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Effect of Fertigation, Microbial Consortium and Foliar Spray of Biostimulants on Growth and Yield of Tuberose (*Polianthes tuberosa* L.) cv. 'Prajwal'

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A B S T R A C T

The present investigation was carried out to study the effect of fertigation, microbial consortium and foliar spray of biostimulants on growth and yield of tuberose during 2016-17. The experiment was laid out in randomized block design with nineteen treatments and replicated twice. The results revealed that application of 100 per cent recommended dose of fertilizer through fertigation (RDFTF) + Microbial Consortium (MC) 12.5 kg ha^{-1} + 3 per cent Panchagavya + 0.4 per cent Humic Acid (T_9) recorded significantly higher growth and yield over 100 per cent recommended dose of fertilizer through soil application (T_{19}) and T_9 also recorded 40 per cent higher yield than control.

Key words: *Polianthes tuberosa* L., Fertigation, Microbial consortium, Biostimulants, Growth, Yield

Tuberose (*Polianthes tuberosa* L.) is a native of Mexico, and is essentially a florist's flower and gains importance as commercial flower crop because of its versatile uses as cut flower, loose flower and due to lovely fragrance, longer vase life of spikes, higher returns and wide adaptability to varied climatic and soil conditions. It has high aesthetic value throughout the globe for its beauty and aroma. Tuberose requires a huge quantity of nitrogen, phosphorus and potassium both in the form of organic and chemical fertilizers. It is also essential to apply appropriate quantity of fertilizers at suitable time to increase the growth and yield in tuberose. In recent years, fertigation has proved to be the most accurate fertilizer application technique through drip irrigation systems directly at the place of dynamic root zone, besides to reduce the wastage of nutrients through enhanced fertilizer use efficiency and leading to increased yields, enhanced quality and early crop maturity (Kurakula *et al*. 2018).

Microbial consortium is a combination of two or more microbial compounds and it is important in integrated soil fertility management practices involving judicious application of organic and chemical fertilizers for sustained flower production in profitable scale. Biostimulants like panchagavya and humic acid help in providing balanced nutrition for the growing plants to get higher production besides quality of flower. Hence, the present investigation was carried out to standardize the fertigation and biostimulants schedule and also to assess the growth and yield of tuberose.

MATERIALS AND METHODS

The field experimental trial was conducted at T. Pudhupatti village of Reddiyarchatram block, Dindigul District. The experimental trial was laid out in randomized block design with 19 treatments and replicated two times. The trial consisted three levels of fertigation viz. 125 per cent, 100 per cent and 75 per cent and was applied at various crop growth stages during the cropping period. Microbial consortium was applied @ 12.5 kg ha^{-1} as soil application and biostimulants namely panchagavya (3 per cent and 4 per cent) and humic acid (0.4 per cent and 0.5 per cent) were foliar sprayed at monthly interval. Biometrical observations viz. plant height (cm), leaf length (cm), leaf width (cm), number of florets $spike^{-1}$, number of spikes $clump^{-1}$, spike length (cm), single flower weight (g) and yield (t ha^{-1}) were recorded in randomly selected five plants and average values

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were taken for statistical analysis. The data was statistically analyzed by adopting the standard procedures (Panse and Sukhatme 1978) and the critical difference was worked out at five per cent (0.05%) probability level.

Treatment details

Treatments	Details
T_1	125% recommended dose of fertilizer through fertigation (RDFTF)
T_2	125% RDFTF + Microbial Consortium (MC) @ 12.5 kg ha^{-1}
T_3	125% RDFTF + MC @ 12.5 kg ha^{-1} + 3% Panchagavya + 0.4% Humic acid
T_4	125% RDFTF + MC @ 12.5 kg ha^{-1} + 3% Panchagavya + 0.5% Humic acid
T_5	125% RDFTF + MC @ 12.5 kg ha^{-1} + 4% Panchagavya + 0.4% Humic acid
T_6	125% RDFTF + MC @ 12.5 kg ha^{-1} + 4% Panchagavya + 0.5% Humic acid
T_7	100% RDFTF
T_8	100% RDFTF + MC @ 12.5 kg ha^{-1}
T_9	100% RDFTF + MC @ 12.5 kg ha^{-1} + 3% Panchagavya + 0.4% Humic acid
T_{10}	100% RDFTF + MC @ 12.5 kg ha^{-1} + 3% Panchagavya + 0.5% Humic acid
T_{11}	100% RDFTF + MC @ 12.5 kg ha^{-1} + 4% Panchagavya + 0.4% Humic acid
T_{12}	100% RDFTF + MC@ 12.5 kg ha^{-1} + 4% Panchagavya + 0.5% Humic acid
T_{13}	75% RDFTF
T_{14}	75% RDFTF + MC @ 12.5 kg ha^{-1}
T_{15}	75% RDFTF + MC @ 12.5 kg ha^{-1} + 3% Panchagavya + 0.4% Humic acid
T_{16}	75% RDFTF + MC @ 12.5 kg ha^{-1} + 3% Panchagavya + 0.5% Humic acid
T_{17}	75% RDFTF + MC @ 12.5 kg ha^{-1} + 4% Panchagavya + 0.4% Humic acid
T_{18}	75% RDFTF + MC @ 12.5 kg ha^{-1} + 4% Panchagavya + 0.5% Humic acid
T_{19}	100% Recommended dose of fertilizer (Soil application)

RESULTS AND DISCUSSION

Growth parameters

Significant differences were observed between the treatments for the growth parameters like plant height, leaf length and leaf width at flowering stage (Table 1). Among the different treatments, the treatment T_9 (100% RDFTF + MC @ 12.5 kg ha^{-1} + 3 per cent panchagavya + 0.4 per cent humic acid) and T_{10} (100 per cent RDFTF + MC @ 12.5 kg ha^{-1} + 3 per cent panchagavya + 0.5 per cent humic acid) were recorded the maximum plant height of 67.38cm and 66.81cm respectively whereas the minimum plant height was registered in T_{19} (100 per cent RDF as soil application). Maximum leaf length and leaf width were observed in T_9 (56.18cm and 3.19cm) followed by T_{10} (55.93 cm and 3.18 cm). The minimum leaf length and leaf width were noticed in T_{19} (41.74cm and 2.29 cm respectively).

Table 1 Effect of fertigation, microbial consortium and biostimulants on growth of tuberose (*P. tuberosa* L.) cv. 'Prajwal'

Treatments	Plant height (cm)	Leaf length (cm)	Leaf width (cm)
T_1	57.92	48.62	2.55
T_2	60.07	50.64	2.72
T_3	65.06	54.65	3.06
T_4	64.71	54.32	3.05
T_5	64.03	53.86	2.98
T_6	63.69	53.57	2.97
T_7	58.61	49.28	2.60
T_8	60.74	51.15	2.77
T_9	67.38	56.18	3.19
T_{10}	66.81	55.93	3.18
T_{11}	66.04	55.41	3.13
T_{12}	65.74	55.16	3.12
T_{13}	55.67	46.13	2.48
T_{14}	59.28	49.89	2.65
T_{15}	62.67	52.89	2.91
T_{16}	62.48	52.66	2.90
T_{17}	61.83	52.08	2.84
T_{18}	61.44	51.76	2.82
T_{19}	49.38	41.74	2.29
SEd	0.30	0.21	0.02
CD (0.05)	0.63	0.44	0.04

Growth and development in plants are a consequence of excellent coordination of several processes operating at different growth stages of plant. The growth of tuberose as influenced by various fertigation treatments has been elucidated through the positive response on plant height, leaf length and leaf width were observed with application of recommended dose of fertilizer through fertigation in to the direct root zone system. The increase in growth may be due to better cell division and cell elongation by the applied nitrogen and the role in protein synthesis and also increased level of auxin and GA activity in the plants (Kumaresan and Jawaharlal 2017).

Combined application of bio fertilizers, organic manures and water-soluble fertilizers through drip irrigation, might have helped in progressive mineralization of nutrients which was available throughout the crop growth period of Bird of paradise (Yathindra *et al*. 2016). The present result also in confirmation with the earlier reports of Ravindra *et al*. (2013) in China Aster. Panchagavya has significantly increased the growth and yield in Palak due to the presence of microorganisms and other nutrients which have been triggered rapid cell division, proliferation and higher vegetative growth of plants (Anuja and Jayalakshmi 2011). Humic acid act as a plant bio stimulant that promote plant growth by stimulating the hormonal activity in plants (Screnella *et al*. 2002).

Yield parameters

Spike and flower characters were significantly increased by optimum level of fertigation, microbial consortium, foliar spray of panchagavya and humic acid. The maximum number of florets spike^{-1} (46.63), number of spikes clump^{-1} (4.45) and spike length (91.69 cm) were recorded in T_9 (100 per cent RDFTF + MC @ 12.5 kg ha^{-1} + 3 per cent panchagavya + 0.4 per cent humic acid) whereas, the minimum number of florets spike^{-1} (32.27), number of spikes clump^{-1} (3.10) and spike length (71.03 cm) were observed in 100 per cent RDF as soil application (T_{19}). Similarly, the fertigation at different concentrations with foliar application of biostimulants has significant influence on single flower weight and yield hectare^{-1}. The maximum single flower weight (1.89 g) and yield (16.25 t ha^{-1}) were noticed with 100 per cent RDFTF + MC @ 12.5 kg ha^{-1} + 3 per cent panchagavya + 0.4 per cent humic acid. While, the lowest single flower weight (1.29 g) and yield (11.63 t ha^{-1}) were registered in T_{19} (100% RDF as soil application).

Table 2 Effect of Fertigation, microbial consortium and biostimulants on yield parameters of tuberose (*Polianthes tuberosa* L.) cv. 'Prajwal'

Treatments	No. of florets spike^{-1}	No. of spikes clumb^{-1}	Spike length (cm)	Single flower weight (g)	Yield (t ha^{-1})
T_1	36.25	3.55	77.11	1.52	12.97
T_2	38.60	3.76	80.72	1.61	13.76
T_3	44.21	4.23	88.21	1.81	15.54
T_4	43.83	4.20	87.74	1.80	15.42
T_5	43.03	4.13	86.59	1.77	15.17
T_6	42.78	4.12	86.04	1.77	15.07
T_7	37.04	3.62	78.28	1.55	13.23
T_8	39.47	3.83	81.88	1.64	14.03
T_9	46.63	4.45	91.69	1.89	16.25
T_{10}	46.21	4.41	91.04	1.88	16.16
T_{11}	45.48	4.32	89.91	1.85	15.90
T_{12}	45.04	4.31	89.48	1.84	15.81
T_{13}	35.11	3.42	75.71	1.47	12.70
T_{14}	37.84	3.69	79.53	1.58	13.49
T_{15}	41.96	4.05	84.91	1.73	14.80
T_{16}	41.27	4.02	84.57	1.72	14.69
T_{17}	40.43	3.94	83.32	1.69	14.40
T_{18}	40.26	3.91	82.96	1.68	14.28
T_{19}	32.27	3.10	71.03	1.29	11.63
SEd	0.34	3.55	0.51	0.01	0.11
CD (0.05)	0.72	3.76	1.04	0.02	0.23

Combinations of water soluble and straight fertilizers were improved the crop yield by increasing the yield attributes of plants. The better performance of the yield and yield attributing parameters might be due to better availability of soil moisture and availability of plant nutrients readily throughout the crop growth period under drip fertigation system. Continuous supply of optimum level of water-soluble fertilizers in accessible form through fertigation at all stages of plant growth, might have resulted in higher nutrient uptake and better translocation of assimilates which in turn increased the flower yield. These findings are supported by Kurakula *et al*. (2018) in Marigold, Gopinath and Chandrasekar (2009) in Carnation and Shrikant *et al*. (2014) in Gerbera. Combined application of fertigation and foliar application of biostimulants might have improved spike length, number of florets spike^{-1} and single flower weight and such influence could be ascribed due to enhanced photosynthetic support optimized by plant

growth hormones. These results are in line with the findings of Ganesh *et al.* (2014) who have stated that providing optimum level of macro and micronutrients through fertigation helps to increase the beneficial effects thereby improved yield in cut chrysanthemum. When the organic substances are added to soil, which breakdown complex nitrogenous compounds slowly and make steady N supply throughout the growth period of the crop. This might have attributed to more availability and subsequent uptake of nutrients by the crop, thus, increasing the yield. Corroborative results were also reported by Patil *et al.* (2005) in onion.

Significant positive effect of incorporation of microbial consortium, foliar nutrition of humic acid and panchgayva and various levels of fertilizer application in achieving higher yield and yield attributing characters could be ascribed to increased availability of nitrogen, phosphorus and potassium to the plants initially through chemical fertilizers and then by organic sources which commensurate the needs of plants throughout the crop growth. Similar result was confirmed by Deepa Devi and Shanthi (2013) in tuberose.

Based on the results of the experiment, it could be concluded that application of 100 per cent RDFTF + MC @ 12.5 kg ha^{-1} + 3 per cent panchagavya + 0.4 per cent humic acid showed significant improvement in growth and yield parameters. The above result indicated that continuous supply of nutrients through soil and foliar application were provided ample scope for getting higher flower yield in tuberose. Similarly, 75 per cent RDFTF + MC @ 12.5 kg ha^{-1} + 3 per cent panchgavya + 0.4 per cent humic acid yielded significantly higher than the 100 per cent RDF as soil application. Therefore, wide scope prevails for an integrated approach with specific emphasis on microbial consortium, bio stimulants and fertigation for obtaining higher yield in Tuberose.

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