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Studies on influence of biostimulants and biofertilizers on bulbs, bulblets and spike yield of tuberose (*Polianthes tuberosa* L.) CV. Prajwal

SR Aghera, RR Viradia and VM Chovatiya

Abstract
The present experiment entitled "Studies on influence of biostimulants and biofertilizers on bulbs, bulblets and spike yield of tuberose (*Polianthes tuberose* L.) cv. Prajwal" was carried out at Fruit Research Station, Lal Baugh Farm, Department of Horticulture, Junagadh Agricultural University, Junagadh (Gujarat) during March 2016 to February 2018. The experiment was laid out in Randomized Block Design with factorial concept (FRBD) consisting two factors with three repetitions. Five treatments of biostimulants and three treatments of biofertilizers were considered as treatment combinations. The results indicated that combined application of humic acid @ 0.2% with *Azotobacter* @ 3 ml/m2 + PSB @ 3 ml/m2 + KSB @ 3 ml/m2 at five spray (1st, 2nd, 3rd, 5th and 7th month after planting) of biostimulants and soil application of biofertilizers at the time of planting and 3rd & 6th month after planting and or ratooning enhanced the bulbs, bulblets and spike yield production in tuberose cv. Prajwal. While, maximum number of florets per spike was increased with treatment combination of panchgavya @ 3.0% with *Azotobacter* @ 3 ml/m2 + PSB @ 3 ml/m2 + KSB @ 3 ml/m2 at five spray (1st, 2nd, 3rd, 5th and 7th month after planting) of biostimulants and soil application of biofertilizers at the time of planting and 3rd & 6th month after planting and or ratooning.

Keywords: Biostimulants, biofertilizers, tuberose, Prajwal, bulb, bulblets and spike yield

Introduction

Tuberose (*Polianthes tuberosa* L.) is one of the most important tropical ornamental bulbous flowering plants cultivated for production of long lasting flower spikes. It is popularly known as Rajanigandha or Nishigandha. It belongs to the family Amaryllidaceae and is native of Mexico. Tuberose is an important commercial cut as well as loose flower crop due to pleasant fragrance, longer vase-life of spikes, higher returns and wide adaptability to varied climate and soil. They are valued much by the aesthetic world for their beauty and fragrance. The flowers are attractive and elegant in appearance with sweet fragrance. It has long been cherished for the aromatic oils extracted from its fragrant white flowers. Tuberose blooms throughout the year and its clustered spikes are rich in fragrance; florets are star shaped, waxy and loosely arranged on spike that can reach up to 30 to 45 cm in length. Early spike emergence and flowering was also noted in ratoon crops compared to the first year crop (Malam *et al*., 2010) [11]. "Prajwal" this hybrid which bears single type flowers on tall stiff spikes is a cross between „Shringar‟ x „Mexican Single‟. The hybrid was released by Indian Institute of Horticultural Research (IIHR), Bangalore. The flower buds are slightly pinkish in colour, while the flowers are white. The individual florets are large in size, compared to „Local Single‟. It yields twenty per cent more loose flowers than „Shringar‟. It is recommended both for loose flower and cut flower purpose.

Increased flower production, quality of flowers and perfection in the form of plants are greatly influenced by climatic, geographical and nutritional factors. Out of them, nutritional factor is playing a major role. At present, nutrients are supplied through chemical fertilizers. The indiscriminate and continuous use of chemical fertilizers has leaded to an imbalance of nutrients in soil which has an adversely effected the soil health, affecting the yield and quality of the product. Therefore, use of organic fertilizers is the need of the today. The use of biostimulants and biofertilizers improves physico-chemical and biological properties of soil, besides improving the efficiency of applied nutrients.

Biostimulants are products of natural and organic origin that stimulates plants to achieve their highest growth and yield potential. Biostimulants are akin to biofertilizers as they also promote crop growth and yield. The use of biostimulants along with fertilizers could reduce chemical fertilizer use to a large extent and as much as 50% as they supplement the soil with essential nutrients. Banana pseudostem sap acts as biostimulants. Banana pseudostem sap is one such natural product which made from banana pseudostem. It is well known that banana is the heavy feeder crop of nutrients. After harvest of banana, remaining plant parts treated as waste. This contain high amount of essential plant nutrients, which is being lost. While separating fibers from the banana pseudostem, the liquid available is known as sap which contains good amount of essential macro and micronutrients like K, Fe as well as growth promoting substances like cytokinin, GA3. Seaweed extract is a marine bioactive substances extracted from marine algae are used in agricultural and horticultural crops, and many beneficial effects, in the terms of enhancement of yield and quality. Seaweed extracts contains major and minor nutrients, amino acids, vitamins, cytokinins, auxin and Abscisic acid like growth promoting substances and have been reported to stimulate the growth and yield of plants, develop tolerance to environment stress, increase nutrient uptake from soil and enhance antioxidant properties. Panchagavya, an organic product has the potential to play the role of promote growth and providing immunity in plant system. Panchagavya consists of main five products viz. cow dung, ghee, urine, milk and curd. However, for a good effect of panchgavya on crop so, add another product like jaggery, ripened banana and tender coconut water, when suitably mixed and used, these have miraculous effects. Physico-chemical properties of Panchagavya revealed that they possess almost all the major nutrients, micro nutrients and growth hormones (IAA & GA) required for crop growth. Predominance of fermentative microorganisms like yeast and lactobacillus might be due to the combined effect of low pH, milk products and addition of jaggery/sugarcane juice as substrate for their growth. Humic acids (HA) are the main fractions of humic substances (HS) and the most active components of soil and compost organic matter. In particular, HS stimulate plant growth by accelerating respiration, by their effects on photosynthesis, by increasing water and nutrient uptake, by affecting enzyme activities. Humic acids promote plant health and growth. The importance of humic acids lies in their ability to promote hormonal activity in plants.

Bio-fertilizers are natural fertilizers which are the preparations containing living cells of microorganism which when inoculated into soil provide essential nutrients to plants. Biofertilizers are biologically active products containing certain strains of bacteria, algae or fungi, as a single or composite culture. They produce hormones and antimetabolites which promote root growth. They decompose organic matter and help in mineralization in soil. When applied to seed or soil, biofertilizers increase the availability of nutrients and improve the yield by 10 to 25% without Adversely affecting the soil and environment. Biofertilizers replace 25-30% chemical fertilizers, increase the yields by 10-40%, decompose plant residues, and stabilize C: N ratio of soil. It's also improve texture, structure and water holding capacity of soil. It involves inoculation of beneficial microorganisms that help nutrient acquisition by plants through fixation of nitrogen, solubilization and mobilization of other nutrients. Azotobacter is an aerobic free living, heterotrophic N- fixing bacterium (fixes about 10-25 kg N/ ha/ season) which is commonly found to be involved in close association with crop and fix atmospheric nitrogen in soil. Phosphate solubilizing bacteria are beneficial bacteria capable of solubilizing inorganic phosphorus from insoluble compounds. They convert insoluble phosphates into soluble forms through the production of organic acids. Potassium-solubilizing bacteria (KSB) can be used as a promising approach to increase K availability in soils, thus playing an important role for crop establishment under K-limited soils. Hence, the present study was planned and undertaken with the objective to assess the effect of biostimulants and biofertilizers on growth, flower yield, and quality of tuberose.

Materials and Methods

The field experiment entitled "Studies on influence of biostimulants and biofertilizers on bulbs, bulblets and spike yield of tuberose (Polianthes tuberose L.) cv. Prajwal" was carried out at Fruit Research Station, Lal Baugh Farm, Department of Horticulture, Junagadh Agricultural University, Junagadh (Gujarat) during March 2016 to February 2018. The experiment was laid out in Randomized Block Design with factorial concept (FRBD) consisting two factors with 15 treatments and three replications. The different treatments were T1 (Control), T2 (Azotobacter @ 2 ml/m2 + PSB @ 2 ml/m2 + KSB @ 2 ml/m2), T3 (Azotobacter @ 3 ml/m2 + PSB @ 3 ml/m2 + KSB @ 3 ml/m2), T4 (Banana pseudostem sap @ 1%), T5 (Banana pseudostem sap @ 1% with Azotobacter @ 2 ml/m2 + PSB @ 2 ml/m2 + KSB @ 2 ml/m2), T6 (Banana pseudostem sap @ 1% with Azotobacter @ 3 ml/m2 + PSB @ 3 ml/m2 + KSB @ 3 ml/m2), T7 (Seaweed extracts @ 1%), T8 (Seaweed extract @ 1% with Azotobacter @ 2 ml/m2 + PSB @ 2 ml/m2 + KSB @ 2 ml/m2), T9 (Seaweed extract @ 1% with Azotobacter @ 3 ml/m2 + PSB @ 3 ml/m2 + KSB @ 3 ml/m2), T10 (Panchgavya @ 3%), T11 (Panchgavya @ 3% with Azotobacter @ 2 ml/m2 + PSB @ 2 ml/m2 + KSB @ 2 ml/m2), T12 (Panchgavya @ 3% with Azotobacter @ 3 ml/m2 + PSB @ 3 ml/m2 + KSB @ 3 ml/m2), T13 (Humic acid @ 0.2%), T14 (Humic acid @ 0.2% with Azotobacter @ 2 ml/m2 + PSB @ 2 ml/m2 + KSB @ 2 ml/m2), T15 (Humic acid @ 0.2% with Azotobacter @ 3 ml/m2 + PSB @ 3 ml/m2 + KSB @ 3 ml/m2). Biostimulants were spray five times (1st, 2nd, 3rd, 5th and 7th month after planting or ratooning) and biofertilizers were drenching three times, at the time of planting, 3rd month after planting or ratooning and 6th month after planting or ratooning.

Results and Discussion

Bulb Parameters

Effect of biostimulants

It is evident from table 1 that the maximum number of bulbs (3.65) per plant and (4.05 Lakh no.) per hectare, bulblets (12.03) per plant and (4.05 Lakh no.) per hectare and weight of bulbs and bulblets per plant (204.53 g) were registered with an application of humic acid @ 0.2% (B4). This might be due to the translocation of humic compound to different parts of the plant, thus, enhancing the growth of the plant. The increase in the bulbs and bulblets production could also be attributed to the mobilization of reserve food material to the sink through increased activity by hydrolyzing and oxidizing enzymes. Humic substances are capable of chelating metal ions, such as Fe, Zn etc., retained in exchangeable form in the soil. These forms of nutrients are easily absorbed by the plants leading to improved metabolic activity that might have led to increase in production of more number of bulbs and bulblets in the present study. Similar results were also obtained by Sankari *et al*. (2015) [20] in gladiolus and Vasudevan *et al*. (1997) [26] in sunflower.

Effect of Biofertilizers

The data presented in Table 1, clearly indicated that significantly maximum number of bulbs (3.53) per plant and (4.13 Lakh no.) per hectare, bulblets (12.28) per plant and (13.64 Lakh no.) per hectare and weight of bulbs and bulblets per plant (208.31 g) were registered in Azotobacter @ 3 ml/m2 + PSB @ 3 ml/m2 + KSB @ 3 ml/m2 (F2). Increase in number of bulbs and bulbs per plant and their related characters by the applications of bio-fertilizers may be due to the improvement in soil properties with the help of micro nutrients added in soil through biofertilizers. Increase in number of bulbs and bulblets per plant may be due to ability of Azotobacter to increase the available nitrogen in soil through atmospheric nitrogen fixation, better root proliferation, uptake in nutrients and water, higher leaf number and area, higher photosynthetic activity and enhanced food accumulation which might have resulted in better plant growth and subsequently higher number of bulbs & bulblets and hence, more spikes/plant. While, PSB improved all these parameters which might be due to enhanced availability of phosphorus due to presence of PSB in rhizosphere which stimulates the root system through efficient translocation to roots of certain growth stimulating compounds formed in the plants, which further enhances the absorption of nutrients thus, resulting in a vigorous growth and yield of tuberose. Also, Azotobacter produces growth promoting substances such as IAA and gibberellins like substances viz., vitamin, riboflavin, etc. which might have helped to increase the bulb and bulblets production. The increase in bulb and bulblets might be due to the solubilization of nutrient in the soil by producing organic acids like amino acids, vitamins and growth promoting substance like indol-3- acetic acid (IAA) and gibberellic acid (GA3) by KSB, which help in better growth of the plants and bulb and bullets production. The increased weight of bulb and bulblets per plant could be mainly due to availability of adequate quantity of nutrients for better filling up of bulb, which resulted in the increased bulb weight. The results of these study are in close conformity with findings of Godse *et al*. (2006) [4], Dongardive *et al*. (2007) [2], Srivastava and Govil (2007) [23-25] and Kaushik *et al*. (2016) [7] in gladiolus; Satya Vir (2007) [21] in tuberose and Khan *et al*. (2009) [8] in tulip.

Interaction effect of biostimulants and biofertilizers

The obtained data in Table (1.1) also cleared that significantly maximum number of bulbs (4.19) per plant and (4.65 Lakh no.) per hectare, bulblets (13.82) per plant and (15.35 Lakh no.) per hectare and weight of bulbs and bulblets per plant (234.40 g) were registered in application of humic acid @ 0.2% with Azotobacter @ 3 ml/m2 + PSB @ 3 ml/m2 + KSB @ 3 ml/m2 (B4F2) during the year 2017-18. The result might be due to positive interaction effect of humic acid with the various biofertilizers was resulted to improve the soil properties which created a condition for better performance in bulb and bulblets production. Increase in number of bulb and bulblets per plant and their related characters by the applications of biofertilizers and biostimulants may be due to the availability of micro and macro nutrients to the plants and increase in hormonal activities within the plant. The increased weight of bulb and bulblets per plant could be mainly due to availability of adequate quantity of nutrients for better filling up of bulb, which resulted in the increased bulb and bulblets weight. Increased production of bulbs and bullets could also be attributed to the mobilization of reserve food material to the sink through increased activity by hydrolyzing and oxidizing enzymes. Humic substances are capable of chelating metal ions, such as Fe, Zn etc., retained in exchangeable form in the soil. These forms of nutrients are easily absorbed by the plants leading to improved metabolic activity that might have led to increase in corm weight, corm diameter, and production of more number of bulbs and bulblets. The results of these studies are in close conformity with findings of Bhalla *et al*. (2006) [1], Pandey *et al*. (2013) [14] and Pansuriya (2018) [15] in gladiolus.

Table 1: Effect of biostimulants and biofertilizers on bulb and bulblets of tuberose cv. 'Prajwal'

Treatments	Number of bulbs per plant	Number of bulbs per hectare (Lakh no.)	Number of bulblets per plant	Number of bulblets per hectare (Lakh no.)	Weight of bulbs and bulblets per plant (g)
Level of Biostimulants (B)					
B0 - (Without spray)	2.67	2.96	29.00	10.02	152.93
B1 – Banana pseudostem sap (1%)	3.56	3.96	35.46	13.11	200.18
B2 – Seaweed extract (1%)	2.99	3.32	32.62	10.97	167.43
B3 – Panchgavya (3%)	3.58	3.98	35.61	13.14	200.53
B4 – Humic acid (0.2%)	3.65	4.05	35.85	13.37	204.12
S.Em.±	0.07	0.08	0.49	0.26	3.94
C.D. at 5%	0.21	0.23	1.39	0.75	11.42
Level of Biofertilizers (F)					
F0 – (Without biofertilizer)	2.62	2.91	28.95	9.78	149.34
F1 – *Azoto.* + PSB+ KSB each @ 2 ml/m2	3.53	3.92	35.44	12.93	197.47
F2 - *Azoto.* + PSB+ KSB each @ 3 ml/m2	3.72	4.13	36.74	13.64	208.31
S.Em.±	0.05	0.11	0.38	0.20	3.05
C.D. at 5%	0.16	0.33	1.08	0.58	8.85
Interaction (B X F)					
S.Em.±	0.12	0.14	0.40	0.45	6.83
C.D. at 5%	0.36	0.39	1.17	1.30	19.79
CV%	7.46	7.46	7.39	7.39	7.42

Table 1.1: Interaction effect of biostimulants and biofertilizers on bulb and bulblets of tuberose cv. 'Prajwal'

Treatments	Number of bulbs per plant	Number of bulbs per hectare (Lakh no.)	Number of bulblets per plant	Number of bulblets per hectare (Lakh no.)	Weight of bulbs and bulblets per plant (g)
T1	1.95	2.17	7.07	7.85	119.87
T2	2.95	3.28	9.73	10.81	165.04
T3	3.11	3.45	10.25	11.39	173.87
T4	2.80	3.11	9.30	10.34	157.81
T5	3.84	4.26	12.68	14.09	215.15
T6	4.06	4.51	13.42	14.91	227.59
T7	2.70	3.00	8.94	9.93	151.60
T8	3.10	3.44	10.22	11.35	173.29
T9	3.17	3.52	10.46	11.62	177.40
T10	2.81	3.12	9.31	10.34	157.88
T11	3.85	4.28	12.70	14.11	215.43
T12	4.08	4.53	13.46	14.95	228.29
T13	2.85	3.17	9.41	10.45	159.54
T14	3.90	4.34	12.88	14.31	218.43
T15	4.19	4.65	13.82	15.35	234.40
S.Em. ±	0.12	0.14	0.40	0.45	6.83
C.D. at 5%	0.36	0.39	1.17	1.30	19.79
CV%	7.46	7.46	7.39	7.39	7.42

Yield Parameters

Effect of biostimulants

Data show in table (2), that the plants treated with foliar application of humic acid @ 0.2% (B4) recorded significantly maximum total number of spikes per plant (3.22), total number of spikes per net plot (38.60) and total number of spikes per hectare (3.57 Lakh no.). It might be due to humic

Acid spray. The humic acid sprayed on the leaves might have translocated to the other parts of the plants, including roots. The root leachates containing very low concentration of humic acid might have helped in the chelation of metal ions in soil making them available in absorbable and usable form for plant growth. This might have been aided by the balanced nutrition made available to the crop by the production of auxin like growth substances by humic acid at early phase of development. Humic acid which consisted of active phenolic group would have inhibited oxidase activity and promoted the prolonged persistence of IAA (Indole Acetic Acid) in plants that might have contributed to the increased yield of spike. Humic acid contains numerous negatively charged anions that attract or hold onto positively charged cations in the soil. The cations growers are concerned with include a host of micro elements good for growing plants, with calcium, ammonium, magnesium, and iron among the most important. This chelation of cations is probably the most important role of humic acid with respect to boosting plant production and flower yields. In short it improves the soil physical, biochemical properties which resulted to improve growth and flowering which resulted to improve in flower yield. Similar results were also obtained by Sankari *et al*. (2015) [20] in gladiolus; Khenizy *et al*. (2013) [9] in gerbera; Farjami and Nabavi (2014) [3] in marigold; Vijayalakshmi and Mathan (1997) [22] in sunflower and Yasser *et al*. (2011) [28] in roselle plants.

While, maximum number of florets per plant (37.87) was recorded with a foliar application of panchgavya @ 3.0% (B3). It is due to the foliar spray of panchgavya which might be due to increased availability and effective absorption of nutrients which are requiring for flower development. These nutrients in biostimulants are readily soluble as they are in liquid forms can be taken up by the plants at once. As, plant receives regular supply of N and P that leads to more vegetative growth, leading to increase in photosynthetic area, which in turn resulted in more synthesis and accumulation of photosynthates and partitioning to the developing flower. Presence of growth regulatory substances such as IAA, GA and cytokinins also contributed in the development of the flower. Auxins and GA promote flowering and cytokinins delay senescence and also promoted the movement of nutrients in the plant, which increases the period of flowering. Cytokinin and essential plant nutrients from panchagavya caused a tremendous influence on the growth rate in plant. Similar results were also obtained by Patil *et al*. (2006) [16], Singh *et al*. (2007) [23] and Mahawer *et al* (2010) [10] in tuberose; Bhalla *et al*. (2006) [1], Raushan (2008) [17] and Kumar *et al*. (2011) [18] in gladiolus and Sharma *et al*. (2011) [22] in carnation

Effect of biofertilizers

The data presented in Table 2, clearly indicated that significantly maximum total number of spikes per plant (3.36), total number of spikes per net plot (40.31), total number of spikes per hectare (3.73 Lakh no.) number of florets per spike (38.22) were recorded with an application of Azotobacter

@ 3 ml/m2 + PSB @ 3 ml/m2 + KSB @ 3 ml/m2 (F2). The result might be due to positive effect of

Biofertilizer on soil which resulted to better yield. Bio inoculants improve the nutrient availability of the plant by addition of atmospheric nitrogen to the soil and promote vegetative growth and yield of the plant. The conversion of photosynthates into proteins results in more flower primordia and development of flower bud attributing to higher flower yield. The increase in number of spikes might be due to possible role of Azotobacter through atmospheric nitrogen fixation, better root proliferation, uptake of nutrients and water and also attribute of PSB to the increase availability of phosphorus and KSB to the increase availability of potash. In addition, KSB are also known to produce amino acids, vitamins and growth promoting substance like indol-3-acetic acid (IAA) and gibberellic acid (GA3) which help in better growth of the plants. The results are close conformity with findings of Srivastava *et al*. (2007) [23-25] and Hadwani *et al*. (2013) [5] in tuberose; Dongardive *et al*. (2007) [2], Srivastava and Govil (2007) [23-25] and Kaushik *et al*. (2016) [7] in gladiolus; Renukaradya *et al*. (2011) [18] in carnation and Palagani *et al*. (2013) [13] in chrysanthemum.

Interaction effect of biostimulants and biofertilizers

The data presented in table (2.1), revealed that the significantly maximum total number of spikes per plant (3.81), total number of spikes per net plot (45.75) and total number of spikes per hectare (4.24 Lakh no.) was registered in combined application of humic acid @ 0.2% with Azotobacter @ 3 ml/m2 + PSB @ 3 ml/m2 + KSB @ 3 ml/m2 (B4F2). It is true that humic acid increased the efficiency of biofertilizers resulted to more availability of various nutrients resulted to higher yield. This could be associated with higher uptake of N, P and K nutrient from soil due to chelating action of humic acid, which resulted in development of more number of spikes. The application of humic with biofertilizers reduces the requirement of other fertilizers. It also increases crop yield, soil aeration, and drainage. Humic acid increased availability of biofertilizers and increase in number of spike per plant may be due to ability of Azotobacter to increase the available nitrogen in soil through atmospheric nitrogen fixation, better root proliferation, uptake in nutrients and water, higher leaf number and area, higher photosynthetic activity and enhanced food accumulation which might have resulted in better plant growth and subsequently higher yield. While, PSB improved these parameters which might be due to enhanced availability of phosphorus due to presence of PSB in rhizosphere which stimulates the root system through efficient translocation to roots of certain growth stimulating compounds formed in the plants, which further enhances the absorption of nutrients thus, resulting in a vigorous growth and yield of tuberose. Also, Azotobacter produces growth promoting substances such as IAA and gibberellins like substances viz., vitamin, riboflavin, etc. which might have helped to increase the bulb and bulblets production hence, more spikes/plant. In addition, KSB are also known to produce amino acids, vitamins and growth promoting substance like indol-3-acetic acid (IAA) and gibberellic acid (GA3) which help in better growth of the plants. Chlorophyll is a major green pigment found in green leaves and is undoubtedly determining the photosynthetic efficiency and productivity of plants. Notably K also played an important role in the synthesis of chlorophyll by taking part in various enzyme activities. Since K is found to influence the total chlorophyll and carotenoids contents of the leaves it may also directly and/or indirectly improve crop yield through increased photosynthesis. The results of present study are in close conformity with findings of Bhalla *et al*. (2006) [1], Pandey *et al*. (2013) [14] and Pansuriya (2018) [15] in gladiolus and Jadhav *et al*. (2014) [6] in marigold.

Whereas, maximum number of florets per plant (38.81) were recorded with an foliar application of panchgavya @ 3.0% with Azotobacter @ 3 ml/m2 + PSB @ 3 ml/m2 + KSB @ 3 ml/m2 (B4F2). The higher production of auxin and growth substances by panchgavya and biofertilizers at early phase of growth would have contributed to the formation of more floral bud formation. This might be due to activity of panchgavya with biofertilizers consisting of active phenolic group that might have inhibited oxidase activity and promoted the prolonged persistence of IAA in plants which might have contributed to the increased number of florets per spike. It might be due to synergetic effect of panchgavya on biofertilizers. The beneficial effect of panchagavya was mainly attributed to the presence of growth regulatory substances such as IAA, GA and cytokinin, essential plant nutrients, naturally occurring beneficial effective microorganisms (EMO‟s) predominately lactic acid bacteria and certain fungi besides beneficial and proven biofertilizers such as, Azotobacter, Phosphobacteria and plant protection substances (Pseudomonas and saprophytic yeasts). Presence of large quantities of IAA and GA, which are physiologically active in photosynthesis and other processes and (Somasundaram, 2003) [24] and also increased biological efficiency of crop plants and creating greater source and sink capacities in the plant system. Auxins and GA promote flowering and cytokinins delay senescence and also promoted the movement of nutrients in the plant, which increases the period of flowering. This may be attributed to the fact that panchagavya is a rich source of beneficial micro-organisms like N-fixers and P-solubilizers bacteria promotes higher microbial population in soil and increased availability of N and P required for flower development as Azotobacter fixes nitrogen, PSB makes the insoluble phosphorus available by secreting organic acids, mainly oxalic acid and KSB mobilizing potash. The results are close conformity with findings of Bhalla *et al*. (2006) [1] in gladiolus and Naidu *et al*. (2009) [12] in chili.

Table 2: Effect of biostimulants and biofertilizers on yield parameters of tuberose cv. 'Prajwal'

Treatments	Total number of spikes per plant	Total number of spikes per net plot	Total number of spikes per hectare (Lakh No.)	Number of florets per spike
Level of Biostimulants (B)				
B0 - (Without spray)	2.16	25.90	2.40	35.17
B1 – Banana pseudostem sap (1%)	3.15	37.81	3.50	37.71
B2 – Seaweed extract (1%)	2.79	33.53	3.10	36.60
B3 – Panchgavya (3%)	3.16	37.98	3.52	37.87
B4 – Humic acid (0.2%)	3.22	38.60	3.57	37.77
S.Em.±	0.06	0.71	0.07	0.19
C.D. at 5%	0.17	2.02	0.19	0.55
Level of Biofertilizers (F)				
F0 – (Without biofertilizer)	2.13	25.60	2.37	35.15
F1 – *Azoto.* + PSB+ KSB each @ 2 ml/m2	3.20	38.38	3.55	37.71
F2 - *Azoto.* + PSB+ KSB each @ 3 ml/m2	3.36	40.31	3.73	38.22
S.Em.±	0.05	0.55	0.05	0.15
C.D. at 5%	0.13	1.57	0.15	0.42
Interaction (B X F)				
S.Em.±	0.10	1.24	0.11	0.33
C.D. at 5%	0.29	3.50	0.32	0.95
CV%	8.72	8.72	8.72	7.22

Table 2.1: Interaction effect of biostimulants and biofertilizers on yield parameters of tuberose cv. 'Prajwal'

Treatments	Total number of spikes per plant	Total number of spikes per net plot	Total number of spikes per hectare (Lakh No.)	Number of florets per spike
T1	1.80	21.63	2.00	31.71
T2	2.31	27.68	2.56	36.62
T3	2.36	28.37	2.63	37.18
T4	2.21	26.47	2.45	36.21
T5	3.51	42.10	3.90	38.18
T6	3.74	44.85	4.15	38.76
T7	2.16	25.95	2.40	35.26
T8	3.09	37.04	3.43	37.10
T9	3.13	37.61	3.48	37.43
T10	2.22	26.68	2.47	36.25
T11	3.53	42.30	3.92	38.27
T12	3.75	44.96	4.16	38.81
T13	2.27	27.29	2.53	36.32
T14	3.56	42.75	3.96	38.37
T15	3.81	45.75	4.24	38.91
S.Em. ±	0.10	1.24	0.11	0.33
C.D. at 5%	0.29	3.50	0.32	0.95
CV%	8.72	8.72	8.72	7.22

Conclusion

Based on the present investigation it can be concluded that the treatment combination of humic acid @ 0.2% with Azotobacter @ 3 ml/m2 + PSB @ 3 ml/m2 + KSB @ 3 ml/m2 was increased bulbs, bulblets and spike yield of tuberose cv. Prajwal. However, florets per spike were increased by

the application of panchgavya @ 3% with Azotobacter @ 3 ml/m2 + PSB @ 3 ml/m2 + KSB @ 3 ml/m2.

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