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Response of GA_3 and Paclobutrazol on vegetative growth and yield attributes of Tuberose (*Polianthes tuberosa* L.)

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Abstract
The present investigation "Response of GA_3 and Paclobutrazol on vegetative growth and yield attributes of Tuberose (*Polianthes tuberosa* L.)" was carried out in Horticulture Research Farm at the Department of Floriculture and Landscape Architecture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C. G.) in the year 2017-18 and 2018-19. The experiment was laid out in Factorial Randomized Block Design with three replication and sixteen treatment combinations of two plant growth regulator namely GA_3 150 ppm (30 and 50 DAP) and paclobutrazol 10 ppm (70 DAP) were taken as growth promoter and growth retardant, respectively. And two cultivars namely prajwal (V_1) and bidhan ujjwal (V_2). In case of variety, the maximum plant height, length of leaf, number of leaves plant^{-1}, fresh dry weight of leaves (g), dry weight of leaves (g) and yield (q ha^{-1}) was recorded with cv. Prajwal (V_1) as compared to cv. Bidhan ujjwal (V_2). The results investigate the effect of different levels of growth promoter and retardant on growth, flowering and yield of different cultivars of tuberose. Among the different treatment of PGRs the significantly maximum plant height, length of leaf, number of leaves plant^{-1}, fresh and dry weight of leaves (g) were observed with application of GA_3 150 ppm (30 and 50 DAP) during both the years. Whereas, significantly maximum yield of bulbs (q ha^{-1}) were recorded with application of GA_3 150 ppm (30 and 50 DAP) + Paclobutrazol 10 ppm (70 DAP) during both the years.

Keywords: Tuberose, PGRs, Gibberellic acid (GA_3), Paclobutrazol (PBZ), Prajwal and Bidhan Ujjwal, growth and yield

Introduction
Flowers are an integral part of human life due to their diversity in beauty, form, texture. Tuberose (*Polianthes tuberosa* L.) is a commercial flowering bulbous plant popularly known as Rajnigandha (Bengali), Gu-e-chari (Hindi) and Nela sempangi in telugu. Tuberose is belonging to the family Amaryllidaceae and is native of Mexico. Tuberose is commonly grown for garden decoration in pots, beds, borders and even for cut flower and loose flower production. Flowers are considered as an excellent source of essential oil. Flower is very popular among the masses because of its sweet and pleasant fragrance apart from its better keeping quality. Quality of tuberose flower is considered to be affected by various pre and post- harvest factors such as temperature, relative humidity, frequency of irrigation, nutrition and time of harvesting of spike. In recent year, use of plant growth regulators is being increased to manipulate the growth, flowering and yield of many ornamental plants. Gibberellic acid (GA_3) and Paclobutrazol (PBZ) are very important plant growth regulators and are widely used in horticulture. The importances of PGR's in flower production are well known for improving productivity and produce quality. But the study on integrated use of both growth promoter and growth retardant in tuberose is very few. The investigation was framed out in a view that initial vegetative growth is important but subsequently reproductive growth is congenial. It is important to check the further vegetative growth by using growth retardant to keep reproductive stage more heal their and productive. Therefore, the combination of both growth promoter and growth retardant at their right level and their right stage of crop is highly desired. The GA_3 regulation of growth itself is involved with both cell division and cell enlargements without cell division (Haberand and Leopold, 1960) [5]. Sachs *et al.* (1960) [23] reported that application of PBZ retarded stem elongation by preventing cell division in the sub-apical meristem, usually without similarly affecting the apical meristem. Gibbrellin activates the vertical growth of plant by sensitizing the apical meristem, while PBZ enforce stop the vertical growth consequently induces the lateral or horizontal growth. It is very important for establishing source and sink relationship, which could be artificially induced by

using PGR's for the proportionate vegetative and reproductive growth. Thus, keeping in view the potentialities of growth regulators like GA_3 and PBZ, the present study was undertaken to find out the suitable concentration of these PGR's for better vegetative growth and yield attributes of tuberose cultivars.

Materials and Methods

The experiment was carried out during two seasons of the years 2017-18 and 2018-19, was carried out in Horticultural Research cum Instruction Farm at the Department of Floriculture and Landscape Architecture, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). The experiment was laid out in Factorial Randomized Block Design with three replications comprising sixteen treatment combinations of Eight levels of PGR's *viz*., G_1 GA_3 150 ppm at 30 DAP, G_2 GA_3 150 ppm at 50 DAP, G_3 $GA_3$150 ppm at 30 and 50 DAP, G_4 PBZ 10 ppm at 70 DAP, G_5 GA_3 150 ppm at 30 DAP + PBZ 10 ppm at 70 DAP, G_6 GA_3 150 ppm at 50 DAP+ PBZ10 ppm at 70 DAP, G_7 $GA_3$150 ppm at 30 and 50 DAP + PBZ 10 ppm at 70 DAP, along with G_8 distill control (water spray) and two varieties *viz*., Prajwal and Bidhan Ujjwal of tuberose were taken. Bulbs of tuberose cv. Prajwal were provided by Horticulture Research Farm at the Department of Floriculture and Landscape Architecture, Indira Gandhi Krishi Vishwavidyalaya, Raipur and the other cv. Bidhan Ujjwal were provided by Horticulture Research Farm, Mandouri, Bidhan Chandra Krishi Vishwavidyalaya, West Bengal. Before planting the bulbs were stored in well ventilated semi shady place for two months. Older leaves emerging from the neck of the bulbs were trimmed off. Before planting, the bulbs were treated with fungicide copper oxychloride (0.1%) and the individual bulbs. weighing 15-30 g with 1.5- 2.5 cm in diameter were selected for planting. Five plants were selected randomly from each plot for recording data on various quality attributes. Desired quantities of the GA_3 were first dissolved in few drops of alcohol (C_2H_5OH) and then volume was made up to 500 ml dissolved water to make the proper concentrations of GA_3. Paclobutrazol was dissolved in required amount of distilled water for preparation of stock solution and then diluted before spraying. The spraying was done in the morning hours with the help of hand spraying. Two time periods of crop growth were chosen for spraying of PGR's i.e., first at 30, 50 DAP and at 70 DAP. Observation were recorded at 30, 60 and 90 days after planting. The various parameters like plant of plant (cm), number of leaves plant^{-1}, length of leaf (cm), Fresh and dry weight of leaves (g) and bulb yield ha^{-1} were also recorded.

Results and Discussion

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads:

Vegetative growth attributes

Plant height (cm): The results pertaining to the effect of varieties and growth regulators on vegetative growth and yield of tuberose at 30, 60 and 90 days after planting during two years apart with pooled mean data are presented in Table (1) and interaction of G X V (treatment combination) data are presented in table (1.2).

Influence of Cultivars

The data presented in (Table 1) show that the cultivars of Tuberose had significantly influenced on vegetative growth and yield parameters characters.

During both year as well as pooled mean data at 30 DAP, the results showed non significant differences among the treatments.

At 60 DAP, during the first year of investigation, plant height significantly differed within the varieties and Prajwal (V_1) recorded significantly maximum plant height (50.65 and 51.20 cm) as compared to Bidhan Ujjwal (43.84 and 43.70 cm). Similar trend was observed in second year of trial as well as pooled mean analysis.

The final observation of plant height at 90 DAP indicated that significantly maximum plant height (84.09 and 83.93 cm,) were observed in Prajwal as compared to Bidhan Ujjwal (61.31 cm and 60.90 cm) during both the tested years, respectively. The two years data of plant height indicated that the plants of Prajwal were taller than Bidhan Ujjwal and this trend was maintained up to the end of study. The variation in plant height between tuberose varieties might be due to congenial environment to express the dominant genes in the genotypes and different genetic makeup of the varieties. The observations are in conformity with the findings of Ramachandrudu *et al.* (2009) [19], Vijayalami *et al.* (2010) [29], Prashanta *et al.* (2016) [18], Madhumati *et al.* (2018) [10] in tuberose.

Effect of plant growth regulators

During first year, second year as well as pooled mean data at 30 DAP, the results showed non-significant differences among the treatments.

At 60 DAP, during the first year data clearly showed that the maximum plant height (53.25 cm) was recorded under the treatment G_3 GA_3 150 ppm (30 and 50 DAP), which was at par with treatment G_7 GA_3 150 ppm (30 and 50 DAP) + PBZ 10 ppm (70 DAP) having plant height of 52.31cm, respectively, while, minimum plant height (40.67 cm) was noticed in G_8 control (water spray). The trend was found similar in second year trial and as well as in pooled data.

The maximum plant height in the first and second year 81.33 cm and 81.56 cm, respectively was observed under G_3 GA_3 150 ppm (30 and 50 DAP), which was at par with G_7 GA_3 150 ppm (30 and 50 DAP) + PBZ 10 ppm (70 DAP), G_5 GA_3 150 ppm (30 DAP) + PBZ 10 ppm (70 DAP) and G_1 GA_3 150 ppm (30 DAP) whereas minimum plant height (77.94 cm, 76.99 cm and 75. 93 cm, respectively) was recorded under G_8 control (water spray) during both the year of investigation respectively. The taller plants were observed with the application of G_3 GA_3 150 ppm (30 and 50 DAP) followed by G_7 GA_3 150 ppm (30 and 50 DAP) + PBZ 10 ppm (70 DAP), indicating that the growth promoter GA_3 had increased the height of the plant when sprayed in both stages i e. early and mid growth.

All the treatments recorded more height in early stage as compared to the control because GA_3 were applied in early stage which resulted in increased height whereas application of paclobutrazol during mid growth stage decreased the rate of increasing height. This significant increase in the plant height with GA_3 may be attributed to the action of gibberellins which promote vegetative growth by way of cell division and cell elongation and this may have resulted in the increase of plant height. GA_3 helps to increase the photosynthetic activity in plants. Thus, it might have increased osmotic uptake of water and nutrients, by maintaining constant turger suppresser against the softening

of cell walls. These results are in close conformity with the findings of Manisha *et al*. (2002) [11], Kumar *et al*. (2011) [8, 9], Singh and Karuna (2011), Bhosale *et al*. (2014) [2] in tuberose.

Interaction effects

The interaction effect due to growth regulators and variety treatments was found to be non-significant for all the characters. This may be due to the similar effect of plant growth regulator on both the varieties of tuberose.

Length of leaf (cm)

The results on length of leaf (cm) were significantly influenced by varieties and application of growth regulators are presented in table (2) and interaction of G X V (treatment combination) data are presented in table (2.1).

Influence of Cultivars

During both year as well as pooled mean data at 30 DAP, the results showed non significant differences among the treatments.

At 60 DAP, during the first year of investigation, length of leaf significantly differed within the varieties. Prajwal (V_1) recorded significantly maximum length of leaf (35.46 cm) as compared to Bidhan Ujjwal (32.35 cm). Similar trend was observed in second year of trial as well as pooled mean analysis.

The final observation of length of leaf at 90 DAP indicated that significantly maximum length of leaf (41.51 and 38.57 cm,) were observed in Prajwal as compared to Bidhan Ujjwal (36.25 cm and 35.63 cm) during both the tested years, respectively. The two years data of length of leaf indicated that the plants of Prajwal were taller than Bidhan Ujjwal and this trend was maintained up to the end of study. Present finding are in conformity with the findings obtained by Bhaskar and Reddy (2006) [1], Patil *et al.* (2009) [17], Prashanta *et al.* (2016) [18], Singh *et al.* (2017) [26], Madhumati *et al.* (2018) [10] in tuberose.

Effect of plant growth regulators

During first year, second year as well as pooled mean data at 30 DAP, the results showed non-significant differences among the treatments.

At 60 DAP, during the first year data clearly showed that the maximum length of leaf (36.48 cm) was recorded under the treatment G_1 GA_3 150 ppm (30 and 50 DAP), which was at par with treatment G_7 GA_3 150 ppm (30 and 50 DAP) + PBZ 10 ppm (70 DAP), G_5 GA_3 150 ppm (50 DAP) + PBZ 10 ppm (70 DAP) and G_1 GA_3 150 ppm (30 DAP) having length of leaf of 35.97 cm, 34.68 cm and 34.03 cm respectively, while, minimum length of leaf (31.27 cm) was noticed in G_8 control (water spray). The trend was found similar in second year trial and as well as in pooled mean.

The maximum length of leaf in the first and second year (44.54 cm and 41.82 cm, respectively) was observed under G_1 GA_3 150 ppm (30 and 50 DAP), which was at par with G_7 GA_3 150 ppm (30 and 50 DAP) + PBZ 10 ppm (70 DAP), G_5 GA_3 150 ppm (50 DAP) + PBZ 10 ppm (70 DAP) and G_1 GA_3 150 ppm (30 DAP) whereas minimum length of leaf (34.65 cm and 34. 32 cm, respectively) was recorded under G_8 control (water spray) during both the year of investigation respectively.

From the above findings, significant increase in the length of leaf may be due to the factor GA_3 increased the growth of plant by increasing internodal length which might be due to enhance cell division and cell enlargement and also due to increase in plasticity of cell, promotion of protein synthesis coupled with higher apical dominance. Another probable reason might be due to the effect of GA_3 on photosynthetic activity resulted in efficiently utilizing photosynthetic products by plants. These results are in close conformity with the findings of Singh and Bijimol (2001) [25], Narayan *et al.* (2002) [13], Padaganur *et al*. (2005) [14], Wagh *et al*. (2012) [30] in tuberose.

Interaction effects

The interaction effect due to growth regulators and variety treatments was found to be non-significant for all the characters. This may be due to the similar effect of plant growth regulator on both the varieties of tuberose.

Number of leaves plant^{-1}

The results on number of leaves plant^{-1} were significantly influenced by varieties and application of growth regulators are presented in table (3) and interaction of G X V (treatment combination) data are presented in table (3.1).

Influence of Cultivars

During both year as well as pooled mean data at 30 DAP, the results showed non significant differences among the treatments.

The perusal of data on the influence of varieties on number of leaves plant^{-1} revealed that in all the growth stages, at 60 and 90 DAP, respectively during the first year of investigation, significantly maximum number of leaves plant^{-1} were recorded under (V_1) Prajwal (21.94 and 22.57, respectively) as compared to (V_2) Bidhan Ujjwal (21.17 and 20.88, respectively). Similar trend was observed in second year of trial as well as in pooled mean analysis.

From the above findings, significantly maximum number of leaves plant^{-1} was observed in Prajwal at all the growth stages, as well as pooled mean data and it might be due to the congenial environment to express the dominant genes in the genotypes and different genetic makeup of the variety. The present research work confirms with the findings of Vijiyalaxmi *et al.* (2010) [29], Desai and Chawla (2010) [3], Rushd *et al.* (2010) [22], Ranchana *et al.* (2015) [20], Ramachandrudu *et al*. (2016) and by Singh *et al.* (2017) [26] in tuberose.

Influence of growth regulators

During both year as well as pooled mean data at 30 DAP, the results showed non-significant differences among the treatments.

At 60 DAP, during the first year of investigation, that the maximum number of leaves plant^{-1} (24.56) was noticed under the treatment G_3 GA_3 150 ppm (30 and 50 DAP). However, it was at par with treatment G_7 GA_3 150 ppm (30 and 50 DAP) + PBZ 10 ppm (70 DAP), G_5 GA_3 150 ppm (30 DAP) + PBZ 10 ppm (70 DAP), G_1 GA_3 150 ppm (30 DAP) and G_4 PBZ 10 ppm (70 DAP) except control. The trend was found similar in second year trial as well as in the pooled mean.

During first year of investigation, at 90 DAP, the data clearly showed that the treatment G_3 GA_3 150 ppm (30 and 50 DAP) had the maximum number of leaves plant^{-1} (58.85) However, it was at par with the treatment G_7 GA_3 150 ppm (30 and 50 DAP) + PBZ 10 ppm (70 DAP), G_5 GA_3 150 ppm (30 DAP) + PBZ 10 ppm (70 DAP) and G_1 GA_3 150 ppm (30 DAP) having number of leaves plant^{-1} as 58.79, 53.35 and 52.15

respectively. While, minimum number of leaves plant^{-1} (39.27) was registered under the treatment G_8 control (water spray). The similar trend was found in second year trial as well as pooled mean. The application of GA_3 at 150 ppm and Paclobutrazol 10 ppm augmented significantly maximum number of leaves plant^{-1} followed by G_7, G_5 and G_3 at all the growth stages.

The increasement in number of leaves plant^{-1} and plant height might be due to the abolition of apical dominance as GA_3 have been categorically shown to be instrumental in lifting apical dominance and cell elongation. Similar results have also been reported by Narayan *et al.* (2002) [13], Manisha *et al.* (2002) [11] Panwari *et al.* (2006) [16], Kumar *et al.* (2011) [8, 9] in tuberose.

Interaction effects

The interaction effects of varieties and growth regulator treatments showed non significant effect for number of leaves per plant at various growth stages of tuberose plants. This may be due to the similar effect of plant growth regulator on both the varieties of tuberose.

Fresh weight of leaves (g)

The data with respect to effect of various growth regulators and variety treatments on fresh weight of leaves (g) are given in table (4) and interaction of G X V (treatment combination) data are presented in table (4.1).

Influence of Cultivars

During both year as well as pooled mean data at 30 DAP, the results showed non-significant differences.

At 60 DAP, during the first year of investigation, fresh weight of leaves significantly differed within the varieties and Prajwal (V_1) recorded significantly maximum fresh weight of leaves (10.19 g) as compared to Bidhan Ujjwal (7.76 g). Similar trend was observed in second year of trial as well as in the pooled mean analysis.

The final observation of fresh weight of leaves at 90 DAP indicated that the maximum fresh weight of leaves (21.85 and 22.15 g) were observed in Prajwal and minimum fresh weight of leaves (19.52 and 20.22 g) were observed in Bidhan Ujjwal during both the tested years respectively. A similar trend was found in pooled mean data. The two years data of fresh weight of leaves indicated that the plants of Prajwal were found to above more fresh weight of leaves than Bidhan Ujjwal and this trend was maintained up to the end of study and this might be due to the congenial environment to express the dominant genes in the genotypes and also different genetic makeup of the variety. Similarly, the fresh weight of leaves is an important genotypic character in tuberose that might be primarily governed by the genetic makeup of the genotypes. Similar results have also been reported by Krishan and Misra (2005) [6], Padamalatha *et al.* (2013) [15] and by Singh *et al.* (2017) [26] in tuberose.

Influence of growth regulators

During both year as well as pooled mean data at 30 DAP, the results showed non-significant differences among the treatments.

Among different treatments of plant growth regulators applied during the first year of investigation, at 60 DAP, the maximum fresh weight of leaves (10.51 g) was recorded with G_3 GA_3 150 ppm (30 and 50 DAP) however, it was at par with the treatment G_7 GA_3 150 ppm (30 and 50 DAP) + PBZ 10 ppm (70 DAP) and G_5 GA_3 150 ppm (30 DAP) + PBZ 10 ppm (70 DAP) which showed 10.19 and 8.89 g fresh weight of leaves, respectively. Whereas, the lowest fresh weight of leaves (7.56 g) was observed under the treatment G_8 control (water spray). Similar trend was observed in second year of trial as well as pooled mean data.

The treatment G_3 GA_3 150 ppm (30 and 50 DAP) recorded maximum fresh weight of leaves (23.03 g). However, this treatment was found statistically similar to G_7 GA_3 150 ppm (30 and 50 DAP) + PBZ 10 ppm (70 DAP) and G_5 GA_3 150 ppm (30 DAP) + PBZ 10 ppm (70 DAP) and G_1 GA_3 150 ppm (30 DAP) which showed 21.85, 21.47 and 21.27 g fresh weight of leaves, respectively. However, minimum fresh weight of leaves (18.41 g) was observed with G_8 control (water spray). Similarly during second year of investigation at 90 DAP, maximum fresh weight of leaves was recorded under the treatment G_3 GA_3 150 ppm (30 and 50 DAP) which was at par with all the treatments except G_8 control (water spray). Whereas, it was found minimum fresh weight of leaves (19.46 g). Findings obtained on the basis of pooled data revealed that the treatment G_3 GA_3 150 ppm (30 and 50 DAP) recorded maximum fresh weight of leaves (23.03 g) which, showed at par values with the treatment G_7 GA_3 150 ppm (30 and 50 DAP) + PBZ 10 ppm (70 DAP) and G_5 GA_3 150 ppm (30 DAP) + PBZ 10 ppm (70 DAP) which recorded 21.85 and 21.27 fresh weight of leaves, respectively. These finding were corroborated with the finding of Tiwari and Singh (2005), Rani and Singh (2005) [21], Padaganur *et al.* (2005) [14] and by Padamalatha *et al.* (2013) [15] in tuberose.

Interaction effects

The treatment combinations of applications of growth regulators and variety were found to be non-significant. This may be due to the similar effect of plant growth regulator on both the varieties of tuberose.

Dry weight of leaves (g)

The results on dry weight of leaves (g) were significantly influenced by varieties and application of growth regulators are presented in table (5) and interaction of G X V (treatment combination) data are presented in table (5.1).

Influence of Cultivars

During both year as well as pooled mean data at 30 DAP, the results showed non-significant differences.

During the first year of investigation, at 60 DAP, dry weight of leaves significantly differed within the varieties and Prajwal (V_1) recorded significantly maximum fresh weight of leaves (3.35 g) as compared to Bidhan Ujjwal (2.82 g). Similar trend was observed in second year of trial as well as in the pooled mean analysis.

The final observation of dry weight of leaves at 90 DAP indicated that the maximum dry weight of leaves (10.32 and 10.34 g) were observed in Prajwal and minimum dry weight of leaves (9.15 and 9.14 g) were observed in Bidhan Ujjwal during both the tested years respectively. A similar trend was found in pooled mean data. The two years data of dry weight of leaves indicated that the plants of Prajwal were found to above more dry weight of leaves than Bidhan Ujjwal and this trend was maintained up to the end of study and this might be due to the congenial environment to express the dominant genes in the genotypes and also different genetic makeup of the variety. Similarly, the dry weight of leaves is an important genotypic character in tuberose that might be primarily

governed by the genetic makeup of the genotypes. Similar results have also been reported by Singh (2004) [27], Krishan and Misra (2005) [6] in tuberose.

Influence of growth regulators

During both year as well as pooled mean data at 30 DAP, the results showed non-significant differences.

During the first year of investigation, at 60 DAP, dry weight of leaves significantly differed within the varieties and Prajwal (V_1) recorded significantly maximum fresh weight of leaves (3.35 g) as compared to Bidhan Ujjwal (2.82 g). Similar trend was observed in second year of trial as well as in the pooled mean analysis.

The treatment G_3 GA_3 150 ppm (30 and 50 DAP) recorded maximum dry weight of leaves (11.15 g). However, this treatment was found statistically similar to G_7 GA_3 150 ppm (30 and 50 DAP) + PBZ 10 ppm (70 DAP), G_5 GA_3 150 ppm (30 DAP) + PBZ 10 ppm (70 DAP) and G_1 GA_3 150 ppm (30 DAP) which showed 10.28, 10.16 and 10.02 dry weight of leaves, respectively. However, minimum dry weight of leaves (8.26 g) was observed with G_8 control (water spray). Similarly during second year of investigation at 90 DAP, maximum dry weight of leaves was recorded under the treatment G_3 GA_3 150 ppm (30 and 50 DAP) which was at par with all the treatments except G_8 control (water spray). Whereas, it was found minimum dry weight of leaves (8.26 g). These finding were corroborated with the finding of Tiwari and Singh (2002) [28], Youssef (2004) [31], Padaganur *et al.* (2005) [14] in tuberose.

Interaction effects

The treatment combinations of applications of growth regulators and variety were found to be non-significant. This may be due to the similar effect of plant growth regulator on both the varieties of tuberose.

Yield attributes

The data with respect to effect of various growth regulators and varieties treatment on yield of bulbs q ha^{-1} are presented in table (6).

Influence of Cultivars

It was observed during the first year of investigation that maximum yield of bulbs q ha^{-1} (38.77q) was recorded under Prajwal and minimum yield of bulbs q ha^{-1} (36.96 q) was observed under variety Bidhan Ujjwal. Similar trend was observed in second year of trial as well as in pooled mean result.

From the above findings, yield of bulbs q ha^{-1} was maximum in variety Prajwal during both the years of experiment as well as in pooled mean data. This might be due to the production of maximum number of florets $spike^{-1}$ and weight of bulbs $plant^{-1}$which resulted in increasing yield ha^{-1}. Also it could be stated that variation in florets yield per spike and per hectare within the varieties might be due to genotypic and environmental differences. These results are in close conformity with the results of similar conformity are found with the research finding of Meenakshi and Nirajan murthy (1997) [12], Gupta *et al.* (2004) [4], Patil *et al.* (2009) [17], Ranchana *et al.* (2013) and by Krishna moorthy (2014) [7] in tuberose.

Influence of growth regulators

During first year of investigation, it is clear from the data that the maximum yield of bulbs (50.27 q ha^{-1}) was registered under G_7 GA_3 150 ppm (30 and 50 DAP) + PBZ 10 ppm (70 DAP), which was statistically similar with the treatment G_3 GA_3 150 ppm (30 and 50 DAP) which showed yield of bulb 47.39 q ha^{-1}. Minimum yield of bulbs (23.93 q ha^{-1}) was noticed under control.

Similarly during second year of investigation, maximum yield of bulbs (50.27 q ha^{-1}) was registered under the treatment G_7 GA_3 150 ppm (30 and 50 DAP) + PBZ 10 ppm (70 DAP) which was at par with G_3 GA_3 150 ppm (30 and 50 DAP) having yield of bulbs 47.39 q ha^{-1}, respectively. While, minimum yield of bulbs (23.93 q ha^{-1}) was noticed under control. Similar trend was observed in pooled mean result except treatment G_8 control (water spray) which showed significant difference from treatment G_7 GA_3 150 ppm (30 and 50 DAP) + PBZ 10 ppm (70 DAP), G_3 GA_3 150 ppm 30 and 50 DAP). In general, findings indicated that the combination of higher concentration of both GA_3 and PBZ initiated more number of spike. The GA_3 is growth promoter which increases early growth whereas, application of PBZ in mid growth stage suppress the growth resulting in more number of spike.

Maximum yield of bulb per hectare in tuberose with the application of GA_3 in early growth stage and paclobutrazol in mid growth stage might be due to increase in number of branches and leaves per plant which might have produced more number of spike $plant^{-1}$ and also increasing weight of flowers ultimately increasing the spike yield $plant^{-1}$ and $hectare^{-1}$. Similar results were also reported by Manisha *et al.* (2002) [11], Sarkar *et al.* (2009) [24], Bhosale *et al.* (2014) [2], Nishith *et al.* (2015) in tuberose.

Interaction effects

The interaction effect due to growth regulators and varieties treatments were found to be non-significant. This may be due to the similar effect of plant growth regulator on both the varieties of tuberose.

Table 1: Effect of plant growth regulators on Plant height (cm) of tuberose (*Polianthes tuberosa* L.) in during the year 2017-18 and 2018 -19.

Treatments	Plant height (cm)								
	30 DAP			60 DAP			90 DAP		
Varieties (V)	2017-18	2018-19	Pooled mean	2017-18	2018-19	Pooled mean	2017-18	2018-19	Pooled mean
Prajwal - V_1	41.10	41.23	41.17	50.65	51.20	50.93	84.09	83.93	84.01
Bidhan Ujjwal - V_2	39.51	38.86	39.19	43.84	43.70	43.77	61.31	60.90	61.11
Sem±	1.18	0.85	1.02	0.55	0.51	0.53	1.01	0.97	0.99
CD (0.05)	NS	NS	NS	1.58	1.46	1.52	2.29	2.79	2.86
PGRs (G)									
G_1 - GA_3 150 ppm (30 DAP)	40.20	40.50	40.35	50.85	50.83	50.83	75.93	76.16	76.05
G_2 - GA_3 150 ppm (50 DAP)	39.97	40.44	40.20	45.18	45.06	45.12	68.95	69.13	69.04
G_3 - GA_3 150 ppm (30 and 50 DAP)	41.59	40.80	41.19	53.25	53.24	53.24	81.33	81.56	81.45

G_4 - PBZ 10 ppm (70 DAP)	39.77	37.60	38.68	42.80	42.35	42.35	66.81	65.06	65.93
G_5 - GA_3 150 ppm (30 DAP) + PBZ 10 ppm (70 DAP)	42.73	42.17	42.45	50.61	51.07	50.84	76.99	76.57	76.78
G_6 - GA_3 150 ppm (50 DAP) + PBZ 10 ppm (70 DAP)	39.87	38.50	39.18	45.30	45.86	45.58	69.20	69.24	69.22
G_7 - GA_3 150 ppm (30 and 50 DAP) + PBZ 10 ppm (70 DAP)	40.17	42.35	41.26	52.31	52.84	51.58	77.94	78.22	78.08
G_8 - Control (water spray)	38.14	38.04	38.09	40.67	41.34	41.00	64.47	6537	63.98
Sem±	2.36	1.70	2.03	1.10	1.43	1.05	2.02	1.94	1.98
CD (0.05)	NS	NS	NS	3.17	2.92	3.04	5.84	5.59	5.72

Table 1.1: Interaction of G X V (Treatment combination) on plant height (cm) of tuberose (*Polianthes tuberosa* L.) in during the year 2017-18 and 2018 -19.

Interaction G x V (treatment combinations)	Plant height cm								
	30 DAP			60 DAP			90 DAP		
	2018-19	2019-20	Pooled mean	2018-19	2019-20	Pooled mean	2018-19	2019-20	Pooled mean
G_1 V_1	45.60	44.47	45.03	55.12	54.94	55.03	83.69	84.30	84.00
G_1 V_2	34.80	36.53	35.67	46.58	46.72	46.65	68.17	68.02	68.10
G_2 V_1	39.14	39.47	39.30	47.81	48.56	48.19	80.72	80.69	80.71
G_2 V_2	40.80	41.40	41.10	42.55	41.55	42.05	57.18	57.58	57.38
G_3 V_1	45.37	44.54	44.95	59.20	59.23	59.21	97.67	97.59	97.63
G_3 V_2	37.80	37.07	37.43	47.31	47.24	47.28	64.99	65.53	65.26
G_4 V_1	40.20	38.80	39.50	42.49	42.20	42.34	76.71	76.60	76.66
G_4 V_2	39.34	36.40	37.87	37.12	36.50	36.81	56.90	53.52	55.21
G_5 V_1	41.13	43.13	42.13	54.14	54.97	54.55	86.44	85.25	85.85
G_5 V_2	44.33	41.20	42.77	47.07	47.18	47.13	67.55	67.89	67.72
G_6 V_1	40.14	38.13	39.14	47.46	47.91	47.69	79.17	78.88	79.02
G_6 V_2	39.60	38.87	39.23	43.14	43.81	43.48	59.23	59.60	59.42
G_7 V_1	41.80	42.93	42.37	55.21	57.57	56.39	91.63	91.52	91.58
G_7 V_2	38.53	41.77	40.15	49.42	48.11	48.76	64.24	64.92	64.58
G_8 V_1	35.40	38.40	36.90	43.79	44.21	44.00	76.70	76.61	76.66
G_8 V_2	40.87	37.67	39.27	37.55	38.46	38.01	52.24	50.14	51.19
Sem±	3.34	2.40	2.58	1.43	1.01	1.21	2.86	2.74	2.27
CD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 2: Effect of plant growth regulators on length of leaf (cm) of tuberose (*Polianthes tuberosa* L.) in during the year 2017-18 and 2018 -19.

Treatments	Length of leaf (cm)								
	30 DAP			60 DAP			90 DAP		
Varieties (V)	2017-18	2018-19	Pooled mean	2017-18	2018-19	Pooled mean	2017-18	2018-19	Pooled mean
Prajwal -V_1	15.14	17.14	16.14	35.46	36.46	35.96	41.51	38.57	40.04
Bidhan Ujjwal -V_2	19.22	19.27	19.25	32.35	32.92	32.63	36.25	35.63	35.98
Sem±	1.06	0.68	0.87	0.55	0.53	0.54	0.62	1.15	0.88
CD (0.05)	3.07	1.98	2.52	1.60	1.52	1.56	1.79	3.31	2.55
PGRs (G)									
G_1 - GA_3 150 ppm (30 DAP)	14.25	17.40	15.82	34.03	34.30	34.16	41.23	35.56	38.56
G_2 - GA_3 150 ppm (50 DAP)	16.14	19.07	17.61	33.64	33.16	33.40	36.35	34.61	35.48
G_3 - GA_3 150 ppm (30 and 50 DAP)	17.19	17.95	17.57	36.48	37.58	37.03	44.54	41.82	43.18
G_4 - PBZ 10 ppm (70 DAP)	16.50	17.47	16.99	32.48	33.68	33.08	35.89	33.98	34.94
G_5 - GA_3 150 ppm (30 DAP) + PBZ 10 ppm (70 DAP)	18.65	19.17	18.91	34.68	35.57	35.13	41.56	40.10	40.83
G_6 - GA_3 150 ppm (50 DAP) + PBZ 10 ppm (70 DAP)	19.00	19.27	19.13	32.69	33.11	32.90	36.91	35.75	35.83
G_7 - GA_3 150 ppm (30 and 50 DAP) + PBZ 10 ppm (70 DAP)	15.64	17.74	16.69	35.97	37.49	36.73	41.90	41.65	41.78
G_8 - Control (water spray)	20.07	17.57	18.82	31.27	32.63	31.95	34.65	34.32	34.48
Sem±	2.13	1.37	1.75	1.11	1.05	1.08	1.24	2.29	1.77
CD (0.05)	NS	NS	NS	3.20	3.04	3.12	3.57	6.63	5.10

Table 2.1: Interaction of G X V (Treatment combination) on length of leaf (cm) of tuberose (*Polianthes tuberosa* L.) in during the year 2017-18 and 2018 -19.

Interaction G x V (treatment combinations)	Length of leaf cm								
	30 DAP			60 DAP			90 DAP		
	2018-19	2019-20	Pooled mean	2018-19	2019-20	Pooled mean	2018-19	2019-20	Pooled mean
G_1 V_1	13.40	15.13	14.27	33.85	35.18	34.52	46.41	36.73	41.57
G_1 V_2	15.09	19.67	17.38	34.21	33.41	33.81	36.05	34.39	35.22
G_2 V_1	20.80	24.54	22.67	36.01	34.05	35.03	38.87	35.42	37.15
G_2 V_2	24.15	18.94	21.54	31.26	32.26	31.76	33.82	33.80	33.81
G_3 V_1	14.57	15.47	15.02	36.77	36.83	36.80	45.19	42.73	43.96
G_3 V_2	19.82	20.44	20.13	36.19	38.33	37.26	43.90	40.91	42.40

$G_4 V_1$	23.61	18.47	21.04	35.91	36.01	35.96	39.35	36.11	37.73
$G_4 V_2$	16.07	16.47	16.27	29.05	31.36	30.20	32.42	31.85	32.13
$G_5 V_1$	12.41	14.74	13.57	36.30	39.03	37.66	42.08	41.71	41.90
$G_5 V_2$	24.90	23.60	24.25	33.07	32.12	32.59	41.03	38.48	39.76
$G_6 V_1$	17.67	18.80	18.23	35.29	36.33	35.81	37.08	36.52	36.80
$G_6 V_2$	20.33	19.73	20.03	30.09	29.89	29.99	32.75	32.97	32.86
$G_7 V_1$	14.87	17.34	16.10	36.32	39.42	37.87	46.59	42.52	44.56
$G_7 V_2$	16.41	18.14	17.28	35.61	35.56	35.59	37.20	40.79	38.99
$G_8 V_1$	16.47	17.93	17.20	33.24	34.87	34.05	36.48	36.78	36.63
$G_8 V_2$	20.34	17.21	18.78	29.29	30.39	29.84	32.83	31.85	32.34
Sem±	3.01	1.94	2.22	1.57	1.49	1.15	1.75	3.25	1.04
CD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 3: Effect of plant growth regulators on number of leaves plant^{-1} of tuberose (*Polianthes tuberosa* L.) in during the year 2017-18 and 2018 -19.

Treatments	**Number of leaves plant^{-1}**								
	30 DAP			**60 DAP**			**90 DAP**		
Varieties (V)	**2017-18**	**2018-19**	**Pooled mean**	**2017-18**	**2018-19**	**Pooled mean**	**2017-18**	**2018-19**	**Pooled mean**
Prajwal -V_1	16.72	19.14	17.93	21.94	22.57	21.41	53.67	58.61	56.14
Bidhan Ujjwal -V_2	18.94	19.27	19.11	21.17	20.88	21.87	46.89	48.58	47.74
Sem±	1.13	1.01	1.07	0.21	0.54	0.37	1.29	1.23	1.26
CD (0.05)	NS	NS	NS	0.60	1.56	1.08	3.71	3.56	3.64
PGRs (G)									
G_1 - GA_3 150 ppm (30 DAP)	17.62	19.23	18.43	22.24	20.90	21.57	52.15	55.84	54.00
G_2 - GA_3 150 ppm (50 DAP)	17.90	19.07	18.49	21.06	20.56	20.81	48.93	51.01	49.97
G_3 - GA_3 150 ppm (30 and 50 DAP)	16.22	19.29	17.75	24.56	24.62	24.59	58.85	62.49	60.67
G_4 - PBZ 10 ppm (70 DAP)	16.54	17.47	17.00	19.46	20.58	20.02	43.01	49.21	46.11
G_5 - GA_3 150 ppm (30 DAP) + PBZ 10 ppm (70 DAP)	17.49	23.00	20.24	22.43	21.65	22.04	53.35	56.22	54.79
G_6 - GA_3 150 ppm (50 DAP) + PBZ 10 ppm (70 DAP)	19.67	20.27	19.97	19.39	20.80	20.10	47.88	48.79	48.33
G_7 - GA_3 150 ppm (30 and 50 DAP) + PBZ 10 ppm (70 DAP)	17.14	17.74	17.44	24.08	24.30	24.19	58.79	59.03	58.91
G_8 - Control (water spray)	20.07	17.57	18.82	19.21	20.38	19.79	39.27	46.21	42.74
S.Em±	2.26	2.03	2.14	0.41	1.08	0.75	2.57	2.47	2.52
CD (0.05)	NS	NS	NS	1.19	3.12	2.16	7.43	7.13	7.28

Table 3.1: Interaction of G X V (Treatment combination) on number of leaves plant^{-1} of tuberose (*Polianthes tuberosa* L.) in during the year 2017-18 and 2018 -19.

Interaction G x V (treatment combinations)	**Number of leaves plant^{-1}**								
	30 DAP			**60 DAP**			**90 DAP**		
	2018-19	**2019-20**	**Pooled mean**	**2018-19**	**2019-20**	**Pooled mean**	**2018-19**	**2019-20**	**Pooled mean**
$G_1 V_1$	17.07	18.80	17.94	22.57	20.58	21.58	54.51	62.70	58.60
$G_1 V_2$	18.17	19.67	18.92	21.91	21.23	21.57	49.80	48.98	49.39
$G_2 V_1$	17.80	19.20	18.50	21.26	20.25	20.75	54.51	54.09	54.30
$G_2 V_2$	18.00	18.94	18.47	20.86	20.87	20.87	43.34	47.92	45.63
$G_3 V_1$	16.23	18.14	17.19	25.24	23.24	24.24	64.31	64.79	64.55
$G_3 V_2$	16.20	20.44	18.32	23.87	26.00	24.93	53.38	60.20	56.79
$G_4 V_1$	16.94	18.47	17.71	19.33	20.25	19.79	46.40	59.00	52.70
$G_4 V_2$	16.14	16.47	16.30	19.59	20.91	20.25	39.63	39.42	39.53
$G_5 V_1$	12.41	22.40	17.41	23.66	21.28	22.47	57.88	57.40	57.64
$G_5 V_2$	22.57	23.60	23.08	21.19	22.02	21.61	48.82	55.03	51.93
$G_6 V_1$	19.00	20.80	19.90	19.91	19.96	19.94	52.81	54.91	53.86
$G_6 V_2$	20.33	19.73	20.03	18.87	21.65	20.26	42.95	42.66	42.80
$G_7 V_1$	17.87	17.34	17.60	24.65	23.28	23.97	61.57	62.75	62.16
$G_7 V_2$	16.41	18.14	17.28	23.51	25.31	24.41	56.00	55.30	55.65
$G_8 V_1$	16.47	17.93	17.20	18.90	18.22	18.56	37.36	53.25	45.31
$G_8 V_2$	23.67	17.21	20.44	19.52	22.54	21.03	41.18	39.16	40.17
Sem±	3.19	2.87	2.63	0.58	1.53	0.91	3.64	3.49	2.73
CD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 4: Effect of plant growth regulators on fresh weight of leaves (g) of tuberose (*Polianthes tuberosa* L.) in during the year 2017-18 and 2018 -19.

Treatments	**Fresh weight of leaves (g)**								
	30 DAP			**60 DAP**			**90 DAP**		
Varieties (V)	**2017-18**	**2018-19**	**Pooled mean**	**2017-18**	**2018-19**	**Pooled mean**	**2017-18**	**2018-19**	**Pooled mean**
Prajwal -V_1	4.56	4.54	4.55	10.19	10.07	10.13	21.85	22.15	22.00
Bidhan Ujjwal -V_2	4.51	4.47	4.49	7.76	7.82	7.79	19.52	20.22	19.87

Sem±	0.32	0.29	0.31	0.16	0.17	0.16	0.38	0.33	0.35
CD (0.05)	NS	NS	NS	0.45	0.48	0.47	1.10	0.94	1.02
PGRs (G)									
G_1 - GA_3 150 ppm (30 DAP)	4.39	3.67	4.03	8.78	9.12	8.95	21.27	21.50	21.38
G_2 - GA_3 150 ppm (50 DAP)	4.36	4.29	4.32	8.74	8.83	8.78	21.10	21.32	21.21
G_3 - GA_3 150 ppm (30 and 50 DAP)	6.09	5.29	5.69	10.51	9.98	10.24	23.03	23.19	23.11
G_4 - PBZ 10 ppm (70 DAP)	5.00	3.98	4.49	8.61	8.28	8.44	19.23	19.60	19.42
G_5 - GA_3 150 ppm (30 DAP) + PBZ 10 ppm (70 DAP)	4.26	5.54	4.90	8.89	9.17	9.03	21.47	21.57	21.52
G_6 - GA_3 150 ppm (50 DAP) + PBZ 10 ppm (70 DAP)	4.02	4.75	4.38	8.53	8.67	8.60	19.09	19.88	19.49
G_7 - GA_3 150 ppm (30 and 50 DAP) + PBZ 10 ppm (70 DAP)	4.58	5.41	4.99	10.19	9.74	9.97	21.85	22.99	22.42
G_8 - Control (water spray)	3.59	3.14	3.36	7.56	7.78	7.67	18.41	19.46	18.94
S.Em±	0.65	0.59	0.62	0.31	0.33	0.32	0.76	0.65	0.71
CD (0.05)	NS	NS	NS	0.90	0.97	0.93	2.20	1.88	2.04

Table 4.1: 1Interaction of G X V (Treatment combination) on fresh weight of leaves (g) of tuberose (*Polianthes tuberosa* L.) in during the year 2017-18 and 2018 -19.

Interaction G x V (treatment combinations)	**Fresh weight of leaves (g)**								
	30 DAP			**60 DAP**			**90 DAP**		
	2018-19	**2019-20**	**Pooled mean**	**2018-19**	**2019-20**	**Pooled mean**	**2018-19**	**2019-20**	**Pooled mean**
G_1 V_1	17.07	18.80	17.94	22.57	20.58	21.58	54.51	62.70	58.60
G_1 V_2	18.17	19.67	18.92	21.91	21.23	21.57	49.80	48.98	49.39
G_2 V_1	17.80	19.20	18.50	21.26	20.25	20.75	54.51	54.09	54.30
G_2 V_2	18.00	18.94	18.47	20.86	20.87	20.87	43.34	47.92	45.63
G_3 V_1	16.23	18.14	17.19	25.24	23.24	24.24	64.31	64.79	64.55
G_3 V_2	16.20	20.44	18.32	23.87	26.00	24.93	53.38	60.20	56.79
G_4 V_1	16.94	18.47	17.71	19.33	20.25	19.79	46.40	59.00	52.70
G_4 V_2	16.14	16.47	16.30	19.59	20.91	20.25	39.63	39.42	39.53
G_5 V_1	12.41	22.40	17.41	23.66	21.28	22.47	57.88	57.40	57.64
G_5 V_2	22.57	23.60	23.08	21.19	22.02	21.61	48.82	55.03	51.93
G_6 V_1	19.00	20.80	19.90	19.91	19.96	19.94	52.81	54.91	53.86
G_6 V_2	20.33	19.73	20.03	18.87	21.65	20.26	42.95	42.66	42.80
G_7 V_1	17.87	17.34	17.60	24.65	23.28	23.97	61.57	62.75	62.16
G_7 V_2	16.41	18.14	17.28	23.51	25.31	24.41	56.00	55.30	55.65
G_8 V_1	16.47	17.93	17.20	18.90	18.22	18.56	37.36	53.25	45.31
G_8 V_2	23.67	17.21	20.44	19.52	22.54	21.03	41.18	39.16	40.17
Sem±	3.19	2.87	2.63	0.58	1.53	0.91	3.64	3.49	2.73
CD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 5: Effect of plant growth regulators on dry weight of leaves (g) of tuberose (*Polianthes tuberosa* L.) in during the year 2017-18 and 2018 -19.

Treatments	**Dry weight of leaves (g)**								
	30 DAP			**60 DAP**			**90 DAP**		
Varieties (V)	2017-18	2018-19	Pooled mean	2017-18	2018-19	Pooled mean	2017-18	2018-19	Pooled mean
Prajwal -V_1	0.42	0.41	0.41	3.35	3.68	3.52	10.32	10.34	10.46
Bidhan Ujjwal -V_2	0.37	0.37	0.37	2.82	2.79	2.80	9.15	9.14	9.16
Sem±	0.01	0.01	0.01	0.11	0.10	0.10	0.19	0.21	0.20
CD (0.05)	NS	NS	NS	0.31	0.28	0.29	0.55	0.60	0.59
PGRs (G)									
G_1 - GA_3 150 ppm (30 DAP)	0.40	0.40	0.40	2.85	3.18	3.01	10.02	10.34	10.18
G_2 - GA_3 150 ppm (50 DAP)	0.37	0.36	0.36	2.76	2.94	2.85	9.83	10.06	9.94
G_3 - GA_3 150 ppm (30 and 50 DAP)	0.42	0.40	0.41	3.89	3.86	3.88	11.15	11.04	11.10
G_4 - PBZ 10 ppm (70 DAP)	0.38	0.40	0.39	2.35	2.70	2.53	8.18	9.19	8.68
G_5 - GA_3 150 ppm (30 DAP) + PBZ 10 ppm (70 DAP)	0.38	0.37	0.37	3.30	3.31	3.31	10.16	10.09	10.12
G_6 - GA_3 150 ppm (50 DAP) + PBZ 10 ppm (70 DAP)	0.43	0.41	0.42	3.11	3.26	3.19	9.99	9.68	9.84
G_7 - GA_3 150 ppm (30 and 50 DAP) + PBZ 10 ppm (70 DAP)	0.40	0.39	0.39	3.82	3.78	3.80	10.28	10.78	10.15
G_8 - Control (water spray)	0.38	0.39	0.39	2.59	2.86	2.72	8.26	7.98	8.12
Sem±	0.03	0.03	0.03	0.22	0.19	0.20	0.38	0.44	0.41
CD (0.05)	NS	NS	NS	0.62	0.55	0.59	1.11	1.26	1.18

Table 5.1: Interaction of G X V (Treatment combination) on dry weight of leaves (g) of tuberose (*Polianthes tuberosa* L.) in during the year 2017-18 and 2018 -19.

Interaction G x V (treatment combinations)	Dry weight of leaves (g)								
	30 DAP			60 DAP			90 DAP		
	2018-19	2019-20	Pooled mean	2018-19	2019-20	Pooled mean	2018-19	2019-20	Pooled mean
G_1 V_1	0.46	0.45	0.46	3.88	3.41	3.65	10.93	10.75	10.84
G_1 V_2	0.33	0.34	0.34	2.47	2.26	2.37	9.10	9.94	9.52
G_2 V_1	0.40	0.39	0.40	3.28	4.56	3.92	10.25	11.41	10.83
G_2 V_2	0.34	0.33	0.33	2.60	2.47	2.54	9.40	8.70	9.05
G_3 V_1	0.46	0.43	0.45	4.49	3.67	4.08	12.23	11.49	11.86
G_3 V_2	0.38	0.36	0.37	3.23	2.36	2.79	10.07	10.59	10.33
G_4 V_1	0.39	0.41	0.40	3.09	4.38	3.74	8.47	10.16	9.32
G_4 V_2	0.36	0.38	0.37	2.31	3.38	2.85	7.89	8.21	8.05
G_5 V_1	0.36	0.34	0.35	3.85	3.41	3.63	10.51	10.47	10.49
G_5 V_2	0.40	0.39	0.40	2.78	3.31	3.04	9.80	9.71	9.76
G_6 V_1	0.46	0.44	0.45	3.50	2.38	2.94	10.93	11.37	11.15
G_6 V_2	0.40	0.39	0.40	3.03	0.00	1.52	9.05	8.00	8.53
G_7 V_1	0.39	0.39	0.39	4.29	2.96	3.62	10.74	11.22	10.98
G_7 V_2	0.40	0.39	0.39	3.27	0.00	1.63	9.82	10.26	10.04
G_8 V_1	0.40	0.40	0.40	3.09	3.56	3.32	8.48	7.89	8.19
G_8 V_2	0.37	0.39	0.38	2.63	0.00	1.32	8.03	8.06	8.05
Sem±	0.04	0.04	0.04	0.31	0.27	0.21	0.63	0.59	0.51
CD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 6: Effect of plant growth regulators and varieties on yield of bulbs q ha^{-1} of Tuberose.

Treatments	Yield of Bulbs q ha^{-1}		
Varieties (V)	**2017-18**	**2018-19**	**Pooled mean**
Prajwal -V_1	38.77	36.58	37.68
Bidhan Ujjwal -V_2	32.96	32.33	32.64
Sem±	0.59	0.73	0.66
CD (0.05)	1.71	2.12	1.92
PGRs (G)			
G_1 - GA_3 150 ppm (30 DAP)	34.97	34.34	34.65
G_2 - GA_3 150 ppm (50 DAP)	31.49	33.16	32.33
G_3 - GA_3 150 ppm (30 and 50 DAP)	47.39	46.14	46.76
G_4 - PBZ 10 ppm (70 DAP)	27.78	25.32	26.55
G_5 - GA_3 150 ppm (30 DAP) + PBZ 10 ppm (70 DAP)	43.77	37.45	40.61
G_6 - GA_3 150 ppm (50 DAP) + PBZ 10 ppm (70 DAP)	27.34	26.18	26.76
G_7 - GA_3 150 ppm (30 and 50 DAP) + PBZ 10 ppm (70 DAP)	50.27	48.93	49.60
G_8 - Control (water spray)	23.93	24.12	24.02
Sem±	1.18	1.47	1.33
CD (0.05)	3.42	4.25	3.83
Interaction G x V (Treatment combinations)			
G_1 V_1	37.44	36.20	36.82
G_1 V_2	32.49	32.47	32.48
G_2 V_1	33.46	36.54	35.00
G_2 V_2	29.52	29.78	29.65
G_3 V_1	49.75	48.19	48.97
G_3 V_2	45.03	44.09	44.56
G_4 V_1	30.07	28.11	29.09
G_4 V_2	25.50	22.52	24.01
G_5 V_1	50.42	38.53	44.48
G_5 V_2	37.12	36.36	36.74
G_6 V_1	28.77	26.02	27.40
G_6 V_2	25.90	26.34	26.12
G_7 V_1	54.12	52.76	53.44
G_7 V_2	46.41	45.10	45.76
G_8 V_1	26.16	26.27	26.22
G_8 V_2	21.69	21.96	21.83
Sem±	1.67	2.08	1.41
CD (0.05)	NS	NS	NS

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