

Original Research Article

<https://doi.org/10.20546/ijcmas.2017.606.304>

Effect of Biostimulants on Growth and Floral Attributes of Tuberose (*Polianthes tuberosa* L.). cv. Prajwal

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ABSTRACT

Keywords

Biostimulants,
Floral
Attributes of
Tuberose,
*Polianthes
tuberosa* L.

Article Info

Accepted:
29 May 2017
Available Online:
10 June 2017

An experiment was conducted at Horticultural Research Farm, Mondouri, and Bidhan Chandra Krishi Viswavidyalaya during April 2015 to March 2016 to study the effect of different organic manures on growth and flowering of tuberose (*Polianthes tuberosa* L.) cv. Prajwal. The experiment was laid out in Randomized Block Design with three replications, with nine treatments. The treatments include vermicompost (2000 g sq/m), neem cake (400 g sq/m) poultry manure (1000 g sq m⁻¹) and FYM (4000 g sq/m) were applied individually and all the treatments were repeated with the combination of treatments of seaweed. The observations on vegetative and reproductive growth were recorded. Among growth parameters, plant height and number of leaves were highest in treatment T₆ (Seaweed+Vermicompost @2000g/sq m), leaf length was found maximum in T₈ (seaweed+ neem cake@200g/sq m) and maximum leaf breadth was found in T₅ (seaweed+poultry manure@1000g/sq m). All the flower parameters varied significantly among treatments except diameter of spike. Flowering parameters like, spikes length, number of florets, weight of ten florets, length of florets and rachis length were found to be maximum in T₆ (Seaweed+ Vermicompost @2000g/sq m). Weight of spikes was maximum in T₈ (Seaweed+Neem cake @400g/sq m) where, floret diameter was maximum in case of T₄ (Neem cake @400g/sq m). With respect to quality parameters, vase life was highest in treatment T₈ (Seaweed+Neem cake @400g/sq m) and in treatment T₆ (Seaweed+Vermicompost @ 2000g/sq m). And the flower yield was found to be maximum in the treatment T₆ (Seaweed+Vermicompost @ 2000g/sq m). The interpretation of the data reveals that sole application of organic manures and in combinations with seaweed significantly affected the quantitative and qualitative characters of tuberose. So it may be concluded that application of seaweed+Vermicompost @ 2000g sq m and Seaweed+Neem cake@ 400g sq m showed significant improvement in vegetative growth, flowering and post harvest attributes through increased availability of nutrients in the soil.

Introduction

Tuberose is botanically known as *Polianthes tuberosa* L. belongs to the family Agavaceae. It is a bulbous perennial plant. The spikes are used as cut flowers and loose flowers. Tuberose cultivars are mainly three types –

single, semi double and double. Single flowered cultivars are more fragrant and extensively used for essential oil extraction as the concrete percent has been observed to be more (0.08 to 0.11%) compared to double.

The deterioration of soil fertility through use of chemical fertilizers and increasing production cost due to chemical fertilizers brought an urge for organic sources of nutrients as a part of nutrient requirement. Tuberose requires a large quantity of NPK, both in the form of organic and inorganic fertilizers. Nitrogen, phosphorus and potassium have a significant effect on spike production and floret quality. Duration of flower in the field was improved through using organic fertilizer. Poultry manure is an excellent organic fertilizer, as it contains high nitrogen, phosphorus, potassium and other essential nutrients. Vermicompost has been shown to have high levels of total and available nitrogen, phosphorus, potassium, micronutrients, microbial and enzyme activities and growth regulator. Neem cake is an excellent source of organic amendment can replace not only the use of chemical fertilizers but also replace the use of pesticides by suppressing pathogens and insects. In North America, the bio-stimulant coalition defined biostimulants as “substances, including micro-organisms, that are applied to plant, seed, soil or other growing media that may enhance the plant’s ability to assimilate applied nutrients, or provide benefits to plant development. The different categories of plant biostimulants that we review are i. microbial inoculants, ii. humic acids, iii. fulvic acids, iv. Protein hydrolysates and amino acids, and v. seaweed extracts. Seaweeds are a diverse assemblage with close to 10,000 species of red, brown and green seaweeds described (*Khan et al*, 2009). Based on abundance and distribution, brown seaweeds (phaeophyta) are some of the most commonly used for the commercial manufacture of extracts for applications in agriculture and horticulture. These extracts are reported to act as chelators, improving the utilization of mineral nutrients by plants and improving soil structure and aeration, which may stimulate root growth. Sea weed extracts also act as biostimulants,

enhancing seed germination and establishment, improving plant growth, yield, flower set and fruit production, increasing resistance to biotic and abiotic stresses, and improving postharvest shelf life.

Materials and Methods

The field experiment was conducted during April 2015 to March 2016 at Horticultural Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal. The experiment was conducted in randomized block design with three replications. The plot size is 1x1.5 m with 30x30 cm spacing. Uniform size of 2.5-3 cm diameter bulbs of tuberose variety Prajwal are planted in the first week of April 2015. The soil is sandy loamy in texture having pH 6.5-7. The available N is 0.07% P is 28.5/ha and K is 78 kg/ha. The application comprises of organic manures like Farm yard manure @ 4kg/sqm, Vermicompost @1.5kg/sqm Neem cake @400/sqm Poultry manure @1 kg/sqm are applied as basal dose then seaweed (*Kappaphycus* spp) at 2.5% is applied in 2nd week of June and the repeated four times at monthly interval. All the cultural practices were kept uniform for all the treatments and standard practices were adopted. Flowers were harvested in November months at peak season of flowering and data were recorded.

Results and Discussion

Vegetative parameters

Significant maximum results were found in the treatment T₆ (Seaweed +Vermicompost 2000g/sq m) with respect to plant height (68.92 cm) and the minimum plant height (54.33 cm) was observed in control (T₀) followed by T₁ (poultry manure 1000g/ sq m) (60.44 cm) (Table 1).

The improvement in plant height in tuberose with the addition of organic manures was also reported by Kabir *et al.*, (2011). The improvement in plant height in banana with the addition of seaweed was also reported by Karthikeyan *et al.*, (2014).

With respect to number of leaves, the treatment T₆ (Seaweed+Vermicompost @2000g/sq.m) showed the highest number of leaves (62.78) and the minimum number of leaves (36.78) was observed in control (T₀) followed by T₁ (Poultry manure@1000g/sq. m) (48.11). The results were related to the findings of Kabir *et al.*, (2011) in tuberose. Tripathy *et al.*, (2012) reported the more number of leaves with the application of organic manure. This result was also supported by Karthikeyan *et al.*, (2014) in banana.

When the sole application and combinations of organic manures were compared, the combination of T₈ (Seaweed+Neemcake @ 400g/sq. m) showed the highest leaf length of (71.83 cm) and the minimum leaf length (60.33. cm) was observed in T₃ (Farmyard manure @ 4000g/ sq m) followed by T₂ (Vermicompost 2000g/ sq m). The improvement in leaf length in tuberose with the application of vermicompost was also reported by Kabir *et al.*, (2011). The improvement in leaf length with the application of seaweed was also noticed by Karthikeyan *et al.*, (2014) in banana.

The treatment T₅ (Seaweed+Poultry manure@ 1000g/sq. m) has shown significantly highest leaf breadth of 3.09 cm and the minimum leaf breadth (2.19 cm) was observed in control followed by T₂ (Vermicompost 2000g/ sqm⁻¹). The improvement in leaf breadth in tuberose with the application of vermicompost was also reported by Kabir *et al.*, (2011). Karthikeyan *et al.*, (2014) also noticed the improvement in leaf breadth in banana with the application of seaweed.

The given results revealed that organic manures and seaweed showed significant effect on growth of the plant. Among organic manures and their combination with seaweed, application of Seaweed+Neem cake@. 400 g/ sq m showed the better results compared to others. This might be due to the fact that it improve the nutrient uptake by roots resulting in root system with improved water and nutrient efficiency and so it easily available for plants, and thus made it helps for the plants to enhanced plant growth and vigour. Seaweeds extracts also attributed to the presence of phyto-hormones such as auxins and cytokinins. Seaweed extracts also stimulated mineral nutrient uptake in plants with increased accumulation of both macro and micro-nutrients (Crouch *et al.*, 1990).

Flower parameters

When different combinations of neem cake, poultry manure, vermicompost and neem cake were used with seaweed then the maximum spike length (106.33 cm) was recorded in treatment (Seaweed+Vermicompost@) 1500g/ sq m) followed by treatment T₅ (Seaweed+Poultry manure 1000g/ sq m) (Table 2).

Highest spike weight (130.00 g) was found in treatment T₈ (Seaweed +Neem cake@ 400 g/ sq m) followed by T₆ (Seaweed + (Vermicompost @ 1500g/ sq m) (128.00g).

The maximum rachis length (33.33cm) was recorded in treatment T₈ (Seaweed+ Neem cake @400g/sq/m) followed by treatment T₆ (Seaweed+Vermicompost @) 1500g/sq. m) (39 cm).

Maximum diameter of 0.66 cm was recorded in T₅ and (Seaweed+Poultry manure@) 1000 g/ sq m and it is at par with T₆ (Seaweed+Vermicompost @) 1500g/sq. m).

Number of florets (40.33) and weight of 10 florets (18g) florets length (7.17) were recorded the maximum in treatment T₆ (Seaweed+Vermicompost @1500g/sq. m).

The results of reproductive parameters revealed that application of organic manures showed significant differences on reproductive parameters. Spikes with good quality attributes like spike length, rachis length, spike girth and spike weight were produced which received seaweed along with other organic manures. These spikes had increased number of florets with increased length and diameter which in turn increased their fresh weight. This might be due to the

fact that seaweed extracts improve nutrient uptake by roots resulting in root system with improved water and nutrient efficiency and improving soil structure and aeration. Seaweed extracts also contain hormones like cytokinin which linked with nutrient mobilization, thereby causing enhanced reproductive parameters. These plants had put forth good vegetative growth which enabled the plants to produce more photosynthates and supply to spikes for their development (Crouch *et al.*, 1990) and (Padaganur *et al.*, 2005). Similar improvement in reproductive attributes by the incorporation of vermicompost was reported by Patil (1999) in Jasmine and Sankar *et al.*, (2015) in tuberose.

Table.1 Effects of organic manure on vegetative parameters of tuberose (*Polianthes tuberosa*) cv. Prajwal

Treatments	Plant Height (cm)	Number of Leaves	Leaf Length (cm)	Leaf Breadth (cm)
T ₀ Control (no organic manure)	54.34	36.78	60.33	2.19
T ₁ Poultry manure@ 1000g/sq m	60.44	48.11	69.23	2.95
T ₂ Vermicompost @1500g/ sq m	65.11	54.78	62.37	2.28
T ₃ Farm yard manure @4000g/sq m	64.33	50.78	67.34	2.86
T ₄ Neem cake @400g/sq m	68.34	50.67	70.33	2.96
T ₅ (Seaweed+ Poultry manure 1000g/sq m)	65.55	55.44	67.82	3.09
T ₆ (Seaweed+Vermicompost 1500g/sq m)	68.92	62.78	70.63	3.08
T ₇ (Seaweed+Farmyard manure 4000g/sq m)	67.33	52.44	68.40	3.00
T ₈ (Seaweed+Neem cake 400g/sq m)	68.89	62.00	71.83	2.95
C.D. at 5%	7.203	9.773	3.233	0.372
SE(m) ±	2.382	3.232	1.069	0.123

Table.2 Effects of organic manure on flowering parameters of tuberose (*Polianthes tuberosa*) cv.Prajwal

Treatments	Length of Spike (cm)	Weight of Spike (g)	Diameter of Spike (cm)	Rachis length (cm)
T ₀ Control(no organic manure)	93.33	98.33	0.42	19.00
T ₁ Poultry manure@ 1000g/sq m	101.83	113.00	0.52	25.67
T ₂ Vermicompost @1500g/sq m	101.22	118.33	0.53	31.33
T ₃ Farm yard manure @4000g/sq m	102.11	116.67	0.54	29.67
T ₄ Neem cake @400g/sq m	102.33	115.17	0.53	32.00
T ₅ (Seaweed+ Poultry manure 1000g/sq m)	105.33	126.00	0.66	27.33
T ₆ (Seaweed+Vermicompost 1500g/sq m)	106.33	128.00	0.63	32.67
T ₇ (Seaweed+Farmyard manure 4000g/sq m)	104.22	126.00	0.65	31.33
T ₈ (Seaweed+Neem cake 400g/sq m)	102.99	130.00	0.66	33.33
C.D. at 5%	4.294	16.582	N/A	4.945
SE(m) ±	1.42	5.484	0.047	1.635

Table.3 Effects of organic manures on flower quality and yield of tuberose (*Polianthes tuberosa*) cv.Prajwal

Treatments	No. of Florets	Weight of 10 Florets (g)	Floret Length (cm)	Floret Diameter (cm)	Vase life (Days)	Number of spikes per plot per year
T ₀ Control(no organic manure)	27.33	14.55	6.00	4.10	7.67	24.33
T ₁ Poultry manure@ 1000g/sq m	28.33	15.44	6.97	4.53	10.00	27.00
T ₂ Vermicompost @ 1500g/sq m	34.00	16.16	6.93	5.60	8.34	27.33
T ₃ Farm yard manure @4000g/sq m	28.33	15.00	6.50	5.30	9.34	26.33
T ₄ Neem cake @400g/sq m	31.00	16.05	6.90	5.83	8.67	27.00
T ₅ (Seaweed+ Poultry manure 1000g/sq m)	37.33	17.33	6.77	5.60	11.34	30.33
T ₆ (Seaweed+Vermicompost 1500g/sq m)	40.33	18.00	7.17	5.77	11.67	33.00
T ₇ (Seaweed+Farmyard manure 4000g/sq m)	35.67	16.76	6.67	5.23	11.00	30.67
T ₈ (Seaweed+Neem cake 400g/sq m)	39.67	16.71	6.90	5.30	11.67	30.67
C.D. at 5%	2.974	1.299	0.594	0.413	2.222	1.521
SE(m) ±	0.984	0.430	0.196	0.137	0.735	0.503

Quality parameters

Vase life

Among the different sole applications of organic manures, treatment T₁ (poultry manure @ 1000g/sq m) showed the highest vase life of 10.00 days. When the sole application and combinations of organic manures with Seaweed were compared, then combination of treatment T₈ (Seaweed+Neem cake @ 400g/sq m) and T₆ (Seaweed + Vermicompost @ 2000g/sq m) showed the

highest vase life of 11.67 day and the minimum field life (7.67 days) was observed in control.

The treatments with neem cake showed the best effect on quality parameters especially vase life. This may be due to more uptake of water by the cut spikes of treatments with neem cake and seaweed while they were in vase which may be of low microbial clogging as the neem cake has antimicrobial properties and also has property of protection from various microbes and improve water uptake

by stem. The increase in vase life and water uptake by application of vermicompost was also noticed by Srivastava *et al.*, (2007), Shankar *et al.*, (2010) and Das *et al.*, (2012).

Yield parameters

Spike yield

Spike yield was significantly varied among different treatments of organic manures. Significant improvement in the yield of spike can be observed upon application of organic manures in all treatments over control.

Among the different sole applications of organic manures, treatment T₂ (Vermicompost 2000g/ sq m) showed the highest number of spikes per sq m (27.33) (Table 3).

When the sole application and combinations of organic manures were compared, the combination of T₆ (Seaweeds + Vermicompost @ 2000g/ sq m) showed highest spike yield of 33.00 spikes per sq m per year and expected yield spikes per year. The minimum (24.67) was observed in control (T₀). The same results of high spike yield with vermicompost were also found by Das *et al.*, (2012), and Tripathi *et al.*, (2012).

The above results showed that seaweed application help to improve the efficiency of plant nutrients, as measured by either by improve nutrient uptake or reduced nutrient losses to the environment, or both or it acts as a soil amendment to help improve soil structure or functions and thus enhance yield. Similar increased yields due to incorporation of vermicompost were reported by Patel (1992), Kulkarni (1994) and Patil (1999), Singh (2000) and Marban *et al.*, (2008). Dogra *et al.*, (2009) and Sankari *et al.*, (2015) also concluded that applications of seaweed

extract significantly enhanced plant growth and yield.

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How to cite this article:

Kahkashan Bano Karim, Nellipalli Vinod Kumar, B. Raghupati and Pal, A.K. 2017. Effect of Biostimulants on Growth and Floral Attributes of Tuberose (*Polianthes tuberosa* L.). cv. Prajwal. *Int.J.Curr.Microbiol.App.Sci*. 6(6): 2557-2564.
doi: <https://doi.org/10.20546/ijcmas.2017.606.304>