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# Studies on the Effect of Paclobutrazol as Foliar Spray on Growth Parameters of Tuberose (*Polianthes tuberosa* L.) var. Prajwal

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**A B S T R A C T**

A field experiment was carried out in Horticulture Research Farm, Bidhan Chandra Krishi Vishwavidyalaya, Mohanpur, to study the effect of paclobutrazol as foliar spray at different dates, on growth, flowering and bulb yield of tuberose (*Polianthes tuberosa* L.) var. Prajwal. The experiment was carried out during the year 2016-2018 (March - March) to find out the suitable dose of paclobutrazol and suitable time of its spraying to get maximum flower production. The experiment was laid out in augmented factorial randomized block design with three replications. The first factor contains three different doses of Paclobutrazol application $P_1$ (100 ppm), $P_2$ (200 ppm), $P_3$ (300 ppm) as foliar spray and the second factor is with three different times of Paclobutrazol application i.e., $S_1$ (45 DAP), $S_2$ (65 DAP), $S_3$ (85 DAP). A control plot is made without any application of paclobutrazol to observe the difference in the treatment effect. The results reveal that, the plant height, number of leaves per clump, leaf area and leaf area index were found maximum in the control treatment and those parameters were found at par with $P_1$ (Paclobutrazol 100 ppm). Regarding the spraying time of the paclobutrazol plant height, number of leaves, leaf area and leaf area index was found maximum with $S_3$ (85 DAP).The number of days taken for first spike emergence was early in $P_1$ (Paclobutrazol 100 ppm) and in $S_1$ (45 DAP). Interaction effect of paclobutrazol and its spraying times was found non-significant for almost all the parameters except for plant height and leaf area.

## Introduction

Tuberose (*Polyanthes tuberosa* L.) is one of the most important tropical ornamental plants and cultivated for production of long lasting flowers spikes. Single varieties are more fragrant than double and contained 0.08 to 0.14 percent concrete which is used in highly grade perfumes. There is high demand of tuberose concrete and absolute in international market which fetches a very good price. Flowers of the single type (single row perianth) are commonly used for extraction of essential oil, loose flowers, making garland etc., while double varieties (more than two rows of perianth) are used as cut flowers, garden display and interior decoration.

In India West Bengal, Tamil Nadu, Maharashtra and Karnataka are major tuberose growing states, out of them West Bengal has maximum area and production.

Paclobutrazol the so called growth retardant is generally used widely in the orchard plants like mango which regulates its alternate bearing habit but it is used very rarely in the flower crops. Paclobutrazol indirectly helps in increasing the flower quality and yield in the flower crops by regulating the gibberellin activity (Khan and Pal, 2009). There is very mere information regarding paclobutrazol effect in the floriculture sector hence we conducted this experiment to asses effect of paclobutrazol in different spraying times.

## Materials and Methods

The experiment was carried out during the year 2016-2018, at the Horticulture Research Farm, Mondouri, at the Bidhan Chandra Krishi Vishwavidyalaya, Mohanpur. The experiment was laid out in augmented factorial randomized block design with three replications. First factor comprises of three different doses of paclobutrazol application $P_1$ (100 ppm), $P_2$ (200 ppm), $P_3$ (300 ppm) as foliar spray and the second factor is with three different times of Paclobutrazol application i.e., $S_1$ (45 DAP), $S_2$ (65 DAP), $S_3$ (85 DAP). Along with these treatments one control plot is made. During the field preparation, well rotten farm yard manure @ 1.5 kg/$m^2$ was applied as basal dose 15 days before planting and mixed properly with soil. N: P: K @ 150: 200: 200 kg/ha was applied, in which, half N, full P and K applied as basal, remaining N applied as split doses, 30 and 45 days after planting. The size of the plot was 1.5 m x 1.0 m with a spacing of 30 cm x 30 cm.

Bulbs of tuberose cv. Prajwal were provided by Horticulture Research Farm, Mandouri, Bidhan Chandra Krishi Vishwavidyalaya. 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.

In this article the data was furnished for the parameters like plant height, number of leaves per clump, number of days taken for first spike emergence, leaf area and leaf area index. Five plants were selected randomly from each plot for recording data on various quality attributes. The data on flowering were recorded during the course of investigation and subjected to statistical analysis as per Panse and Sukhatme (1967). The appropriate standard error of mean S.E. (m) and the critical difference (C.D.) were calculated at 5% level of probability.

## Results and Discussion

### Plant height

### Paclobutrazol

The data presented in Table 1 shows that the data in respect of plant height was significantly influenced by various paclobutrazol levels. Irrespective of the paclobutrazol doses the height of the plant decreases with increasing of the doses in both the years. During the year 2016-17, significantly superior plant height (55.89 cm) was recorded in $P_1$ (Paclobutrazol 100 ppm) while the minimum height (48.35 cm) was shown in $P_3$ (Paclobutrazol 300 ppm). In the ratoon crop i.e., in the year 2017-18, the same pattern of plant height had been observed. Superior plant height (58.00 cm) was recorded in $P_1$ (Paclobutrazol 100 ppm) while the minimum height (51.00 cm) was shown in $P_3$ (Paclobutrazol 300 ppm). In the pooled data, the plant height (57.89 cm) was found to be maximum in $P_1$ (Paclobutrazol 100 ppm) while the minimum plant height (54.45 cm) was observed in the $P_3$ (Paclobutrazol 300 ppm).

### Spraying time

The data shown in the Table 1 reveals that the plant height increased significantly with the delay in the spraying of paclobutrazol. In the year 2016-17, $S_3$ (Spraying 85 DAP) had given maximum height (54.00 cm) and the minimum height (49.99 cm) was observed in $S_1$ (Spraying 45 DAP).

In the year 2017-18, $S_1$ (Spraying 45 DAP) had given maximum height (55.80 cm) and the minimum height (52.60 cm) was observed in $S_2$ (Spraying 65 DAP).

The data in the Table 1 depicts that in the pooled data, the plant height (57.77 cm) was found maximum in $S_3$ (Spraying 85 DAP) and the minimum height (54.94 cm) was observed in $S_1$ (Spraying 45 DAP).

### Paclobutrazol X Spraying time

The interaction effect of paclobutrazol and spraying time was found non-significant in ratoon crop and significant in main crop and pooled data. However, combining the data of both the years shown that the maximum plant height (60.86 cm) was observed in the control treatment, it was at par with $P_1S_3$ (58.70 cm), while the minimum plant height (48.91 cm) was found in $P_3$ $S_1$ (300 ppm PBZ and 45 DAP).

The decrease in the height and number of leaves may be because of due to anti-auxin activity, disturbed carbohydrate metabolism and inhibition of cell division and elongation of apical meristem might contribute to growth reduction in plants treated with paclobutrazol.

The early application of paclobutrazol has shortened the plants effectively. These results are in conformity with Padaganur *et al.,* (2005) in Tuberose and Nishith *et al.,* (2015) in Gaillardia.

### Number of leaves per clump

The data in respect of number of leaves per clump as influenced by paclobutrazol and spraying time were presented in Table 1.

### Paclobutrazol

There is a significant decrease in the number of leaves per clump in both the years when treated with different doses of paclobutrazol. In the main crop during the year 2016-17, the maximum number of leaves (45.71) was observed in $P_1$ (100 ppm Paclobutrazol) while the minimum number of leaves per clump (41.45) was shown in $P_2$ (200 ppm Paclobutrazol).

In the ratoon crop i.e., in the year 2017-18, the number of leaves per clump decreased with the increase in the doses of paclobutrazol. The maximum number of leaves (58.75) was observed in $P_1$ (100 ppm Paclobutrazol) while the minimum number of leaves per clump (55.86) was shown in $P_3$ (300 ppm Paclobutrazol)

Regarding the pooled data the number of leaves per clump (52.23) was found to be maximum in $P_1$ (100 ppm Paclobutrazol) while the minimum number of leaves per clump was shown in $P_2$ (200 ppm Paclobutrazol) (49.55).

### Spraying time

The data shown in the Table 1 reveals that the number of leaves per clump increased significantly with the delay in the spraying of paclobutrazol.

In the year 2016-17, $S_3$ (Spraying 85 DAP) had given maximum number of leaves per clump (44.60) and the minimum number of leaves per clump (42.61) was observed in $S_1$ (Spraying 45 DAP). In the year 2017-18, $S_3$

(Spraying 85 DAP) had given maximum number of leaves per clump (58.89) and the minimum number of leaves per clump (55.83) was observed in $S_1$ (Spraying 45 DAP).

The data in the Table 1 depicts that in the pooled data, the number of leaves per clump (51.75) was found maximum in $S_3$ (Spraying 85 DAP) and the minimum number of leaves per clump (49.22) was observed in $S_1$ (Spraying 45 DAP).

**Paclobutrazol X Spraying time**

The interaction effect of different levels of paclobutrazol and zinc was found significant in the main crop but it was non-significant in the ratoon crop and pooled data.

The pooled data in Table 1 shows that the maximum number of leaves per clump (55.86) was shown in the control treatment, while the minimum number of leaves per clump (47.86) was observed in $P_3$ $S_1$ (300 ppm PBZ and Spraying 45 DAP).

**Days to 1st spike emergence after planting**

The data for this number of days to taken for first spike emergence after planting was taken only once for the main crop in the year 2016-17.

**Paclobutrazol**

The data presented in Table 1 reveal that the effect of paclobutrazol on days to first spike emergence was statistically significant. It is evident from the data during the year 2016-17, the earliest first spike emergence (191.00 days) was recorded with $P_1$ (Paclobutrazol 100 ppm) followed by $P_2$ (202.78 days).

The delayed first spike emergence (206.67 days) was recorded with $P_3$ (Paclobutrazol 300 ppm).

**Spraying time**

Different spraying times significantly influenced the number of days taken for first spike emergence after planting of the bulbs. The spraying time $S_1$ (Spraying 45 DAP) had given the earliest first spike emergence (195.66 days) while spraying time $S_3$ (Spraying 85 DAP) had taken the maximum number of days to first spike emergence after planting (203.55 days).

**Paclobutrazol X Spraying time**

The interaction effect due to various levels of paclobutrazol and spraying times on the days to first spike emergence was found non-significant.

Number of days taken for spike emergence after planting and number of days taken for first floret opening was minimum in the plants treated with lower dose of paclobutrazol $P_1$ (Paclobutrazol 100 ppm) this might be due to the fact that the reserve food material can be utilized for reproductive purpose with restriction on vegetative growth due to gibberellins action of cycocel which a growth retardant is (Joshi and Reddy, 2006 in China aster).

Similar results were found by Dani *et al.*, (2010) in marigold.

**Leaf area ($cm^2$)**

**Paclobutrazol**

Leaf area was significantly influenced by the effect of paclobutrazol levels. In the main crop, the maximum leaf area (49.89$cm^2$) was observed in $P_1$ (Paclobutrazol 100 ppm) while the minimum leaf area (46.17$cm^2$) was shown in $P_3$ (Paclobutrazol 300 ppm). In the ratoon crop, the leaf area decreased with the increase in the doses of paclobutrazol.

**Table.1 Effect of paclobutrazol and spraying time on growth parameters of tuberose cv. Prajwal**

| Treatments | Plant height (cm) | | | Number of leaves per clump | | | Number of Days taken for spike emergence (days) | Leaf Area ($cm^2$) | | | Leaf area index | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Main crop 2016-17 | Ratoon Crop 2017-18 | Pooled | Main crop 2016-17 | Ratoon Crop 2017-18 | Pooled | Main crop 2016-17 | Main crop 2016-17 | Ratoon Crop 2017-18 | Pooled | Main crop 2016-17 | Ratoon Crop 2017-18 | Pooled |
| **Paclobutrazol (P)** | | | | | | | | | | | | | |
| **$P_1$ (100 ppm)** | 55.89 | 58.00 | 57.89 | 45.71 | 58.75 | 52.23 | 191.00 | 49.89 | 53.08 | 51.49 | 2.53 | 3.47 | 3.00 |
| **$P_2$ (200 ppm)** | 51.05 | 54.47 | 56.36 | 41.45 | 57.64 | 49.55 | 202.78 | 47.76 | 51.86 | 49.81 | 2.20 | 3.32 | 2.76 |
| **$P_3$ (300 ppm)** | 48.35 | 51.00 | 54.45 | 43.90 | 55.86 | 49.88 | 206.67 | 46.17 | 50.55 | 48.36 | 2.25 | 3.14 | 2.70 |
| **S.Em(±)** | **0.604** | **0.625** | **0.456** | **0.594** | **0.725** | **1.100** | **2.283** | **0.486** | **0.679** | **0.394** | **0.027** | **0.039** | **0.061** |
| **C.D at 5%** | **1.793** | **1.858** | **1.308** | **1.765** | **2.153** | **6.691** | **6.784** | **1.444** | **1.840** | **1.129** | **0.082** | **0.114** | **0.394** |
| | | | | | | | | | | | | | |
| **Spraying time (S)** | | | | | | | | | | | | | |
| **$S_1$ (45 DAP)** | 49.99 | 55.80 | 54.94 | 42.61 | 55.83 | 49.22 | 195.66 | 46.89 | 50.38 | 48.64 | 2.22 | 3.13 | 2.68 |
| **$S_2$ (65 DAP)** | 51.29 | 52.60 | 55.92 | 43.84 | 57.52 | 50.68 | 201.22 | 48.16 | 50.80 | 49.48 | 2.35 | 3.25 | 2.80 |
| **$S_3$ (85 DAP)** | 54.00 | 55.06 | 57.77 | 44.60 | 58.89 | 51.75 | 203.55 | 48.76 | 54.29 | 51.52 | 2.42 | 3.55 | 2.98 |
| **S.Em(±)** | **0.604** | **0.625** | **0.456** | **0.594** | **0.725** | **0.469** | **2.283** | **0.486** | **0.679** | **0.394** | **0.027** | **0.039** | **0.061** |
| **C.D at 5%** | **1.793** | **1.858** | **1.308** | **N. S** | **2.153** | **1.344** | **6.784** | **1.444** | **1.840** | **1.129** | **0.082** | **0.114** | **0.394** |
| | | | | | | | | | | | | | |
| **Control** | 61.53 | 60.20 | 60.86 | 50.21 | 61.51 | 55.86 | 213.67 | 51.73 | 55.89 | 53.80 | 2.89 | 3.82 | 3.35 |

**Table.2 Interaction effect of Paclobutrazol and Spraying time on plant height and leaf area of tuberose cv. Prajwal**

| Treatments | Plant height (cm) | | | Leaf area ($cm^2$) | | |
|---|---|---|---|---|---|---|
| | Main crop 2016-17 | Ratoon Crop 2017-18 | Pooled | Main crop 2016-17 | Ratoon Crop 2017-18 | Pooled |
| **Paclobutrazol x Spraying time** | | | | | | |
| **$P_1S_1$** | 54.42 | 60.00 | 57.21 | 49.55 | 51.65 | 50.60 |
| **$P_1S_2$** | 55.63 | 54.20 | 54.91 | 50.36 | 53.08 | 51.72 |
| **$P_1S_3$** | 57.61 | 59.80 | 58.70 | 49.77 | 54.50 | 52.13 |
| **$P_2S_1$** | 49.13 | 56.00 | 52.56 | 46.15 | 51.65 | 48.90 |
| **$P_2S_2$** | 50.14 | 53.40 | 51.77 | 47.91 | 50.13 | 49.02 |
| **$P_2S_3$** | 53.88 | 54.00 | 53.94 | 49.21 | 53.80 | 51.50 |
| **$P_3S_1$** | 46.43 | 51.40 | 48.91 | 44.98 | 47.87 | 46.42 |
| **$P_3S_2$** | 48.12 | 50.20 | 49.16 | 46.22 | 49.21 | 47.71 |
| **$P_3S_3$** | 50.51 | 51.40 | 50.95 | 47.31 | 54.59 | 50.95 |
| **S.Em(±)** | **1.045** | **1.083** | **0.790** | **0.842** | **1.072** | **0.682** |
| **C.D at 5%** | **3.116** | **N. S** | **2.401** | **N. S** | **N. S** | **2.052** |

The treatment $P_1$ (Paclobutrazol 100 ppm) had given maximum leaf area (53.08$cm^2$) while the minimum leaf area (50.55$cm^2$) was observed in the plot treated with higher dosage of $P_3$ (Paclobutrazol 300 ppm).

The pooled data pertaining to the leaf area is shown in Table 1. The table clearly shows that significantly maximum leaf area (51.49$cm^2$) was observed in $P_1$ (Paclobutrazol 100 ppm) and it was followed by $P_2$ (49.81$cm^2$), while the minimum leaf area (48.36$cm^2$) was shown in $P_3$ (Paclobutrazol 300 ppm).

## Spraying time

Regarding the spraying times to the tuberose plants, during the year 2016-17, the leaf area was found significant. The maximum leaf area (48.764 $cm^2$) was found in $S_3$ (Spraying 85 DAP) and the minimum (46.89 $cm^2$) was observed in $S_1$ (Spraying 45 DAP). While in the ratoon crop i.e., (2017-18), significantly maximum leaf area (54.29 $cm^2$) was observed in $S_3$ (Spraying 85 DAP) and the minimum leaf area (50.38 $cm^2$) was observed in $S_1$ (Spraying 45 DAP).

The effect of different spraying times on the leaf area of tuberose was found significant in the pooled data. The maximum leaf area (51.52 $cm^2$) was found in $S_3$ (Spraying 85 DAP) and the minimum leaf area (48.64 $cm^2$) was observed in $S_1$ (Spraying 45 DAP).

## Paclobutrazol X Spraying time

The data in the Table 2 reveals that the interaction effect of paclobutrazol and spraying time on leaf area was found significant in the pooled data. In the pooled data, the maximum leaf area (53.80 $cm^2$) was observed in the control treatment and the minimum leaf area (46.42 $cm^2$) was observed in the treatment combination $P_3S_1$ (300 ppm PBZ and 45 DAP).

Gibberellin activities, stimulating meristematic cell division and growth, were prevented by paclobutrazol that the soil had absorbed. This caused reducing speed of cell

division and extension so that the growth of plant height was retarded (Nasrullah *et al.,* 2012). These results are in conformity with Padaganur *et al.,* (2005) in Tuberose and Nishith *et al.,* (2015) in Gaillardia.

## Leaf area Index

### Paclobutrazol

From the Table 1 it is apparent that different paclobutrazol levels significantly influenced the leaf area index of tuberose. During the year 2016-17, the maximum leaf area index (2.53) was observed in the paclobutrazol level $P_1$ (Paclobutrazol 100 ppm) whereas $P_2$ (Paclobutrazol 200 ppm) had given minimum leaf area index (2.20). In the year 2017-18, the maximum leaf area index (3.47) was observed in the paclobutrazol level $P_1$ (Paclobutrazol 100 ppm) whereas $P_3$ (Paclobutrazol 300 ppm) had given minimum leaf area index (3.14).

In the pooled data the maximum leaf area index (3.00) was observed in the paclobutrazol level $P_1$ (Paclobutrazol 100 ppm), whereas $P_3$ (Paclobutrazol 300 ppm) had given minimum leaf area index (2.70).

### Spraying time

The spraying times of paclobutrazol had shown significant effect on leaf area index of tuberose plants. In the main crop the maximum leaf area index (2.42) was observed in $S_3$ (Spraying 85 DAP) and it was minimum (2.22) in the $S_1$ (Spraying 45 DAP). While in the ratoon crop i.e., (2017-18), the maximum leaf area index (3.55) was observed in $S_3$ (Spraying 85 DAP) and the minimum leaf area index (3.13) was observed in $S_1$ (Spraying 45 DAP).

The effect of different spraying times on the leaf area index of tuberose were found significant in the pooled data. The maximum leaf area index (2.98) was found in $S_3$ (Spraying 85 DAP) and the minimum leaf area index (2.68) was observed in $S_1$ (Spraying 45 DAP).

### Paclobutrazol X Spraying time

The interaction effect of paclobutrazol and spraying time on leaf area index was found non-significant.

Paclobutrazol reduced the leaf area of tuberose plants because of the reason that gibberellin activities, stimulating meristematic cell division and growth, were prevented by paclobutrazol that the soil had absorbed. This caused reducing speed of cell division and extension so that the leaf area was retarded (Nasrullah *et al.,* 2012). These findings are in conformity with Dani *et al.,* (2010) in marigold and Saiyad *et al.,* (2010) in Gaillardia.

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