield per tree were significantly varied among all the different treatments under study. Mango tree sprayed with opteine 6 ml/ 10 lit. of water concentration was recorded significantly the highest fruit set 12.41, 6.75 and 1.68 per cent fruit per panicle at pea nut stage, marble stage and at harvest, respectively. However, the lowest fruit set was recorded in control i.e. 9.26, 3.76, 1.0 per cent fruits/panicle at peanut stage, marble stage and harvest stage, respectively. All the tree sprayed with different opteine concentration was showed maximum fruit at different stage than the control. In mangoes, the effects of Biovita biofertilizer based on *A. nodosum* were observed in mangoes of the Dashehari cultivar, which presented higher productivity than untreated mangoes (Reddy *et al.*, 2011) [15]. Seaweed concentrates triggers early flowering and fruit set in a number of crop plants (Arthur *et al.*, 2003) [2]. In many crops yield is associated with the

number of flowers at maturity. As the onset and development of flowering and the number of flowers produced are linked to the developmental stage of plants, seaweed extracts probably encourage flowering by initiating robust plant growth. Yield increases in seaweed-treated plants are thought to be associated with the hormonal substances present in the extracts, especially cytokinins.

Further, fruit weight, number of fruits per tree and shelf life was significantly varied among different treatments. Significantly the highest fruit weight (270.75 g) was recorded in treatment T₃ (opteine 6 ml/10 lit. of water) while, the lowest (225.94 g) was recorded in control. Significantly the highest fruit per tree (319.84) was recorded in T₃ treatment (6ml opteine/ 10 lit. of water) and lowest fruit per tree (201.75) was recorded in control. Mango fruits treated with opteine 6 ml/ 10 lit. of water (T₃ treatment) was recorded significantly the highest shelf life (15.50 days) and the lowest shelf life (12.75 days) in control. Mohamed and Osama (2013) [12] reported that the economical point of view treating the mango trees three times with seaweed extracts at 0.2 % gave the best results with regard to yield.

Norrie and Keathley (2006) [13] have reported that *A. nodosum* extracts showed positive effects on the yield of 'Thompson seedless' grape (*Vitis vinifera* L.) consistently over a 3 year period. So, increasing yield by seaweed extract (SWE) spraying may be due to association with its hormonal substances present especially cytokinins (better mobilization photosynthesis). The promoting effect of seaweed extract (SWE) on growth and nutritional status of the trees surely reflected on making C/N ratio in favour of producing more fruits. These results are in agreement with those obtained by El-Sawy (2005) [6]; Hegab *et al.* (2005) [8]; Abd El- Motty-Elham *et al.* (2010) [11] and El- Sayed- Esraa (2010) [7]. Silva *et al.* (2014) [17] demonstrated that the application of *A. nodosum* extract in strawberry leaves resulted in less intense red fruits, that is, with a more open color angle when compared to control. This is probably related to the high capacity of the extract to increase plant resistance to diverse abiotic stresses, as already reported for vines (Mancuso *et al.*, 2006) [10], olive trees (Chouliaras *et al.*, 2009) [4] and *Arabidopsis thaliana* (Rayirath *et al.*, 2009) [14].

Effect of opteine on chemical properties of mango fruits cv. Alphonso

The data pertaining to chemical properties of mango fruits cv. Alphonso as influenced by opteine treatments are presented in Table No. 2 to 3 and results are summarized here under.

Table 1: Effect of opteine on Fruit set, yield attributing characters and shelf life of mango fruits cv. Alphonso.

Treatments	Pea nut stage (fruits/panicle)	Marble stage (fruits/panicle)	Harvest stage (fruits/panicle)	Fruit weight(g)	Yield/ Tree (Fruits/tree)	Shelf life (Days)
T ₁	10.21	5.47	1.28	242.67	250.75	14.50
T ₂	10.31	5.68	1.36	245.07	260.75	14.63
T ₃	12.41	6.75	1.68	270.75	319.84	15.50
T ₄	11.18	5.86	1.32	246.54	284.50	14.75
T ₅	11.11	5.69	1.34	253.63	250.33	14.38
T ₆	9.26	3.76	1.00	225.94	201.75	12.75
SEm±	0.15	0.08	0.03	2.45	10.64	0.32
CD @ 5%	0.46	0.25	0.08	7.39	32.08	0.96

Effect on Total Soluble Solids (⁰Brix), pulp acidity (%) and Sensory evaluation

Data presented in Table No. 2 indicated that TSS of Alphonso mango fruit pulp ranged from 19.30 to 19.88 ⁰ Brix. Significantly the highest TSS (19.88 ⁰ Brix) was recorded in

T₃ treatment and it was at par with T₅ treatment i.e. 19.81⁰ Brix, while the lowest (19.57⁰ Brix) was recorded in control. During initial stage; there was no significant difference between treated and control fruits. In control the highest TSS was recorded on 12th days may be due to highest ethylene

production induced ripening earlier in control fruits than treated fruits. The application of *A. nodosum* extract in strawberries, both by fertigation and foliar spraying, decreased the content of soluble solids in relation to control (Silva *et al.*, 2014)^[17]. This decrease suggests the deceleration of fruit metabolism during storage, with lower sucrose hydrolysis and consequent use of reducing sugars in respiratory processes (Mishra and Kar, 2004)^[11].

Data indicated that the pulp acidity was more in treated fruits as compared to control fruits upto 16th day, which was significantly superior over control. Significantly the lowest (0.22%) acidity was recorded in control compared to opteine treated fruits. Analysis of the titrable acidity showed that there was a progressive reduction in the contents throughout the storage period in all treatments. In addition, it was verified

that the lowest contents occurred in mangoes not treated with the extract, with significant differences from treatments with *A. nodosum*. This is an indication that treatments with seaweed extract decelerate the normal process of senescence of mangoes, since the decrease in fruit acidity is associated to the consumption of acids in the respiratory process, due to maturation (De melo and De Souza, 2018; Souza *et al.*, 2011)^[5, 18].

Data presented in Table No.2 regarding sensory evaluation of Alphonso mango fruits also significantly varied among the different treatments. Highest average score 8.34 was recorded in the treatment T₃, while the lowest score (7.46) was recorded in treatment T₅ and T₆. These results are in agreement, with those obtained by De melo and De Souza (2018)^[5] in 'Tommy Atkins' mango.

Table 2: Effect of opteine on Total Soluble Solids (^oBrix), acidity (%) and Sensory qualities of mango fruits cv. Alphonso at ambient storage condition.

Treatments	Total Soluble Solids (^o Brix)				Acidity (%)				Sensory qualities			
	4 days	8 days	12 days	16 days	4 days	8 days	12 days	16 days	colour	Flavour	Texture	Average
T ₁	10.13	11.93	15.54	19.30	1.91	1.29	0.62	0.25	7.75	7.50	7.63	7.63
T ₂	10.12	12.08	15.59	19.71	1.93	1.29	0.62	0.25	8.00	7.75	7.50	7.75
T ₃	10.03	11.61	15.70	19.88	1.92	1.31	0.66	0.28	8.25	8.38	8.38	8.34
T ₄	10.16	12.16	15.27	19.74	1.92	1.31	0.63	0.29	7.63	7.75	7.38	7.59
T ₅	10.16	12.19	15.60	19.81	1.93	1.31	0.64	0.27	7.50	7.63	7.25	7.46
T ₆	10.30	12.27	15.82	19.57	1.82	1.24	0.54	0.22	7.63	7.50	7.25	7.46
SEm±	0.01	0.07	0.03	0.03	0.01	0.01	0.01	0.01	0.12	0.15	0.18	-
CD @ 1%	0.06	0.30	0.14	0.13	0.04	0.03	0.03	0.03	0.50	0.61	0.77	-

Effect on reducing sugars (%), non reducing sugars (%) and total sugars (%)

Reducing sugars content was significantly varied among all the different treatments in table No. 3. Significantly the highest reducing sugars were recorded in T₃ and T₄ treatments i.e. 4.43 per cent on 16th day of storage, whereas control recorded the lowest reducing sugars i.e. 4.23 per cent. The majority of reducing sugars are represented by glucose and fructose, non-reducing sugars by sucrose, and total soluble sugars by the sum of these three saccharides (Ribeiro, 2006)^[16]. Thus, it is clear that the consumption of sucrose increases with fruit maturation, resulting from the respiration process. In contrast, the degradation of sucrose by the invertase enzyme is accompanied by the increase of glucose and fructose, products of this catabolism, which have their levels increased with the maturation of plant organs.

Similar to the total sugars, non reducing sugars per cent was also significantly influenced due to opteine treatment during ambient temperature storage. Significantly the highest (9.99%) non reducing sugars were recorded in T₃ treatment.

However, the lowest reducing sugars were recorded in control (9.60%) at the 16th day storage.

Data indicated that total sugars percent was also significantly influenced by opteine treatment. Significantly the highest (14.94%) total sugars content of Alphonso mango pulp was recorded in T₃ treatment, while lowest in control (14.35%) at end of 16th day.

Treating mango trees with seaweed extract at 0.1 to 0.4 % twice, thrice and four times significantly improved both physical and chemical characteristics of mango fruits in terms of increasing T.S.S. %, total and reducing sugar % whereas, they decreasing total acidity % (Mohamed and Osama, 2013)^[12]. Results similar to those observed in this study were also verified by Lall *et al.* (2017)^[9] in a study that evaluated the application of *A. nodosum* extract in guavas. The authors highlight the beneficial effects of the product on the productivity of guava fruits, which were heavier and with lower concentrations of soluble solids and ascorbic acid, as well as total sugars, reducing and non-reducing sugars, similar to results presented here.

Table 3: Effect of opteine on reducing sugars (%), non reducing sugar (%) and total sugars (%) of mango fruits cv. Alphonso at ambient storage condition.

Treatments	Reducing sugars (%)				Non reducing sugar (%)				Total sugars (%)			
	4 days	8 days	12 days	16 days	4 days	8 days	12 days	16 days	4 days	8 days	12 days	16 days
T ₁	1.13	1.75	2.39	4.37	1.96	4.53	8.09	9.96	3.21	6.70	10.84	14.84
T ₂	1.13	1.81	2.33	4.32	1.97	4.53	7.85	9.90	3.22	6.59	10.99	14.77
T ₃	1.16	1.81	2.42	4.43	1.98	4.68	8.61	9.99	3.24	6.60	11.19	14.94
T ₄	1.15	1.82	2.41	4.43	1.98	4.62	8.19	9.70	3.25	6.56	11.22	14.65
T ₅	1.16	1.85	2.28	4.27	1.96	4.56	8.29	9.76	3.23	6.65	11.34	14.55
T ₆	1.21	1.99	2.25	4.23	1.93	4.39	7.77	9.60	3.23	6.60	11.69	14.35
SEm±	0.01	0.01	0.01	0.01	0.02	0.07	0.04	0.03	0.01	0.02	0.02	0.02
CD @ 1%	0.02	0.03	0.05	0.05	1.96	4.53	8.09	9.96	NS	0.09	0.07	0.08

Conclusion

The field trial conducted on "Evaluation of bio-efficacy and product impact on flowering and fruit set on mango

(*Mangifera indica*) cv. Alphonso". The tree sprayed with opteine was recorded the highest fruit set per panicle, fruit weight and number of fruit per tree as compared to control.

Trees sprayed with opteine at different concentrations showed the highest fruit set at peanut, marble and at harvest stage than control. Significantly the highest fruit weight (270.75 g), number of fruits per tree (319.84) and shelf life (15.50 days) were recorded in treatment T₃ (opteine 6 ml/10 lit. of water). Further, TSS, acidity, reducing, non reducing sugars and total sugars at ripe stage were better in opteine treated fruits as compared to control. Sensory evaluation of Alphonso mango fruits indicated that T₃ treatment was superior over control and better than other treated fruits.

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