CHAPTER – V
DISCUSSION

While presenting the results of the present investigation entitled “Effect of physical treatments and pre-soaking of corms with benzyl adenine on growth, flowering and corms production on gladiolus cv. “Psittacinus” in the chapter of experimental results, both significant and non-significant variation where noted in growth, flowering and corm parameters due to the effect of different treatment.

In this chapter, an attempt has been made to critically assess the effect of different treatments on all such parameters and present a conceptual frame work for better understanding of the treatment effects. The findings of the present experiment have also for support of the results reported by other available reviewing, wherever, found necessary. The results of the investigation have been highlighted on the following aspects.

5.1 Effect of physical treatments
5.2 Effect of benzyl adenine
5.3 Interaction effects of physical treatments and benzyl adenine
5.4 Economics

5.1 EFFECT OF PHYSICAL TREATMENTS

5.1.1 Vegetative growth parameters

The different physical treatments that were performed on corms significantly influenced the vegetative growth of gladiolus. Treatments showed considerable increase in plant biometric characters. The treatment P2 (Removal of terminal sprout) exhibited highest average of vegetative characters. Essentially percentage of sprouting (72.86 %) at 10 DAP; plant height (46.14 cm and 59.97 cm) and number of leaves (3.92, 5.89) at 45 and 60 DAP respectively. The treatment P2 also showed maximum number of tillers per plant (4.35). However, in case of percentage of sprouting at 5 DAP and plant height at 30 DAP exhibited highest results
in treatment P₁ (control). Whereas, the result was found non significant in case of percentage of sprouting at 15 DAP and number of leaves at 30 DAP. Removal of terminal sprouts resulted in the rapid growth of lateral sprouts. The hormonal status changes significantly. ABA concentration decreases and IAA and cytokinin activity increases which might be leaded to the shoot development and as a result the plant height increases. At the end of the dormant period, buds begin to grow and form sprouts. Generally, the apical bud begins to sprout first marking the beginning of apical dominance stage. Planting corms with apical dominance often results in plants with single stems and hence, reduced yields. Removal of the apical bud leads to the formation of lateral buds which in turn increase the sprouting in the corm. The initial delay in the percentage of sprouting and plant height may be as a result of terminal bud removal that causes the disturbance in the normal growth of the corms. The results are in accordance with the findings of Aksenova et al. (2013) who reported that apical dominance is highly affected by the de sprouting treatment.

5.1.2 Flowering and yield parameters

The data revealed that among the different flowering parameters like days to emergence of first spike and days was significantly affected by different physical treatments. Whereas, the days required for opening of first floret in the spike, flowering span (days) and fresh weight of whole spike (g) showed non-significant result. Minimum days required for emergence of first spike (78.41 days) was in treatment P₁ (control). The analysis of variance presented that the treatment P₂ (Removal of terminal sprout) exhibited favourable influence on yield parameters, the maximum number of spikes per plant (3.26), number of spikes per plot (109.25) and yield of spikes per hectare (4.88 lakh).

The precise cause of flowering delayed may be attributed to the axillary shoots being in a less advanced physiological phase than the apical shoot, as they begin to develop only after sprout removal. The delay in flowering as may be as a result of removal of apical dominance. The result is in agreement with the results obtained by Starman and Faust (1999) in chrysanthemum.

The increase in yield parameters could be a result of more even distribution of assimilates between several growing points rather than just the apical
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one. Similar findings were obtained by Wainwright and Irwin (1987) in Antirrhinum and by Starman and Faust (1999) in chrysanthemum.

5.1.3 Quality parameters

The data revealed that among the different quality parameters the length of rachis (cm) was significantly affected by different physical treatments. Whereas, the length of spike (cm), number of florets per spike, floret diameter (cm), *insitu* longevity of spike (days) and vase life of spike (days) showed non-significant result. Maximum increase in rachis length (35.17 cm) was found in P1 (control). Removal of terminal bud accumulates more photosynthates which are utilized for the production of more spikes. Terminal bud removal also checked apical dominance and diverted extra energy in to the production of more number of lateral shoots and flowers which reduced the quality of flowers. As the number of spikes per plant increase the quality of the spikes reduces. Similar results were obtained by Mahasena *et al.* (2015) in gladiolus.

5.1.4 Corm and cormels production

The different physical treatments that are performed on corms significantly influenced the corm and cormel production of gladiolus. The treatment P2 (Removal of terminal sprout) exhibited highest average of corm and cormel parameters. Essentially highest number of corms per plant (3.49), cormels per plant (7.57), yield of corms per hectare (5.95 lakh), yield of cormels per hectare (11.35 lakh), weight of corms (24.97g), weight of cormels (4.20 g) and average diameter of corms (3.43 cm) noted. This may be due to the reason that the removal of terminal bud leads to the increase in number of tillers per plant which leads to the increase in corm and cormels production.

Singh and Dohare (1994) reported that when apical buds were manually removed from gladiolus, maximum number and weight of corms and cormels per plant were obtained in response. This was reported in three cultivars of gladiolus, namely Pusa Suhagin, Mayur and Melody.
5.2 EFFECT OF BENZYL ADENINE

5.2.1 Vegetative growth parameters

The treatments with different concentrations of benzyl adenine that were performed on corms were significantly influenced the vegetative growth of gladiolus. Treatments showed considerable increase in plant biometric characters. The treatment C₂ (BA @ 100 ppm) exhibited highest average of vegetative characters. Essentially the highest percentage of sprouting (32%) at 5 DAP; plant height (48.29 cm and 63.00 cm) and number of leaves (4.16 and 6.55) at 45 and 60 DAP, respectively were observed. While the treatment C₄ (BA @ 300 ppm) showed maximum number of tillers per plant (5.89). However, in case of percentage of sprouting at 10 DAP (100%), plant height at 30 DAP (35.85 cm) and number of leaves at 30 DAP (2.70) as the highest results were observed in treatment C₁ (control). Whereas, the result was found non significant in case of percentage of sprouting at 15 DAP and number of leaves at 30 DAP.

The results may be attributed to the Benzyl adenine is an important cytokinin and has the capability of multiple shoot induction in several plants and also known as branching agent. The results also confirmed the findings of Carey (2008) that exogenous application of benzyl adenine promotes multiple shoots in several ornamental plants, including Petunia, Sempervivum and salvia. Furthermore, Wróblewska and Dębicz (2013) reported the increase in the number of lateral buds through the application of benzyl adenine in Portulaca umbraticola plants. Sajjad et al. (2015) also reported that application of benzyl adenine lead to sprouting of multiple sprouts from a single corm.

Initial decrease in plant height as compared to control with application of BA might be due to reducing apical dominance. Similar results have been reported by Sindhu and Verma (1998) and Maurya and Nagda (2002) in gladiolus. The further increase in plant height might be because of the simulative effect of cytokinins. Benzyl adenine is also a cytokinin and its application can cause increase in plant height. Similar results were found by Neetu et al. (2016). The increased production of leaves with the application of benzyl adenine may be due to an enhanced induction of leaf initial break i.e., differentiation of leaf primordial in the apical growing region leading to an increased production of leaves per plant. Different
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cultivars might have shown such results because of the source and sink hypothesis of cytokinins in diverting nutrients. Kashyap and Sharma (2006) reported that more number of leaves and side shoots were observed in BA treated plants of gloxinia and were maximum with the treatment of BA at 150 ppm. Neetu et al. (2016) in gladiolus cv. ‘Archana’ reported that more number of leaves was observed in plants treated with BA at 100 ppm.

5.2.2 Flowering and yield parameters

The data revealed that all the flowering parameters were significantly affected by treatments with different concentrations of benzyl adenine. Minimum days required for emergence of first spike (74.15 days), opening of first floret in the spike (87.25 days) and higher fresh weight of whole spike (87.28 g) was noted in treatment C1 (control). While in case of flowering span the maximum days was recorded in treatment C3 (BA @ 200 ppm). Among the yield parameters the analysis of variance presented that the treatment C4 (BA @ 300 ppm) exhibited favorable influence on yield parameters, the maximum number of spikes per plant (3.12), number of spikes per plot (117.78) and yield of spikes per hectare (4.70 lakh).

Padmalatha et al. (2013) reported that the delay in the emergence of spike and floret in BA treatments may be due to the role of BA in cell division which leads to splitting and formation of two competitive sinks, inflorescence and corm production ultimately delaying the emergence of shoot. Furthermore, Sajjad et al. (2015) also reported that Benzyl adenine caused the significant delay in flowering and its 150 ppm application increased days to opening of 1st floret at 107.50 days compared to 77.05 days in control plants.

The increase in flowering span of gladiolus may be due to the effect of kinetin for reducing the senescence. This occurs due to minimizing the loss of Chlorophylls, proteins, and nucleic acids as well as reducing the protease activity during maturity and senescence. The results are in agreements with the findings of Singh (1999) who noticed that application of kinetin at different concentration prolonged duration of flowering in tuberose. The findings of Neetu et al. (2016) revealed that spraying at kinetin 150 ppm improved duration of flowering in cultivar Sabnam. Marousky (1974) reported that increase in fresh weight of the spike is because BA can increase hexos sugar (sucrose and fructose) availability in the cell by
increasing in α-amylase and invertase enzyme activity and at last increase the fresh weight of spike

Murti and Upreti (1995) reported that increase in the yield of the spikes might be due to the reason that cytokinins stimulate cell division and lateral bud development which led to multiple shooting. This report is in conformity with Baskaran and Misra (2007), they found that BA at 100 ppm as corm dip treatment gave the maximum number of shoots per corm. The results are closely related with the findings of Aier et al. (2015).

5.2.3 Quality parameters

The different concentrations of benzyl adenine significantly influenced the quality parameters such as length of spike, length of rachis, number of florets per spike and floret diameter. Whereas, in case of the parameters such as *in situ* longevity (days) and vase life of spike (days), the effect of corm treatment with benzyl adenine was non-significant.

The data revealed that length of spike, length of rachis, number of florets per spike and floret diameter was significantly influenced by benzyl adenine. Highest spike length (77.06 cm), rachis length (39.20 cm) and floret diameter (6.15 cm) was found in C2 (BA @ 100 ppm). However, number of florets per spike (11.37) was noticed in C1 (Control).

This may be because of BA at higher concentration promoted the sink activity of developing corm and cormels at the expense of flower spike, this might be the reason for increase in number of corms and cormels and poor quality flower spikes. Similar results were also observed by Tawar et al (2008) in gladiolus cv. Jester. The obtained results are also in accordance with the work of many researchers (Aier et al., 2015; Sajjad et al., 2015; Neetu et al., 2016 and Baskaran et al., 2009).

5.2.4 Corm and cormels production

The data revealed that all the corm and cormel parameters were significantly influenced by the treatments with benzyl adenine. Maximum number of corms per plant (5.20), cormels per plant (8.24), yield of corms per hectare (5.70 lakh)
and yield of cormels per hectare (8.24 lakh) was noticed in treatment with BA @ 300 ppm (C4). However, average weight of corms per plant (25.98 g) average weight of cormels per plant (4.87 g) and average diameter of corms (3.39 cm) was found best in C2 (BA @ 100 ppm).

Baskaran et al. (2009) reported that the application of benzyl adenine induced the multiple shoots and also increased the yield of corms, which actually enhanced the multiplication rate of corms more than twice, compared to non treated corms. BA, like other cytokinins characteristically causes more splitting and cell division resulting in increased size of corms in gladiolus. Pal and Chowdhary (1998) reported that soaking of corms for 24 hours before planting was found to produce the highest number of corms and cormels per plant over 12 hour soaking in gladiolus. Whereas, Khan et al. (2012) found that higher concentration of BA enhanced multiple shooting and accelerated corm production in gladiolus. The result is in conformity with the work of Raju (2000) in lilies and Rajaram et al. (2002) in gladiolus.

The application of benzyl adenine increased the number of corms, which resulted to raise the corm production twice than the untreated plants. The positive effect of cytokinins to increase the yield of underground structures has been reported on Allium (Pogroszewska et al., 2007 and Puchalski et al., 1979). The findings are also in agreement with the work of Aier et al. (2015) in Red Candyman, a cultivar of gladiolus.

5.3 INTERACTION EFFECTS OF PHYSICAL TREATMENTS AND BENZYL ADENINE

5.3.1 Vegetative growth parameters

The data revealed that the interaction effect of physical treatments and benzyl adenine significantly influenced on percentage of sprouting (5 and 10 DAP), plant height (30, 45 and 60 DAP), number of leaves (60 DAP) and number of tillers per plant. However, the results were found non-significant in case of percentage of sprouting (15 DAP) and number of leaves (30 and 45 DAP). Maximum percentage of sprouting at 5 DAP (42.5%) and maximum plant height at 30 DAP (36.73 cm) was found in treatment P1C1 (control). Highest plant height at 45 DAP (48.85 cm) found in treatment P1C2 as well as at 60 DAP (63.48 cm) was observed in treatment P2C2.
case of percentage of sprouting at 10 DAP was the highest (100%) from treatments \( P_1C_1 \), \( P_1C_2 \) and \( P_1C_3 \). However, maximum number of tillers per plant (5.93) and maximum number of leaves per plant at 60 DAP (6.62) was observed from treatment \( P_2C_4 \).

Cline (1991) reported that the reduction in growth parameters during initial stages of growth may be because of interaction effects of physical treatments and benzyl adenine which arrested the growth of terminal bud and produced more productive tillers. The further increase in plant growth is due to the simulative effect of benzyl adenine which increased the plant height progressively. Similar findings were also observed by Neetu et al. (2016) in gladiolus. The increase in number of leaves and number of tillers per plant may be due to the multiple shoot induction that is caused as a result of multiple sprouting caused due to the terminal sprout removal and the treatment with the benzyl adenine (Carey, 2008).

### 5.2.2 Flowering and yield parameters

The data revealed that the flowering and yield parameter were significantly affected by interaction effects of physical treatments and different concentrations of benzyl adenine. Minimum days required for emergence of first spike (72.10 days) and opening of first floret in spike (86.50 days) was found in control (\( P_1C_1 \)). Whereas, the parameters such as flowering span and fresh weight of whole spike showed non-significant results. Among the yield parameters the analysis of variance presented that the treatment \( P_2C_4 \) (Removal of terminal sprout +BA @ 300 ppm) to exhibit favourable influence on yield parameters, the maximum number of spikes per plant (4.00), number of spikes per plot (121.67) and yield of spikes per hectare (6.00 lakh).

The delay in flowering may be because of the late sprouting of corms that caused the delay in converting the leaf primordial to floral primordial as a result of physical treatments and the due to the role of BA in cell division, which leads to splitting and formation of two competitive sinks, inflorescence and corm production ultimately delaying the emergence of shoot (Padmalatha et al., 2013). Increase in yield caused as a result of interaction effect may be due to the more number of productive tillers that are caused as a result of terminal sprout removal which increased cell division and lateral bud development, which led to multiple
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shooting (Murti and Upreti. 1995) caused by benzyl adenine. This report is in conformity with Baskaran and Misra (2007), they found that BA at 100 ppm as corm dip treatment gave the maximum number of shoots per corm. The results are closely related with the findings of Aier et al. (2015).

5.2.3 Quality parameters

The interaction effect of physical treatments and benzyl adenine significantly influenced the quality parameters such as length of spike, length of rachis and floret diameter. Whereas, in case of the parameters such as number of florets per spike, *insitu* longevity (days) and vase life of spike (days) the interaction effect was found non-significant. The treatment P$_1$C$_2$ (control+ BA @ 100 ppm) recorded maximum length of spike (79.61 cm), length of rachis (42.22 cm) and floret diameter (6.37 cm). This might be because the physical treatments accumulate more photosynthates which are utilized for the production of more spikes. Terminal bud removal also checks the apical dominance and diverted extra energy in to the production of more number of lateral shoots and flowers, which might have reduced the quality of flowers. Tawar et al. (2008) reported that benzyl adenine at higher concentration favours the sink activity of developing corm and cormels at the expense of flower spike, this might be the reason for increase in number of corms and cormels and poor quality flower spikes. As a result the interaction of these factors resulted in the reduction of flower quality.

5.2.4 Corm and cormels production

The data revealed that all the corm and cormel production parameters were significantly influenced by the interaction effect of physical treatments and benzyl adenine. Maximum number of corms per plant (6.00), cormels per plant (8.43), yield of corms per hectare (9.00 lakh) and yield of cormels per hectare (12.65 lakh) was noticed in interaction of removal of terminal sprout + BA @ 300 ppm (P$_2$C$_4$). However, the highest weight of corms per plant (24.94 g), weight of cormels per plant (5.69 g) and diameter of corm ( 4.03 cm) was found in P$_2$C$_2$ (Removal of terminal sprout + BA @ 100 ppm).

Due to increased number of leaves and plant height which might have led to overall improved rate of photosynthesis and nutrient and water uptake. As a
result of this, increased availability of metabolites to the developing corms and cormels led to improve the corm and cormels number in the plants. Similar results were also observed by Singh (2010) in tuberose.

The improvement in corm and cormel qualities may be due to the increase in cell elongation, cell splitting and cell division that caused as a result of interaction of benzyl adenine and physical treatments, which might have favoured the increase in average weight of corms, average weight of cormels and average diameter of corms. The results are in accordance with the findings of Singh & Dohare (1994) and Baskaran et al. (2009) in gladiolus.

5.4 ECONOMICS

The treatment T₈ (Removal of terminal sprout + BA @ 300 ppm) gave maximum net returns of Rs. 19, 08, 956 ha⁻¹ and highest benefit cost ratio (2.97). While, the minimum net returns (Rs. 3, 64, 248 ha⁻¹) and minimum benefit cost ratio (0.66) was observed in treatment T₁ (control). This may be due to the more number of productive tillers that are caused as a result of terminal sprout removal that increased cell division and lateral bud development, which led to multiple shooting (Murti and Upreti. 1995) caused by benzyl adenine, Which in turn increased the spike production and corm production that resulted in the increased net returns per hectare. This report is in conformity with Baskaran and Misra (2007), they found that BA at 100ppm as corm dip treatment gave the maximum number of shoots per corm. The results are closely related with the findings of Aier et al. (2015).