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Efficacy of seaweed and neemcake on growth and flowering attributes of tuberose (*Polianthes tuberosa* L.) in the plains of West Bengal

Karishma Maherukh[1]*, Kunal Adhikary[2], Alauddin Rahaman[3] and Arun Kumar Pal[4]

[1,3,4]Department of Floriculture and Landscaping, Faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, 74125, West Bengal, India
[2]Department of Horticulture, School of Agriculture, ITM University Gwalior, Jhansi Rd, Turari 474 001, M.P., India

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ABSTRACT

An experiment was carried to evaluate the effect of combined application of seaweed and neem cake on growth and flowering of tuberose (*Polianthes tuberosa*)cv. Prajwal. The study was laid out under Randomized Block Design (RBD) with eleven treatments and three replications where different combinations of neem cake and seaweed were compared with control. The result of the experiment revealed that the application of neem cake and seaweed significantly affected the quantitative and qualitative characters of tuberose. Among all the treatments, treatment T_{11} (Seaweed 4g/m^2 + Neem cake 0.4 kg/m^2) was found most effective regarding the growth and flowering attributes in comparison to control. The treatment T_{11} (Seaweed 4g/m^2 + Neem cake 0.4 kg/m^2) also gave most promising result regarding vase life and spike yield.

Key word: *Antioxidant, Bio-stimulants, Bio-fertilizer. Nitrification inhibitor, Biotic & abiotic stress.*

Introduction

Tuberose (*Polianthes tuberosa* L.*)*, the most commercially exploited flower crop belongs to the family Amaryllidaceae and native to Mexico.It is a half hardy, perennial bulbous plant grows 18-24 inches in height, flowers remain fresh for pretty long period and stand long distance transport. Each spike contains more than 30-60 flower buds varies on the cultivars. The commercial flower production is increasing as the demand of the loose as well as cut flower is gaining momentum with the increasing aesthetic sense and the higher socio-economic standard of the people in the country. Among the commercially grown flowers in India, tuberose occupies a great position because of its great demand as a cut flower, loose flower as well as of its great economic potential in essential oil industry (Alan *et al.,* 2007).

Prajwal claimed to be a nematode resistant variety (Khan and Ghosh, 2007) due to the capacity to release high content of phenol and polyphenol oxidase which are responsible for the resistance. The hybrid was developed from the cross Shringar X Mexican single, bears single type flowers on tall stiff spikes. The flower buds of prajwal are slightly pinkish white and the flowers when in bloom are white. The enhancement of flower production relies upon several factors like climate, geographical location and also nutritional factors. Amongst them, nutrition management is considered to be one of the most

([1] Ph.D, [2]Assistant Prof., [3] Ph.D, [4] Prof.)

important. Continuous use of chemical fertilizers not only increases the cost of cultivation but also deteriorate the soil and environmental health and reducing the microbial activities in the soil (Alan *et al.* 2007). Integrated use of various bio-stimulants *viz.*, organic manures, bio fertilizers and chemical fertilizers as components may help in increasing productivity of tuberose. Neem cake is the most useful manure in plants as it adds organic matter and act as nitrification inhibitor. It also reduces alkalinity in soil by releasing organic acids on decomposition. It can replace not only the use of chemical fertilizers but also could be the alternative of the chemical pesticides by suppressing pathogens and insects. About 10,000 species of red, brown and green seaweeds are diversely distributed around the world (Khan *et al.* 2009). Among them brown seaweeds (phaeophyta) extracts are most commonly used for applications in agriculture and horticulture. Seaweed extracts are reported to stimulate the growth and yield of plants, develop tolerance to biotic and abiotic stress, increase nutrient uptake from soil (Turan and Kose, 2004) and also enhance antioxidant properties. Therefore, the present investigation was carried out to assess the effect of different combinations of seaweed and neem cake on vegetative and reproductive attributes of tuberose cv. Prajwal.

Materials and Methods

The present study was conducted in the subtropical humid climate zone at Horticultural Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal featured of a hot and humid summer with maximum temperature of 35.6^{0}C and minimum temperature of 20 ^{o}C and 98% of relative humidity during April 2017 to March 2018. It was laid out in Randomized Block Design with three replications and eleven treatments. There were total 33 plots and each plot was 1.5m × 1m in size. Twenty medium size healthy and disease-free bulbs of 2-2.5 cm diameter were planted at 30×30 cm spacing during the last week of April in each experimental plot. Different treatment combinations used in this experiment were: T_1 (Control), T_2 (Seaweed 2g/m^2 +0.2 kg Neem Cake/m^2), T_3 (Seaweed 2g/m^2 +0.4 kg Neem Cake/m^2), T_4 (Seaweed 2.5g/m^2 +0.2 kg Neem Cake/m^2), T_5 (Seaweed 2.5g/m^2 +0.4 kg Neem Cake/m^2), T_6 (Seaweed 3g/m^2 +0.2 kg Neem Cake/m^2), T_7 (Seaweed 3g/m^2 +0.4 kg Neem Cake/m^2), T_8 (Seaweed 3.5g/m^2 +0.2 kg Neem Cake/m^2), T_9 (Seaweed 3.5g/m^2 +0.4 kg Neem Cake/m^2), T_{10} (Seaweed 4g/m^2 +0.2 kg Neem Cake/m^2), T_{11} (Seaweed 4g/m^2 +0.4 kg Neem Cake/m^2). Both the neem cake and seaweed were applied 40 days after planting as a soil application and subsequently two or more applications were done after 30 days interval. Soil moisture was maintained by applying flood irrigation at regular intervals according to the need of the crop. Cultural practices like weeding, irrigation, hoeing was similar for all the treatments throughout the experiment. Five randomly selected plants were tagged from each plot to record the observations. Different vegetative and reproductive parameters were recorded by using standard methods. The data were analyzed statistically at 5% level of significance with the help of OPSTAT.

Results and Discussion

Vegetative growth parameters: The presented data (Table 1) showed significant variation among the different combined application of neem cake and seaweed in vegetative characters.

Plant height: Among the different applications of Seaweed and Neem cake, treatment T_{11}had the highest plant height with 67.36 cm and it was found to be at par with T_{10} (64.33 cm) and T_4 (64.33 cm), while the minimum plant height (49.00 cm) was observed in control (T_1).

Leaf length (cm): A perusal of data on leaf length presented in Table 1 showed that different level of seaweed along with neem cake significantly influenced the leaf length. The maximum leaf length (65.33cm) was found in treatment T_{11}which was found to be at par with T_7 (63.50 cm) and T_{10}(62.67 cm) respectively. Whereas the minimum leaf length (48.33 cm) was recorded in untreated plants (T_1).

Number of leaf per plant: With respect to the number of leaves per plant, treatment T_{11} showed the highest count of 50.33 numbers followed by the treatment T_7 (48.33) and T_9 (47.70). The lowest number of leaves was found in T_1 (control).

Leaf breadth: It is seen from the data (Table 1) that differences in leaf breadth was found significant among the treatments. Significantly higher leaf breath was found in the treatment T_{11} (1.97 cm) and it was followed by the treatment T_6 (1.93 cm) and T_7 (1.93 cm). Minimum leaf breadth (1.47 cm) was observed in T_1 (control).

Table 1. Effect of seaweed and neem cake on vegetative parameters of tuberose (*Polianthes tuberose* L.) cv. Prajwal.

Treatments	Plant height(cm)	Leaf length (cm)	Leaf number/plant	Leaf breadth (cm)
T_1	49.00	48.33	34.77	1.47
T_2	58.10	57.50	37.30	1.70
T_3	60.33	59.07	38.67	1.63
T_4	64.33	62.40	38.27	1.60
T_5	64.03	61.73	39.50	1.50
T_6	62.33	59.54	41.43	1.93
T_7	65.10	63.50	48.33	1.93
T_8	58.50	55.14	47.20	1.83
T_9	62.77	60.65	47.70	1.90
T_{10}	64.33	62.67	42.17	1.80
T_{11}	67.36	65.33	50.33	1.97
CD (5%)	4.59	4.88	1.35	0.16
SE.m(±)	1.57	1.65	0.46	0.05

T_1: Control, T_2: Seaweed 2g/m^2 +0.2 kg Neem Cake/m^2, T_3: Seaweed 2g/m^2 +0.4 kg Neem Cake/m^2, T_4: Seaweed 2.5g/m^2 +0.2 kg Neem Cake/m^2, T_5: Seaweed 2.5g/m^2 +0.4 kg Neem Cake/m^2, T_6: Seaweed 3g/m^2 +0.2 kg Neem Cake/m^2, T_7: Seaweed 3g/m^2 +0.4 kg Neem Cake/m^2, T_8: Seaweed 3.5g/m^2 +0.2 kg Neem Cake/m^2, T_9: Seaweed 3.5g/m^2 +0.4 kg Neem Cake/m^2, T_{10}: Seaweed 4g/m^2 +0.2 kg Neem Cake/m^2, T_{11}: Seaweed 4g/m^2 +0.4 kg Neem Cake/m^2.

Hence the results revealed that the higher vegetative growth in plant facilitated by a favorably influenced combination of seaweed and neem cake. These findings are well supported with the result of combined application of Seaweed +Neem cake @ 400 g/ m^2 obtained by Karim *et al*. (2017) in *polianthestuberosa* cv. Prajwal and foliar spray of seaweed (5%) in banana plant by Karthikeyan *et al*., (2014).

Flowering attributes: Data on different flowering parameters influenced by combined application of seaweed and neem cake were presented in Table 2.

Spike length (cm): Length of flower spike for different treatments showed a statistically significant variation in tuberose cv. Prajwal. The lengthiest spike (116.23 cm) was recorded in T_{11} followed by the treatment T_7 (114.10 cm) whereas the shortest spike (80.43 cm) was found in the control (T_1).

Spike weight: Concerning the spike weight, treatment T_{11} (Seaweed 4g/m^2 +0.4 kg Neem cake/m^2) had the highest spike weight of 141.17 g which was significantly superior over all other treatments and it was closely followed by the treatment T_7 (140.33 g). The lowest spike weight (102.33 g) was observed in T_1 (control).

Diameter of Spike (cm): Both the treatment T_7 and T_{11} were recorded with maximum spike diameter (1.67 cm) whereas the treatment T_1 gave minimum (1.31 cm) spike diameter.

Diameter of florets (cm): In case of floret diameter, no significant difference was found between the treatments T_5, T_7, T_{10} and T_{11}, which were recorded with the maximum diameter (4.57 cm). The minimum diameter of florets (4.13 cm) was recorded in T_1 and T_8.

Rachis length (cm): The highest rachis length of 38.33 cm was found in the treatment T_{11} followed by treatment T_7 (36.27 cm) and T_{10}(35.33 cm) respectively, whereas the lowest rachis length (24.5 cm) was obtained in T_1 (control).

Weight of 10 florets (g): Weight of 10 florets was significantly increased by the application of seaweed and neem cake over control. The maximum weight of florets (21.83 g) was recorded in treatment T_{11} (Seaweed 4g/m^2 +0.4 kg Neem cake/m^2), closely followed by T_7 (20.21 g). The minimum data was noted in T_1 (untreated plants) regarding weight of 10 florets.

Floret number per spike: Among different treatments, T_{11} (Seaweed 4g/m^2 +0.4 kg Neem cake/m^2) had the highest number of florets per spike (44.87) which was at per with the treatment T_7 (44.77), whereas the lowest floret number (29.22) was obtained in the control (T_1).

Similar results for better quality spike was also reported by Karim *et al*. (2017); they found highest spike length, spike weight, spike diameter and maximum rachis length with the combined application of Seaweed + Neem cake@ 400 g/ m^2 in tube-

Table 3. Effect of seaweed and neem cake on vase life and spike yield of tuberose (*Polianthes tuberose* L.) cv. Prajwal

Treatments	Vase life	Number of spike per plot	Number of spike perhectare (In lakhs)
T_1	7.67	22	1.17
T_2	8.33	26	1.39
T_3	9	28.67	1.53
T_4	9.33	27.33	1.46
T_5	10	28.33	1.51
T_6	9.67	27.67	1.48
T_7	10.33	29.33	1.56
T_8	11	28	1.49
T_9	11	28.33	1.51
T_{10}	11.33	28	1.49
T_{11}	11.66	31	1.66
C.D. (5%)	1.57	3.6	1.17
SE.m(±)	0.53	1.22	1.39

T_1: Control, T_2: Seaweed 2g/m^2 +0.2 kg Neem Cake/m^2, T_3: Seaweed 2g/m^2 +0.4 kg Neem Cake/m^2, T_4: Seaweed 2.5g/m^2 +0.2 kg Neem Cake/m^2, T_5: Seaweed 2.5g/m^2 +0.4 kg Neem Cake/m^2, T_6: Seaweed 3g/m^2 +0.2 kg Neem Cake/m^2, T_7: Seaweed 3g/m^2 +0.4 kg Neem Cake/m^2, T_8: Seaweed 3.5g/m^2 +0.2 kg Neem Cake/m^2, T_9: Seaweed 3.5g/m^2 +0.4 kg Neem Cake/m^2, T_{10}: Seaweed 4g/m^2 +0.2 kg Neem Cake/m^2, T_{11}: Seaweed 4g/m^2 +0.4 kg Neem Cake/m^2.

rose. Dogra *et al*. (2014) also concluded the application of different concentration of seaweed extract significantly enhanced the plant growth and yield of onion. Similarly Meena *et al*. (2015) reported highest floral attributes with application of neem cake in tuberose.

Quality and yield parameters: The illustrated data in Table 3 is depicting significant variations among different treatment combinations of the quality and yield attributes.

Vase-life: It seems that all the treatment statistically increased the vase life of tuberose flowers as compare to the untreated plants. In this case treatment $T_{11}$was recorded the longest vase life (11.66 days) which was at per with T_{10} (11.33 days). The shortest vase life was noted in control. Suseela *et al.* (2016) also obtained higher vase life in tuberose cv. Suvasini with the application of 25% poultry manure along with 25% neem cake.

Spike yield: The spike yield was significantly highest (31 spike/ plot) in treatment T_{11} (Seaweed 4 g / m^2 +0.4 kg Neem cake/m^2) followed by the treatment T_7 (Seaweed 3g/m^2 +0.4 kg Neem cake/m^2), i.e. 29.33 spike/ plot. The treatment T_1 (control) had the lowest number of spikes per hectare (22 spike/ plot). Dogra *et al.* (2009) also reported that application of seaweed enhance yield of onion.

The results of growth and flowering parameters

Table 2. Effect of seaweed and neem cake on flowering parameters of tuberose (*Polianthes tuberose* L.) cv. Prajwal.

Treatments	Spike Length (cm)	Spike Weight (g)	Spike Diameters (cm)	Floret diameter (cm)	Rachis Length (cm)	Weight of 10 florets (g)	Number of floret per spike
T_1	80.43	102.33	1.31	4.13	24.5	14.00	29.22
T—$_2$	95.87	113.50	1.37	4.33	27.67	16.33	36.17
T_3	110.50	122.50	1.36	4.47	27.5	17.17	42.77
T_4	112.03	126.00	1.53	4.33	29.67	18.33	39.17
T_5	105.03	132.67	1.43	4.57	35.00	17.83	42.33
T_6	96.13	128.08	1.53	4.37	32.33	19.00	41.11
T_7	114.10	140.33	1.67	4.57	36.27	20.27	44.77
T_8	110.33	137.00	1.57	4.13	31.33	18.67	42.77
T_9	110.17	136.33	1.40	4.40	30.33	19.77	43.44
T_{10}	109.20	138.33	1.57	4.57	35.33	19.83	43.44
T_{11}	116.23	141.17	1.67	4.57	38.33	21.83	44.87
CD (5%)	1.21	12.08	0.06	0.24	4.26	2.36	5.05
SE.m(±)	0.44	4.09	0.09	0.02	1.46	0.87	1.68

T_1: Control, T_2: Seaweed 2g/m^2 +0.2 kg Neem Cake/m^2, T_3: Seaweed 2g/m^2 +0.4 kg Neem Cake/m^2, T_4: Seaweed 2.5g/m^2 +0.2 kg Neem Cake/m^2, T_5: Seaweed 2.5g/m^2 +0.4 kg Neem Cake/m^2, T_6: Seaweed 3g/m^2 +0.2 kg Neem Cake/m^2, T_7: Seaweed 3g/m^2 +0.4 kg Neem Cake/m^2, T_8: Seaweed 3.5g/m^2 +0.2 kg Neem Cake/m^2, T_9: Seaweed 3.5g/m^2 +0.4 kg Neem Cake/m^2, T_{10}: Seaweed 4g/m^2 +0.2 kg Neem Cake/m^2, T_{11}: Seaweed 4g/m^2 +0.4 kg Neem Cake/m^2.

revealed that the combined application of seaweed and neem cake showed significant differences regarding various parameters. When plant receives seaweed along with neem cake it can produce vigorous vegetative growth and good quality flower spikes. It might be due to the reason that seaweed extracts improve the lateral root formation, total root volume and root length (Mancuso *et al.*, 2006), stimulated mineral and nutrient uptake in plants (Norrie *et al.* 2006). Seaweed extract improves the uptake efficiency of stomata in treated plants compared to non-treated plants (Mancuso *et al.*, 2006). On the other hand, neem cake acts as a natural fertilizer with pesticidal properties. Being totally natural, it is also compatible with rhizosphere microflora, hence improve the soil fertility. Due to its residual limonoid content, neem cake protects tuberose plant roots from nematodes.

From the present study it was concluded that neem cake and seaweed helps to improve the growth and flowering of tuberose by improving the soil structure and aeration, which may stimulate root growth. Seaweed contains some major and minor nutrients, amino acid, vitamins, cytokinin, auxin and abscisic acid like growth promoting substances which improving the absorption capacity and reducing ethylene production. The observation showed that the performance of vegetative and flowering characters were best with the application of seaweed 4 g/m^2 along with neem cake 0.4 kg/m^2 and also most effective for extending the vase life.

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