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Bio-efficacy study of Physio-activator (opteine) on eggplant (*Solanum melongena* L.)

B Ashok Kumar and U Thapa

Abstract
The present investigation carried out to check the Bio-efficacy study of Physio-activator (opteine) on eggplant cv. Pathakatta. The test product applied as foliar spray with seven different treatments i.e. 400ml, 500ml, 600ml, 7500ml, 1250ml/ha, control and Biozyme. The statistical analysis was done using Randomized Block Design (RBD) with three replications and seven treatments. It was noticed in the experiment that application of opteine enhanced the crop growth and promoted reproductive growth in later stages of crop compared to control plants. Amongst the different concentration of opteine it was observed that when the plant is sprayed with concentration of 600 ml/ha increased yield attributing characters such as number of fruits, fruit diameter and fruit weight ultimately fruit yield increased. The other parameters like plant height, number of branches, days to fruit set and days to first harvest shows positive effect with the application opteine @ 750 ml/ha. The fruit quality parameters like Anthocynin content was also influenced significantly with application of different concentration of opteine. It may be concluded from the present investigation that the application of Physio activator (opteine) as a foliar spray was found highly economical for brinjal production.

Keywords: Eggplant, seaweed extract, Physio-activator, growth, yield, quality

1. Introduction
Vegetables are very essential to human health as they are rich in dietary fibre and source of essential vitamins, minerals, trace elements and antioxidants. Vegetables are herbaceous annuals require ample amount of nutrients within short period of time to get optimum yield. In India eggplant is a major vegetable crop, contributes 8.32% production share and 7.56% area share among total vegetable crops (NHB, 2016) [2]. India ranked 2nd position in eggplant with13.558 million MT production and 0.711 mha area (Hort. Stats, 2017) [12]. The wide diversity of eggplant in India led the availability of fruits with wide range of shapes (egg or oval, long, round) and colors (Kalloo, 1993). It contains considerable amount of CHO's, proteins, low calorific value with some minerals useful in ayurvedic medicine. The application of nutrients is major concern among production practices to optimize eggplant productivity.
Seaweed extract is new generation of natural organic source of nutrients promote the plant growth and development entire crop cycle from seed germination to plant maturity in a number of ways, including, improving the efficiency of the plant's metabolism to induce yield and enhanced crop quality (Saravanan *et al*., 2003) [17]. Seaweed liquid extract newly gained importance as foliar spray for lots of crops including various varieties of grasses, flowers, cereals, vegetables and spices (Pramanick *et al*., 2014) [16]. The seaweed extracts are good source of macronutrients (Ca, K and P) and micro-nutrients (Cu, Zn, B, Mn, Co and Mo), organic acids, vitamins, amino acids, antioxidants and composite minerals that can be recovered from its extracts (Hong *et al*. 2007; Craigie, 2011; Stirk *et al*., 2014; Herrera *et al*., 2014) [11, 5, 20, 10]. The seaweed extracts directly manipulate a wide array of responses in plants such as, root and shoot growth, superior chlorophyll content, enhanced nutrient uptake, augmented flower and fruit set leading to elevated yields, delayed senescence and longer shelf life of fruits (Khan *et al*., 2009; Stirk *et al*., 2014; Dominguez *et al*., 2014) [13, 20, 4]. Further, Zodape *et al*. (2010) [22] tried various modes of seaweed extract applications such as a foliar spray, application to soil and soaking of seeds before sowing and reported that extract not only enhances the germination of seeds but also increases uptake of plant nutrients and gives resistance to frost and fungal diseases. The use of seaweed extract as bio-fertilizers and physio-activator offers a potential solution to this problem as reported by several workers. Seaweed extracts are classified as bio-stimulants because they contain bioactive substances at low concentrations that exhibit growth-stimulating properties (Khan *et al*., 2009) [13].

Opteine is a world leading bio-stimulant in a flowable formulation of *Ascophyllum nodosum* with the Physio-activator technology, which has positive effect on plant physiology. It activates the production of flowering involved in pollination, fertilization, fruit set and cell division at early fruit growth. *Ascophyllum nodosum* is a prominent seaweed species belong to the brown algae type most commonly used in agriculture (Ugarte *et al*., 2006) [21]. According to a report by FAO, (2006) [9] a substantial amount of seaweeds (15 million metric tons annually) are used as supplement for nutrients and bio-stimulants for the production of agricultural and horticultural crops. In addition, the growth enhancing potential of the opteine might be attributed to the presence of macro and micronutrients. Though several reports are available on the use of opteine in plant culture, there has been less research on the use of this extract under tropical and sub-tropical field conditions.

The present experiment aimed to know optimum doses of opteine as a physio-activator for growth, yield and quality of brinjal.

2. Materials and Methods

The experiment was carried out in New Alluvial Zone of West Bengal, at open field, in the arena of Experiential Learning Programme under Department of Vegetable Science, Faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia (West Bengal). The soil analysis data revealed that soil of the experimental field [Sand (%) 74.2; Silt (%) 14.2; Clay (%) 11.5] was sandy loam in texture and slightly acidic in nature with a pH range of 6.64 to 7.2. The physic-chemical properties of the soil like organic carbon, 0.54%; available Nitrogen (N), 0.053%; available Phosphorus (P), 15.1 kg/ha; and available Potash (K), 153.57 kg/ha.

The experiment laid out in Randomized Block Design (RBD) using seven treatments replicated three times. The field was divided into 21 plots with plot size of 3x15=45sq.m. The test product was applied as foliar spray in three times (1st, at flowering stage; 2nd, at 14 days after first spray; and 3rd, at 14 days after second spray). The time of application along with different doses of opteine and competitor product has shown in table (1). After the land was prepared recommended dosage of N, P and K was applied in the form of urea, single super phosphate and murate of potash respectively along with 25 tonnes of FYM was applied. Other cultural practices in each experiment were followed as per the standard and recommended packages of practices of individual crops.

The observations were recorded on five randomly selected plants. The Plant height and no. of branches were counted at 90 DAT. The regular visual observations from blooming to harvesting were record for days to 50% flowering, days to 1st fruit set, days to 1st harvest and no. of fruits per plant. The five fruits from each selected plant were taken for fruit length, diameter, and fruit weight. The average yield from all harvests was recorded as total yield. The quality parameters especially anthocynin content analyzed using standard procedures. The mean values were averaged and expressed as mean of the respective characters. The observations were recorded at the scheduled dates as programmed.

The statistical data analyzed using analysis of variance (ANOVA) and differences were considered significant at 5% level of probability (Panse and Sukatme, 1985) [15].

Table 1: Treatment details of physio-activator (opteine) on eggplant

S. No.	Product	Rate/ha	Time of application
T1	Water	Water	1st flower; 15 days after 1st spray; 14 days after 2nd spray
T2	Opteine	400 ml/ha	1st flower; 15 days after 1st spray; 14 days after 2nd spray
T3	Opteine	500 ml/ha	1st flower; 15 days after 1st spray; 14 days after 2nd spray
T4	Opteine	600 ml/ha	1st flower; 15 days after 1st spray; 14 days after 2nd spray
T5	Opteine	750 ml/ha	1st flower; 15 days after 1st spray; 14 days after 2nd spray
T6	Opteine	1250 ml/ha	1st flower; 15 days after 1st spray; 14 days after 2nd spray
T7	Biozyme	600 ml/ha	1st flower; 15 days after 1st spray; 14 days after 2nd spray

3. Results and Discussion

3.1 Effect of opteine on morphological and reproductive parameters

Data presented in table (2) shows that influence of different doses of foliar application of opteine was significant for growth and yield attributing parameters. The plant growth parameters *viz*. plant height and numbers of branches per plant recorded highest with spray of opteine @750 ml/ha as compared to other spray treatments and obtained lowest in control plants. These two characters are also found lowest of 77.41cm and 7.24, respectively, with the application of biozyme @ 600 ml/ha. Similarly, the study conducted by Mohammed, (2013); Damir *et al*. (2006) [14, 6] also showed that, seaweed extract spray found significant effect on plant height and shoot number.

The minimum days required for first fruit set (65.437 days) and days to first harvest (79.177 days) were recorded from plants sprayed with foliar application of opteine @ 750 ml/ha which was *at par* with the application of opteine @ 600 ml/ha as shown in figure (1). The maximum days required to first fruit set and first harvesting was observed from the control treatment and with the biozyme. From the present investigation it was clearly noticed that the plant sprayed with opteine @ 600ml/ha produces 50% of flowering within a very short period of 58.58 days where as plants takes more days for 50% flowering with the application of biozyme treatment. The experiments conducted by Dwivedi *et al*. (2014); Khan *et al*., (2009) [7, 13] reported that seaweed extracts not only boost the vegetative growth of the plant but also triggers flowering and fruiting in crops ultimately seed yield.

Table 2: Effect of Physio-activator (opteine) on morphological and reproductive parameters

Treatments	Plant height (cm)	No. of branches per plant	Days to 50% flowering	Days to 1st fruit set	Days to 1st harvest	No. of fruits per plant
Control (Water)	74.167	6.792	64.667	72.433	84.545	9.792
Opteine (400 ml/ha)	81.500	7.642	61.550	69.622	82.817	10.633

Opteine (500 ml/ha)	84.667	8.067	60.000	66.440	80.575	12.750
Opteine (600 ml/ha)	87.000	8.122	58.583	66.617	79.720	13.833
Opteine (750 ml/ha)	89.000	8.368	60.178	65.437	79.177	12.667
Opteine (1200 ml/ha)	83.667	8.077	61.133	68.167	80.992	11.500
Biozyme (600 ml/ha)	77.417	7.247	62.667	69.333	81.025	10.417
C.D.	6.561	0.277	2.657	1.885	1.710	1.512
SE(m)	2.261	0.096	0.916	0.650	0.589	0.521
SE(d)	3.197	0.135	1.295	0.919	0.833	0.737
C.V.	6.713	3.016	3.661	2.330	1.776	10.950

3.2 Effect of opteine on yield and qualitative parameters

The significant results were obtained for yield and yield attributing characters like number of fruits, length of fruit, weight of fruit and yield with the application of opteine. All the characters responded positively as shown in table (3). The spray of 600ml/ha opteine resulted highest number of fruits (13.833) followed by the application of opteine @ 750ml/ha. The maximum length of fruit (19.543 cm), diameter of fruit (5.908 cm) also recorded with foliar application of opteine @ 600ml/ha. The lowest length of fruits (17.67cm) and diameter of fruits (4.94cm) were noticed from the biozyme spray as well as with control. The similar results of improved fruit weight, length and diameter of fruit with application of sea weed extract were reported by Mawgoud *et al.* (2010) [1]. The maximum fruit weight (271.5 gm), and fruit yield (3.103 kg/plant) has been recorded from plants with foliar spray of opteine @ 600 ml/ha. It was observed that fruit weight and fruit yield was more even with the all doses of opteine in comparison to application of biozyme. The lowest fruit yield of 2.168 kg/plant noticed in control followed by low fruit yield of 2.328kg /plant obtained with biozyme. The highest fruit yield, 23.528t/ha was recorded from spray concentration @ 600 ml/ha opteine. Among all, boosting effect was found with 600ml/ha of opteine. Similar trend of result with eggplant was reported when treated with seaweed extract spray (Bozorgi, 2012; Eswaran *et al*., 2005; Satish *et al*., 2015) [3, 8, 18].

The quality parameters especially, anthocyanin content found significant with the foliar application of opteine. The highest anthocyanin content of (275.622 mg/100gm) was observed with the foliar application of opteine @ 600 ml/ha. The lowest anthocyanin content of 257.872 (mg/100gm) was obtained in treatment with 500 ml/ha of opteine. Shi and Maguer, (2000) [19] also found similar results on other vegetable crops.

Table 3: Effect of physio-activator (opteine) on yield and quality parameters

Treatments	Length of fruits (cm)	Diameter of fruit (cm)	Fruit weight (gm)	Fruit yield (kg/plant)	Fruit yield (t/ha)	Anthocynin content (mg/100gm)
Control (Water)	17.400	4.838	195.833	2.168	14.706	215.383
Opteine (400 ml/ha)	18.338	5.405	225.000	2.649	17.785	223.253
Opteine (500 ml/ha)	19.233	5.757	250.700	2.962	19.413	257.872
Opteine (600 ml/ha)	19.543	5.725	271.500	3.103	23.528	275.622
Opteine (750 ml/ha)	19.183	5.908	249.833	2.795	22.397	248.053
Opteine (1200 ml/ha)	18.258	5.775	241.883	2.866	22.378	229.812
Biozyme 600 ml/ha	17.675	4.945	211.667	2.328	17.305	223.263
C.D.	0.838	0.288	40.997	0.291	1.510	4.914
SE(m)	0.289	0.099	14.126	0.100	0.520	1.693
SE(d)	0.408	0.140	19.978	0.142	0.736	2.394
C.V.	3.820	4.441	14.712	9.108	6.488	1.735

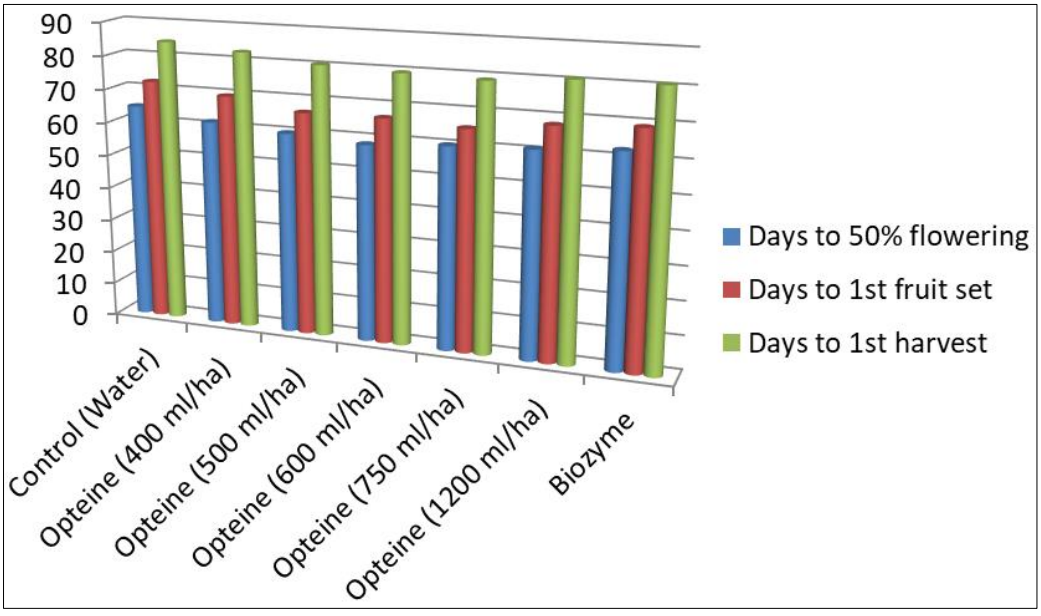

Fig 1: Effect of Physio-activator (opteine) on days to 50% flowering, 1st fruit set and 1st harvest

4. Conclusion

From the above investigation it may be conclude that the optimum concentration of 600 ml/ha opteine was found to be superior for yield and yield attributing characters followed by 750 ml/ha of opteine spray was found positive effect on plant growth and earliness in terms of fruit set and harvest of fruits compared to control plants and with biozyme spray.

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