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Research Article

Effect of Foliar Spray with Seaweed Extract on Growth and Chemical constituents of *Crossandra infundibuliformis* (L.) Nees

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Abstract

This investigation was conducted during the winter season of 2011 on *Crossandra infundibuliformis* which is commonly called as "fire cracker flower". The flower of the plant is extensively used for making garland. It is widely cultivated for commercial purposes in Kancheepuram and Villupuram Districts of Tamilnadu, India. The present study investigated the effect of Biostimulator, i.e., seaweed extract of *Gracilaria corticata* on the growth and chemical composition of the most popular plant *Crossandra infundibuliformis*. The experiment included of spraying of seaweed extract at 1000 and 2000 ppm in addition to check treatment (water). A complete randomized block design with three replicates was adopted. Results indicated that spraying the plants with seaweed extract at higher rate significantly increased plant height compared to control. Spraying seaweed extract at higher rate tended to have the highest values from photosynthetic pigments, P and K content of leaves. Spraying the plants with seaweed at the higher rates significantly increased total sugar content whereas, seaweed extract at two tested rates significantly increased NO_3 content compared to control treatment.

Keywords: *Crossandra infundibuliformis*, *Gracilaria corticata,* Seaweed extract, growth.

Introduction

Plant bio-stimulation has recently become an increasingly more common treatment in modern agricultural production; among such substances seaweed extracts play a vital role. Seaweed concentrates are known to cause many beneficial effects on plants as they contain growth promoting hormones (IAA and IBA, Cytokinins) trace elements (Fe, Cu, Zn, Co, Mo, Mn, and Ni), vitamins and amino acids (Challen and Hemingway, 1965). The application of seaweed extract for different crops was of great importance. The beneficial effect of seaweed extract application is as a result of many components that may work synergistically at different concentrations, although the mode of action still remains unknown (Fornes *et al*., 2002). However, application of seaweed extract increased chlorophyll content (Whapham *et al* ., 1993 and Thirumaran *et al*., 2009). Turan and Köse (2004) on grapevine, Mancuso *et al*. (2006) and Rathore *et al.* (2009) on soybean observed increases in yield as well as N, P and K with application of seaweed extract. Zodape *et al*.(2008), Arthur *et al*. (2003) on pepper and Zodape *et al*.(2010) on mung bean indicated that application of seaweed extract significantly increased seed yield and pod weight as well as improved nutritional values of seeds, i-e., protein and carbohydrates. Also, Eyszkowska *et al*. (2008) reported that nitrate in lettuce of examined cultivars insignificantly increased after treatments with Goteo and Aminoplant (an organic fertilizer which contains amino acids and short peptide chains). Abdel Mawgoud *et al*.(2010) cleared that application of seaweed extract at concentrations of 1, 2 and 3 g/L increased the response of all growth parameters and yield of watermelon. Aqueous extract of *Sargassum wightii* when applied as a foliar spray on *Zizyphus mauritiana* showed an

increased yield and quality of fruits (Rama Rao, 1991). Growth promoting effect of seaweed liquid fertilizer (*Enteromorpha intestinalis*) on the sesame crop plant (Gandhiyappan and Perumal, 2001). Seaweed foliar applications increased harvestable bean yields by an average of 25% (Temple, 1989), staked tomato yields by up to 99% (Csizinszky, 1984), early yield of one variety of greenhouse cucumber (Passam *et al.* , 1995), and greenhouse tomato total fruit.

Crossandra (*Crossandra infundibuliformis)*, sometimes called firecracker flower, can be used as a houseplant or in the landscape. This tropical flower is easy to grow and will bring attention in any setting. Crossandra is native to India and Sri Lanka, where its blossoms are often combined with jasmine to adorn women's hair. Crossandra thrives in warm, humid environments and cannot tolerate cold weather. Therefore, this work aimed to evaluate the effect of the influence of seaweed extract of *Gracilaria corticata* on the growth and chemical constituents of Crossandra plant.

Materials and Methods

Foliar Spraying of Seaweed Extract

Grassilaria corticata occurring along the coastal regions of South India was investigated for the purpose. Fresh thalli of *Gracilaria* were collected from the coastal area around Kanyakumari district of Tamilnadu. The algal material was washed thoroughly to remove all the impurities. Fresh material was cut into small pieces and the weight of it approximately one kg. Sample extracted using blender and then mortarpestle. It was filtered through a double layered muslin cloth to remove debris. These filtrates were designated as 100% .

Plant Material

Seeds of Crossandra were germinated under protection in green house and grown thereafter in well-ventilated conditions. Transplants were removed out side at four-leaf stage for hardening off prior to transplanting. Healthy transplants at 80 days old were set up in the field for the purpose.

The Experimental Layout

The plot was thoroughly ploughed and divided into equal rows; each plot was one row of 1m width and 10 m length. The distance between plants was 25 cm on both sides of rows. The ploughed soil received 357 kg calcium super phosphate (15.5% P_2O_5), 10 ton compost and 238 kg/h^1 agricultural sulfur as one dose before transplanting. Potassium sulphate (48% K_2O) at 357 kg//h^1 was added at three times, i.e., after 30, 60 and 90 days from transplanting. The ammonium sulphate (20.5% N) at 695 kg//h^1 was directly application in three equal portions at 20 , 40, and 60 days after transplanting according to the local cultivation method.

Time and Method of Application

Seaweed extract was applied at the rate of 1000 and 2000 ppm. Control plants were sprayed with tap water. Spraying treatments were started after one month from transplanting and every 15 days for 4 times through the growth season.

Experimental Design

The design of the experiments was complete randomized block with three replicates. The plot area was 10 m^2 (one row of 10 m length and 1m width).

Vegetative Growth Characters

Random samples of 5 plants from each experimental unit were taken and the following measurements were recorded

a. Plant length and leaf number

Chemical Constituents

a. Photosynthetic pigments of leaves, were measured using N,N dimethyl formamide according to Rami Moran (1981).The leaf content of chlorophyll a, b and caroteneiods were calculated.

b. Nutrient content , nitrogen, phosphorus and potassium were determined in dried leaves according to Cottenie *et al* (1982).

c. Nitrate content, nirate-nitrogen was extracted from leaf samples and measured according to Al-Redhaiman *et al* .(1998).

Results and Discussion

Vegetative Growth Characteristics

Spraying with Seaweed extract increased the linear growth of the experimental plant compared to control treatment. The increase was aggravated and significant when higher concentrations were used (Table 1).

Regarding the leaf number, it is clear that application of seaweed extract followed almost exactly the same trend but, the differences did not reach the levels of significant when compared to those of untreated plants. Respecting to the growth enhancing potential of the seaweed extract might be attributed to the presence of macro and micronutrients and may be due to the presence of some growth promoting substances present in the seaweed extract (Mooney and Van Staden, 1985; Blunden 1991). Exogenous application of seaweed extract has already been shown to enhance plant growth by Featonby and Van Staden (1983), Sivasankari *et al*. (2006) and Abdel Mawgoud *et al*.(2010) on watermelon.

Chemical Constituents

Leaf Pigments

Table (2) shows that spraying the plants with seaweed extract stimulated the chlorophyll content and its components as well as carotenoid compared to control treatment. However, it is clear that seaweed application tended to have the highest values from photosynthetic pigments and such effect were distinct via using the higher rate. Seaweed extracts have been found to contain significant amounts of cytokinins, auxins and betaines, which enhance chlorophyll concentration in the leaves (Schwab and Raab, 2004) Our findings coincide with some earlier findings of Whapham *et al*. (1993), they observed that application of seaweed (*Ascophyllum nodosum)* increased chlorophyll of cucumber seedlings and tomato plants. Also, seaweed extract spray enhanced the leaf chlorophyll in plants (Blunden *et al*., 1996). Recently Thirumaran *et al*.(2009) on *Cyamopsis tetragonoloba* indicated that seaweed extract increased photosynthetic pigmenst such as chlorophyll a, b, total chlorophyll and carotenoids.

Nutrient Content

Data presented in Table (3) presented the response of nitrogen, phosphorus and potassium contents to the spraying treatments. The obtained results indicate that spraying plants with significantly increased N content in the leaf tissues than check ones as well as other spraying treatments, with clear superiority to the higher level. Regarding the phosphorus content, the results indicate that seaweed extract significantly increased P content compared to control.

Table:1 Some vegetative growth characters of Crossandra plant as affected by seaweed extract application

Treatments	Plant height cm	Leaf Number
Control	27.75	18.02
Seaweed Extract at 1000 ppm	30.61	21.83
Seaweed Extract at 2000 ppm	32.25	25.68

Table 2: Chlorophyll and caroteniods of leaf Crossandra plant as affected by amino acids and Seaweed extract application

Treatments	**Chlorophyll a**	**Chlorophyll b**	**Chlorophyll a+b**	**Carotenoids**
	mg/gm fresh weight			
Control	0.389	0.149	0.538	0.136
Seaweed Extract at 1000 ppm	0.493	0.178	0.671	0.178
Seaweed Extract at 2000 ppm	0.535	0.199	0.734	0.213

Table 3: Chemical composition of leaf of Crossandra plant as affected by seaweed extract application

Treatments	**N%**	**K%**	**P%**	**NO3 ppm**
Control	2.06	0.62	0.39	136
Seaweed Extract at 1000 ppm	2.07	0.68	0.48	138
Seaweed Extract at 2000 ppm	2.10	0.75	0.52	140

Similar effects and findings about beneficial effect of seaweed extract were reported by Turan and Köse (2004), Mancuso *et al*. (2006) and Rathore *et al*. (2009). Comparing the effect of spraying treatments on K content, it could be noticed that seaweed extract increased K content compared to control and such effect was more distinct and significant via using the higher level. The enhancing potential of seaweeds might be attributed to the presence of potassium as a main component in the seaweed extract. However, K content was positively affected as a result of using seaweed extract as mentioned by Crouch *et al.* (1990) on lettuce, Turan and Köse (2004) on grapevine, Mancuso *et al*. (2006) and Rathore *et al*. (2009) on soybean. Data presented in Table (3) show that the seaweed extract at the two tested concentrations significantly affected the nitrate as compared to untreated check plants.

Conclusion

In the present study, the 2000 ppm concentration of Seaweed extract of *Gracillaria corticata* showed best results in *Crossandra infundibuliformis*. The seaweed extracts were found to be more effective in promoting the growth and chemical constituents of the important commercial Crossandra plant.

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