Gladiolus is a very important flower crop that is cultivated all over the world. Because of its wider adaptability to various agro climatic regions and its easy mode of propagation it can be easily cultivated in India. Its long vase life makes it a prominent flower in the export market. Even though, it is not widely cultivated by the farmers in India like other flower crops. The reasons are given below:

- Commercial propagation of the gladiolus is only by corms and the cost of the gladiolus corms is high
- From one corm we can only get one single spike
- One plant can produce only one corm

Hence, this research aspired to increase the number of spike and number of corms from a plant through different physical and chemical treatments on the corms. The research highlights of related flower crops with aspects of physical and chemical treatment have been reviewed to constitute the research and support results of this experiment. The brief reviews are presented under the following heads.

2.1 Effect of physical treatments on growth, flowering and corms production.

2.2 Effect of growth regulators treatments on growth, flowering and corms production.

2.1 EFFECT OF PHYSICAL TREATMENTS ON GROWTH, FLOWERING AND CORM PRODUCTION

2.1.1 Gladiolus

Gill et al. (1978) in their experiment observed the effect of corm size on quality of gladiolus flower. Corms of six sizes (<2, 2-10, 10-20, 20-30, 30-40 or >40 g) were used in this experiment. They observed a positive correlation between corm size and plant height, number of leaves per plant and length of flower stalk.

Bankar and Mukhopadhyay (1980) carried out an experiment to investigate effects of corm size, depth of planting and spacing on the production of flowers and corms in gladiolus. The experiment consisted of three corm sizes, viz., 1.5 - 2.5, 2.5 - 3.5
or 3.5-4.5. It was observed that large corms significantly increased the height of plant (58.61 cm) and length of spike (101.12 cm).

Bhattacharjee (1981) investigated the effects of corm size, planting depth and spacing on flowering and corm production of gladiolus cv. ‘Friendship’ at Bangalore, India. Corms of three different sizes, viz. 2.5 - 3.5, 4.0 - 5.0 or 5.5 - 6.5 cm in diameter were planted at the spacing of 15, 20 or 25 cm at the depths of 5, 7 or 9 cm. It was found that spike length, floret number, flower diameter and size and weight of corms were increased with the increase in corm size.

Mckay et al. (1981) studied the effect of corm size and division of mother corm on flowering in four cultivars of gladiolus. They used six sizes of gladiolus corm which were >50 mm, 38-50 mm, 33-38 mm, 25-33 mm, 19-25 and 13-19 mm in diameter and were planted whole or after being cut into half parts corm from whole, in which the large corms produced the highest inflorescence yield with better quality.

Mukhopadhyay and Yadav (1984) evaluated the effect of corm size and spacing on growth, flowering and corm production of gladiolus in West Bengal, India. Corms ranging in size from 3.5-5.0 cm in diameter were planted at three spacing, viz., 30 × 10, 30 × 15 and 30 × 25 cm. It was observed that large corms (4.0-5.0 cm) produced more flowers, corms and cormels compared to medium and smaller corms.

Sciortino et al. (1986) investigated the effect of size of propagating materials and planting density on the yield of corms for forced flower production in gladiolus cv. Peter Pears. They used the cormel size of 1-4 cm in diameter planted at the rate of 70-140 cormels per square meter. It was found that the best yield of corms (>14 cm in circumference) increased with increasing cormel size.

Syamal et al. (1987) studied the effect of corm size, planting distance and depth of planting on growth and flowering of gladiolus cv. Happy End in India. They found that large corms (4-5 cm in diameter) gave earlier sprouting. Increased corm size gave a significant increase in inflorescence and stem length.

Gowda (1988) studied the effect of corm size on growth and flowering of gladiolus cv. Picardy under the climatic and soil condition of Bangalore, India. The crop was planted using corms of 3.0-4.0, 4.1-4.5 and 4.5-5.0 cm in diameter. The best results in respect of growth and flowering were obtained from large corms. Medium size corm i.e. 4.1-4.5 cm diameter was suggested for the use under Bangalore condition.
Dod et al. (1989) carried out an experiment to investigate the effect of different
dates of planting and size of corms on growth and flower yield of gladiolus cv. Dibonar.
They planted the corms of 1.0-2.0, 2.1-3.0 and >3.0 cm in diameter. The best results were
obtained with the largest corms (>3.0 cm in diameter) planted on the earliest date.

Hong et al. (1989) studied the effect of leaf number left after cutting the flower,
corm lifting date and corm size on flowering and corm production in the next crop of
gladiolus cv. ‘True Love’ at Suwon, Korea. It was observed that the number of daughter
corms and flowering ability increased with increasing corm size up to 4-5 cm in diameter
and then declined.

Suh and Kwack (1990) also reported that with the use of large corms, formation
of good quality corms was promoted.

Ko et al. (1994) conducted the experiment on effect of planting time and corm
size on the duration of flower and corm production of gladiolus in Korea among the
corms of different size viz., 6-8, 8-10 or 10-12 cm were planted. It was found that earlier
planting with larger corms (10-12 cm in diameter) produced longer cut-stems and spikes
and higher cut flower weight, maximum number of florets (14.3), floret length and
diameter and higher percentage of best quality flowers.

Laskar and Jana (1994) studied the effect of planting time and size of corms on
plant growth, flowering and corm production of gladiolus in India. Gladiolus corms of
different sizes (1.5, 3.0 or 4.5 cm in diameter) were planted and it was observed that the
best flowering spikes and corms were obtained from large sized corms 1.86-1.95 corms
and 1.58-1.63 flower spikes per plant respectively.

Mohanty et al. (1994) conducted an experiment where large (2.45-2.55 cm in
diameter), medium (1.25-1.30 cm) and small (0.85-0.90 cm) corms of gladiolus cv.
‘Vinks Beauty’ were planted. They noticed that corm size had significant effects on plant
growth with plants produced form large corms being taller and thicker showing more
leaves with wider leaf blades, longest spike and rachis than those from medium or small
corms.

Mollah et al. (1995) carried out an experiment to investigate the effect of
cormel size and spacing on growth and yield of flower and corm of gladiolus at Pahartali,
Chittagong, Bangladesh. They reported that large weighed cormels (7.0 ± 0.2 g) with the
widest spacing (15 × 15 cm) produced the maximum length of spike (36.34 cm), longest
rachis (11.90 cm), maximum plant height (56.60 cm), maximum percentage of flowering
plant (54.60), heavier corms (31 g) and highest number of cormels (21.87) per plant.
Ogale *et al.* (1995) studied the role of corm size on flowering and corm yield of gladiolus at Mumbai, India. Flowering behaviour and final corm yields from corms of 6 different sizes (1-35 g) at different stages of developmental maturity were studied in cultivars Happy End and Apricot. In both the cultivars they found a direct correlation between corm size, flower production and final corm yield.

Patil *et al.* (1995) conducted the effect of different spacing and corm sizes on the flower and corm production of gladiolus in India. Gladiolus corms of three sizes (2.1-3.0, 3.1 - 4.0 or 4.1 cm) were planted at spacing of 30 × 10, 30 × 20 or 30 × 30 cm. They found that corm size and spacing had no significant effects on floret size, number of florets per spike or size of corms produced. However, number of spikes and number of corms and cormels produced per plot were significantly affected by both factors, increasing with planting density and corm size at planting. The largest corms yielded 58.68 spikes, 56.67 corms and 722.85 cormels per plot, compared with 34.13 spikes, 33.96 corms and 437.48 cormels per plot for the smallest corms.

Rabbani and Azad (1996) carried out an experiment to investigate the effect of plant spacing, viz., 20 × 10, 20 × 15, 20 × 20 cm and corm size, viz., large (30 g), medium (16.0 g) and small (6.5 g) on growth, flowering, corm and cormel production of gladiolus cv. ‘Friendship’. Plant spacing had significant effect on days to 80% spike initiation, rachis length, number of florets, days required to 80 % spike harvest and yield of spike per hectare. Corm size had significant effect on all the parameters studied. Large and medium size corms were found superior than small size corm.

Singh (1996) studied the effect of cormel sizes and levels of nitrogen on corm production of gladiolus cv. ‘Pink Friendship’ in India. The different cormel sizes were 1.30-1.90 or 1.91-2.50 cm in diameter and the rates of nitrogen were 100, 150, 200, 300 or 350 kg per hectare. It was found that large the cormels sized produced large corms with the highest number of cormels per plant.

Kalasareddi *et al.* (1998) conducted an experiment to study the effect of corm size (very small, small, medium or large) on flowering of gladiolus cv. Snow White. Corm size significantly influenced the time taken for spike, emergence, flowering, complete flowering, spike length, spike girth, number of flowers per spike and number of spikes per hectare. Large corms flowered earlier than smaller corms and produced better quality spikes. The highest yield of spikes (373.33 t/ha) was obtained from largest sized corms.
Singh (1998) carried out an experiment on gladiolus cv. ‘Sylvia’ corms of 3 sizes, viz. large (6.0 + 0.15 cm diameters), medium (4.2 + 0.15 cm) and small (3.3 + 0.15 cm), were planted in November. Percentage sprouting was higher in large corms (99.73%) compared to 81.90% and 67.60% for medium and small corms, respectively. Large corms were also superior in terms of number of shoots per corm, time to sprouting, plant height, spike length, number of spikes, number of florets per spike (15.53 vs. 12.51 and 9.52 for medium and small corms, respectively) and diameter of corm produced (5.98 cm vs. 3.98 and 3.67 cm for medium and small corms, respectively).

Singh and Singh (1998) studied the effect of corm size on flowering and corm production of gladiolus cv. ‘Sylvia’ in Himachal Pradesh, India. Corms of three different sizes, viz. large (6.0 + 0.15 cm), medium (4.2 + 0.15 cm) and small (3.3 + 0.15 cm) were planted in November. They found that the percentage of sprouting was higher in large corms (99.73%) compared to 81.90% and 67.60% in medium and small corms, respectively. Large corms were also superior in terms of number of spikes, number of shoots per corm, time to harvest, plant height, spike length, number of flowers per spike (15.33, 15.51 and 9.52 for large, medium and small, respectively) and diameter of corm produced (5.98, 3.98 and 3.67 cm) for large, medium and small corms respectively.

Sharma and Gupta (2003) studied the effects of corm size (3.1-3.5, 3.6-4.0, 4.1-4.5 and 4.6-5.0 cm) and spacing (10 × 40, 20 × 40, 30 × 40 and 40 × 40 cm) on the growth and flowering of gladiolus. Plant height, number of leaves per plant, spike length, number of florets per spike and number of spike per plant increased, whereas the number of days to spike emergence and blooming decreased with increasing corm size. The number of corms per plant, corm weight and diameter, number of cormels per plant and cormel weight per plant increased with increasing corm size and plant spacing.

Memon et al. (2009) in Pakistan concluded that among the corms of different sizes those were used in the experiment the large sized corms (3.2-3.5 cm) significantly increased the leaf breadth, length of flowering spike, and number of florets per spike over those produced from small and medium ones (2.7-3.0 cm), whereas plant height was greatly decreased in response to large sized corms. Regarding corm production, large sized corms produced significantly higher weight of corms per plant, cormels per plant and combined total weight of corms and cormels per plant in gladiolus.

Sudhakar and Kumar (2012) studied the effect of corm size and spacing on growth and flowering in gladiolus sp cv. ‘White friendship’ in Tamil nadu condition.
Corms of different sizes, viz. 3.5–4.5 cm, 4.6-5.5 dia. cm and above 5.5 cm were planted at the spacing, viz. 30 × 20 cm, 30 × 25 cm and 30 × 30 cm were planted and found that corm size of large 5.5 cm and spacing of 30 × 30 cm were found excellent in respect of vegetative, floral and corm yield compared to others.

Nomita and Preethi (2013) concluded that among the different split treatments that is performed on corms revealed that large corms when split into 2 pieces and planted produced significantly greater plant height(117.74 cm), number of leaves per plant (9.33) and leaf length (69.46 cm). Maximum number of florets per spike (14.72), spike length (105.79 cm) and rachis length (75.52 cm) were also recorded.

2.1.2 Tuberose

Sadhu and Das (1978) concluded that the size of bulb plays an important role on growth and flowering of tuberose. It influences the sprouting of bulbs and time required is inversely proportional to size of the bulb.

Pathak et al. (1980) noted that bulb size also influences flowering. Larger bulbs cause early flowering and gives higher yield of spikes and flowers.

Yadav et al. (1984) studied the effect of four bulb sizes 1.5-2, 2.1-2.5, 2.6-3 and 3.1-3.5 cm in diameter on growth and flower production in Tuberose cv. Single for a period of three years and recorded that plant crop with large sized bulbs (3.1-3.5 cm) significantly improved the spikes. Considering the total production of three years planting of bulbs having 2.6-3.0 cm recorded the highest yield of spikes (15.1 lakhs/ha) and flowers (30.1 tons/ha). In general, bulb having diameters between 2 and 3 cm are suitable for planting.

Misra et al. (2000) conducted the experiment to determine the effect of bulb size and spacing on growth and flowering of two tuberose (P. tuberosa) cultivars (single and double) and he concluded that bulb size significantly influenced the initiation of spikes in both cultivars. The maximum days for spike initiation by smaller bulb size was 170.8 and 222.7 days for single and double cultivars, respectively. The larger bulb size produced the highest number of spikes per plant in both the cultivars.

Raja and Palanisamy (2000) concluded that from the mother bulbs and fingers of tuberose (Polianthes tuberosa) of varying sizes (extra large, large, medium
and small) were planted. Mother bulb more than 2.5 cm in diameter performed better than the fingers. The small bulb in the fingers took fewer days to emergence than larger bulbs. Plant height and number of plantlets per plant and number of leaves per plant increased with increasing size of planting materials. Mother bulbs 2.5-3.0 cm took 97 days to initiate flower stalk emergence, the medium and small bulbs did not produce flowers. The number of flower stalk, flower weight per stalk, length of flower stalks and flower yield per clump were higher for large mother bulbs as compared to large finger.

Kumar et al. (2003) studied the effect of bulb size (<1.5, 1.5-2.5 or 2.5-3.5 cm in diameter), spacing (20x20, 25x25, 30x30 cm) and planting depth (3, 6 or 9 cm) on the growth and development of tuberose (Polianthes tuberose) cv. Single. Sprouting was delayed with the increase in bulb size and planting depth, and reduction in spacing. Large bulb resulted in the earliest spike emergence (93.89 days). Spike emergence was delayed with the increase of the planting depth. Spike lengths 88.78 and 89.37 cm and rachis lengths 19.76 and 20.06 cm were greatest with medium and large bulbs. Increasing bulb size 2.5 cm and planting depth up to 9 cm increased bulb production. Small bulb in combination with the widest spacing resulted in the earliest bulb sprouting (8.28 days), medium bulbs with moderate planting depth 6 cm and spacing 25x25 cm gave highest yield of flower and bulb.

Behere (2007) studied the effect of bulb size and growth regulators on sprouting, flowering and flower yield of tuberose cv. Double. Tuberose bulbs of four different sizes $S_1 (>3.5)$, $S_2 (2.5-3.5cm)$, $S_3 (1.5-2.5cm)$ and $S_4 (1-1.5cm)$ were planted. The results revealed that maximum plant height (46.78 cm), sprouting percentage (87.85 %), earliest spike emergence (111.7 days), maximum number of spikes per plant (2.5), per net plot (87.5), per hectare (276666), highest number of florets per spike (30.52), maximum floret diameter (31.7mm) and highest vase life(10.63 days) was recorded in larger daughter bulbs $S_2 (2.5-3.5cm)$. Whereas, in case minimum days to sprout emergence (8.89 days) was treatment of small daughter bulbs $S_4 (1-1.5cm)$ was found better.

Mane et al. (2007) concluded that among the bulbs of different sizes the large bulb size (3cm) recorded significant increase in number of spikes per plant, the length and girth of spike and keeping quality of the spike at room temperature.
Ahmad et al. (2009) observed the effect of different bulb size on growth, flowering and bulblet production of tuberose (Polianthes tuberosa L.) cv. Single under agro-ecological conditions of Faisalabad country during 2005-06, so as to explore the best bulb size for the best quality flower spikes production as well as maximum bulb and bulblet production. It was observed that large bulb size resulted in vigorous growth, maximum yield and more number of bulblets as compared to small and medium sized bulbs.

Pal et al. (2011) conducted the experiment to study the methods of bulb production of tuberose cv. Prajwal, with five bulb size of tuberose i.e. whole bulb, $\frac{1}{2}$ bulb, $\frac{1}{4}$th bulb, $\frac{1}{6}$th bulb and $\frac{1}{8}$th bulb. Highest number of bulbs per clump (large, medium and small) per plot was recorded in whole bulb (4.22, 9 and 30.33 nos.) followed by $\frac{1}{2}$ bulb (3.44, 6.77 and 15.33) and maximum weight of bulbs per clump (large, medium, small) was produced by whole bulb (192.44, 95.33, 55.55) followed by $\frac{1}{2}$ bulb (185.22, 92.50, 34.99). The maximum diameter of bulbs per clump (large, medium and small) was produced by whole bulb (4.32cm, 1.86 cm, 0.92 cm) followed by $\frac{1}{2}$ bulb (4.27 cm, 1.64 cm, 0.92 cm).

Wagh et al. (2012) studied the effect of bulb size and GA$_3$ on vegetative and floral characters of tuberose (Polianthes tuberosa L.) cvs. Prajwal and Calcutta Single were studied. The results revealed that among the two varieties, Prajwal (V$_1$) showed significant increase in growth, flowering, quality and yield attributes, as compared to Calcutta Single. While, in case of bulb size; bulbs having diameter of 2.6–3.5 cm had significant effect on vegetative growth, quality and quantity production of tuberose spikes, bulbs and bulblets as compared to bulbs having diameter 1.5–2.5 cm.

Muhammad et al. (2016) conducted the trial to investigate the effect of bulb sizes i.e. small, medium and large (1.5-2.0, 2.1-2.5 and 2.6-3.0 cm in diameter respectively) on the growth and flowering of tuberose cv. Single. The results of the experiment revealed that bulb size had significant influence on all parameters studied. Plant height and number of leaves per plant at different stages of growth i.e. 84, 112, 140, 168 and 200 days after planting were increased significantly with the increase of bulb size of tuberose. The number of side shoot per plant was increased with the increase of bulb size. On an average 19.58 side shoot was obtained from large bulb and the lowest 9.01 was from small bulb. The highest height of side shoot (57.58 cm)
was recorded from the large bulb while the lowest plant height (44.39 cm) was obtained from small bulb size. Number of leaves per side shoot increased with the increase of bulb size. The maximum number of leaves per side shoot (17.31) was obtained from the side shoot produced from the large bulb and the minimum (9.91) from small bulb. The highest duration of flowering was obtained from the large bulb (19.65 days) and the shortest duration of flowering was obtained from the small bulb (13.97 days). Spike produced from the large bulb had the maximum diameter (1.13 cm), while it was minimum (0.77 cm) in the spike produced from the small bulb. The highest number of floret (47.50) was obtained from the plants grown from large bulb and the lowest (34.38) from small bulb. The maximum number of spike (424.08 thousand) was obtained from plants of large bulbs. On the other hand, plants from small bulb produced minimum number (287.24 thousands). The maximum average weight of spike (41.76 g) was obtained from large bulb which was minimum (33.25 g) in small bulb. The yield of spike gradually increased as the size of bulb increased. The highest yield (17.79 t/h) was obtained from large size bulb while the lowest (9.60 t/h) was in small bulb. It is concluded that large bulb was found to be superior to medium and small bulb for growth and flowering of tuberose cv. Single.

2.2 EFFECT OF GROWTH REGULATORS ON GROWTH, FLOWERING AND CORM PRODUCTION

2.2.1 Gladiolus

Tuskamoto and Yazawa (1973) concluded that soaking of gladiolus in 20 ppm of benzyl adenine for 24 hrs produced 100% sprouting within 2-3 weeks.

Sehgal (1984) observed increased number of shoots in gladiolus cvs Gebrge Mazure, Australian Fair and Royal Jubilee soaked in BA at 40 ppm.

Roychoudhuri (1989) reported that kinetin promoted plant height, leaf number, number of corms, diameter of corm, weight of corm and cormlets in gladiolus cv. Psittacinus Hybrid. Maximum plant height (75.69 cm) and weight of corm (13.90 g) were obtained with kinetin (25 ppm).

Mahesh and Misra (1993) reported that spray of 200 ppm GA$_3$ had no effect on diameter of floret, days for blooming and spike length but number of florets and durability of whole spike were significantly highest in gladiolus plant.
Muthoo and Maurya (1993) reported that gladiolus cv. Oscar corms when soaked for 6 hours in BA at 100 mg per litre promoted early shoot sprouting.

Bhat (1994) studied on those gladiolus cormels of cv. ‘Syliva’ when soaked in BA at 250 ppm for 12 hours produced bigger size cormels.

Pal and Choudhary (1998) revealed that the gladiolus cv. ‘Topic Sea’ corms were soaked for 24 hours in BA 40 ppm gave early sprouting.

Goo-Dae Hoe et al., (1998) conducted a trial on gladiolus cormlets and produced in-vitro and observed that dipping cormlets in 10 mg/l. BA for 24 h was more effective at breaking dormancy than either GA₃ or ABA treatments.

Dataram and Verma (2001) reported that GA₃ (100 ppm) increased maximum vegetative growth of gladiolus except for diameter of neck which was highest with the application of cycocel (250 ppm).

Maurya and Nagda (2002) studied the effect of foliar spray of GA₃ (50, 100 ppm), cycocel (500, 1000 ppm) and NAA (50, 100 ppm) on corm and cormel yield of gladiolus (Gladiolus grandiflorus L.) cv. Friendship and found that GA₃ (100 ppm) recorded maximum size of corm (7.42 cm), maximum number of corms per plant (1.87) and highest corms weight per plant (78.7 g).

Rajaram et al. (2002) concluded that Benzyl Adenine at 25 ppm increased the growth of corms, cormels and also influenced on increasing the sprouting percentage of cormels per plant.

Kumar and Singh (2005) in gladiolus cv. Congo Song found that lower dose of ethrel (250 ppm) resulted in the longer duration of flowering (12.16 day) as compared to control, but its higher concentration (500, 750 ppm) reduced of it over control. Ethrel treatment also increased the corm weight over control. The weight per corm was increased lineary with increasing levels of ethrel and at higher concentration (750 ppm) produced the heaviest daughter corm (43.13 g).

Baskaran and Misra (2007) observed that the corms dipped in BA at 50 ppm significantly increased the length of rachis as compared to control.

Patil (2007) conducted the experiment on effect of growing conditions and growth regulators on sprouting, flowering, flower yield, corm and cormel production of gladiolus cv. American Beauty. Among the different growth regulators kinetin at 25 ppm gave maximum number of sprouts per plant (2.46), maximum number of corms per plant
(3.23), heaviest weight of cormels per plant (27.87 g) and largest number of corms per hectare (2.93).

Umrao et al. (2007) conducted an experiment to find out effect of GA$_3$ and sand as media on growth, flowering and corm production in gladiolus cv. ‘Nova Lux’. Pre-planting soaking of corms in gibberellic acid as well as planting with or without sand significantly affected the most of characters studied. In both the media, the higher levels (100 or 150 ppm) of GA$_3$ increased the number of sprouts per corm, girth and height of plant, number and width of leaf, length and placement of florets, number of flowering spikes per mother corm, number of opened fresh florets at a time, longevity, yield and vase-life of spike, weight of daughter corm, total yield of corms and number of cormels per plant.

Havale et al. (2008) studied the effect of growth regulators and chemicals on corms and cormels production of gladiolus cv. Jester and revealed that BA (50 ppm) recorded maximum number of corms/plant/plot/ha weight of corms and weight of cormels/plant.

Reddy (2008) concluded that the Benzyl Adenine at 100 ppm recorded maximum number of cormels per corm, cormel weight per corm and highest propagation coefficient.

Tawar (2008) reported that spraying of BA (50 ppm) at 40 and 60 days after planting attributed to superior results regarding number of corms, cormels/plant/plot/ha and weight of corms and cormels over all other treatments.

Baskaran et al. (2009) in gladiolus observed that BA (100 ppm) increased number of corms per plant followed by kinetin (250 ppm). Maximum numbers of cormels was produced in case of plants treated with kinetin (500 ppm) as corm dipping.

Kumar (2010) concluded that the Benzyl Adenine at 100 ppm recorded maximum number of spikes per corm and also increased the corm weight of gladiolus.

Khan et al. (2012) concluded that the Benzyl Adenine at 125 ppm enhanced multiple shooting and also influences in increasing the corm yield of gladiolus.

Sheetal et al. (2012) concluded that among the four concentrations of GA$_3$ (0, 100, 200 and 300 ppm) the analyzed data indicated that maximum plant height,
number of leaves, leaf width, spike length, rachis length, corm diameter, corm weight and early flowering was recorded at 300 ppm GA$_3$.

Aier et al. (2015) concluded that Benzyl Adenine at 250 ppm exhibited maximum economic yield in terms of number of spikes per corm and number of corms per plant.

Sajjad et al. (2015) concluded that soaking of corms in Benzyl Adenine favoured the modifications in various traits of interest including sprouting of multiple buds and an increase in the production of corms.

Neetu et al. (2016) conducted the experiment on effect of different kinetin concentration on growth and flowering attributes in gladiolus cultivars. Treatment consisted of kinetin at 50 ppm, 100 ppm, 150 ppm and 200 ppm along with control on 5 cultivars of gladiolus viz., Archana, Gunjan, J. V. Gold, Sabnum and Snow Princes. The results revealed that, maximum length of leaf was recorded with kinetin at 150 ppm followed by kinetin 200 ppm with cv. Gunjan, whereas, width of longest leaf were noted in cv. Snow Princes with kinetin concentrations at 200 and 100 ppm respectively. However, maximum number of leaves per plant was registered with cv. Gunjan at 200 ppm kinetin followed by J. V. Gold at 150 ppm respectively. Among flowering parameters early spike emergence and length of spike were noticed with cv. ‘Sabnum’ when kinetin was used at higher concentration 200 ppm. In general higher size of first floret was recorded with cv. J.V. Gold at 50 ppm kinetin, whereas, higher size of fifth floret was recorded with cv. J.V. Gold at 100 ppm. Kinetin at 200 ppm exerted maximum length of spike in cv. ‘Sabnum’, whereas maximum number of florets per spike was also recorded with cv. ‘Sabnum’ when kinetin applied at 100 ppm.

### 2.2.2 Tuberose

Parmar et al. (1994) reported that the bulb of tuberose cv. ‘Double’ when dipped in BA at 500 ppm significantly increased sprouting and bulb production per plant.

Reddy et al. (1997) in a trial on tuberose cv. ‘Double’ with different concentrations of GA, BA and phosphon. He found that vase life was longest (7.67 days) for flowers from BA and GA – treated plants.

Bhaskar and Rao (1998) reported that adding 100 ppm of Benzyl Adenine in vase water was the most effective in improving the water uptake, maintaining a
better water balance and thereby increasing the fresh weight of flowers, which finally contributed to the increased vase life (10.22 days) and increased number of opened florets (61.73 per cent) per spike. By adding 100 ppm BA to the vase water the petal senescence was delayed and freshness maintained for a longer time.

Nagaraja et al. (1999) reported that, the bulb of tuberose cv. ‘Single’ when soaked for 24 hours at BA 100 ppm significantly increased the growth and number of corms per plant.

Singh (1999) in tuberose observed that number of bulbs per plant and bulb weight per plant was highest in plants sprayed with 100 ppm kinetin.

Arora and Singh (2000) evaluated that the harvesting stages of tuberose (P. tuberosa) spikes showed increase in vase life with the advancement in the stage of bud development. The spikes of cultivar with double flower showed very poor vase life. The opening of buds was considerably improved with vase solution containing 1% sucrose was best, whereas, for cv. Double, with high sucrose concentrations (3%) were most effective. BA (Benzyl Adenine) synergised the effect of sucrose + 8-HQC on vase life as well as opening of buds.

De and Dhiman (2001) reported that pre-soaking of tuberose bulbs with GA3 (50, 100, 150, 200 and 250 ppm) before planting resulted in improvement of vase life by lower levels of GA3 (50-100 ppm).

Singh and Bijimol (1999) experimenting with tuberose and found maximum diameter of florets, number of bulbs and weight of bulbs per plant with kinetin (100 ppm) in tuberose cv. Double.

Hutchinson et al. (2003) concluded that BA at 25 ppm and 50 ppm improved the vase life and floret opening of tuberose cut flower.

Padaganur et al. (2005) In tuberose, cv. Single it was found that foliar spray of GA3 at 150 ppm resulted in maximum plant height, number of leaves, number of shoots, leaf area, spike length, spike weight, number of florets per spike and spike yield.

Sagar et al. (2005) reported that soaking of tuberose bulbs in solution of GA3 (200 ppm) for 24 hours resulted in maximum plant height, spike length, rachis length and also least days were required for emergence of flower spikes and opening of first pair of florets on spike.
Tyagi and Singh (2006) reported that significantly minimum days to flowering (80.12 days), maximum number of florets per spike (39.10), length of spike (78.92 cm) and vase life (13.85 days) were recorded with 160 ppm GA$_3$ in tuberose cv. Pearl Double.

Devadaman et al. (2007) conducted an experiment on tuberose involving three growth regulators and three concentrations i.e. GA$_3$ at 50, 100 and 150 ppm, NAA at 100, 150 and 200 ppm and thiourea at 1000, 1500 and 2000 ppm. Application of GA$_3$ (150 ppm) as spray significantly influenced spike and flower characters i.e. minimum days required for spike emergence (43.48), maximum spike length (87.20 cm), girth of spike (2.84 cm), length of rachis (21.37 cm), length of floret (6.56 cm) and diameter of floret (3.88 cm). Similarly maximum vase life was also recorded in treatment GA$_3$ (150 ppm).

Bharathi and Kumar (2009) reported that foliar spray of kinetin (200 ppm) increased flower diameter in tuberose cv. ‘Suvasini’.

Asil et al. (2010) concluded that the Benzyl Adenine at 50 ppm and 100 ppm increased the floret diameter and vase life of the cut flower.

Bhosale (2014) conducted the experiment on effect of storage period and GA$_3$ soaking of tuberose bulbs on growth, flowering, flower yield and quality. Tuberose bulbs were planted in 3rd week of February, with four GA$_3$ soaking treatments for 12 hours viz. G$_0$ - Control (soaking in distilled water), G$_1$ - 100 mg/l, G$_2$ - 200 mg/l and G$_3$ - 300 mg/l. The bulbs soaked with different concentration of GA$_3$ were kept in shade for half an hour before planting. The results revealed that one month storage period after uplift of bulbs and GA$_3$ 200 ppm soaking before planting treatments significantly improved growth parameters (days to sprouting, sprouting percentage and plant height), and floral characters (days to spike emergence, days to first spike harvested and length of spike, number of florets per spike and diameter of floret) over a control treatment.

2.2.3 Lillium

Dantuluri and Misra (2002) obtained, maximum number of flowers/plant (3.80), maximum number of bulbils (6.17) and longest duration of flowering (19.09 days) in Asiatic hybrid lily cv. ‘Corrida’ with application of BA (200 ppm).
Janowska et al. (2009) concluded that Benzyl Adenine 100-600 mg/dm$^3$ concentrations improves 2-3 times the flower yield of the cultivars Black Magic, Mango and Albomaculata of calla lilly.

Situma et al. (2015) concluded that the treatment with Benzyl Adenine on ornamental lilly at 50 ppm increased the number of sprouts in the lilly corms.

### 2.2.4 Tulip

Nelofar et al. (2005) reported that BA (200 ppm) recorded the maximum vase life (6.82 days) followed by GA$_3$ (100ppm) 6.46 days with tulip cut stems pulsed for 4.00 hour duration.

### 2.2.5 Anthurium

Beena and Mercy (2003) found that maximum longevity of spadix (103 days) in *Anthurium andreanum* var. Liver Red was recorded with the application of kinetin (500 ppm).

### 2.2.5 Orchid

Nambiar et al. (2012) concluded that Benzyl Adenine treatment on dendrobium orchids at 200 ppm increased the length of the spike inflorescence production and umber of inflorescence per spike.

### 2.2.7 Narcissus

Seyedeh et al. (2015) studied the Effects of four levels of Benzyl Adenine (0, 100, 200 and 500 mg/l) on Narcissus grown in pot containing soil. Results showed that leaf and flower development increased with an increase in BA concentration from 100 to 500 mg/l$^{-1}$

### 2.2.8 Rose

Chakradhar and Khiratkar (2000) reported that foliar application of BA (100 ppm) in rose cv. Gladiator resulted in maximum number of laterals per plant, number of flowers. However, length of flowering shoot, number of leaves, leaf area and flower diameter decreased with increasing concentration of BA.

### 2.2.9 Chrysanthemum

Sen and Maharana (1971) reported that in chrysanthemum cv. ‘Early Yellow’, application of B-9 at 0.4 and 0.5 per cent reduced plant height. However, B-9 at all levels (0.2, 0.4 and 0.2 per cent) caused increase in branch number over
control. Among flowering characters, 0.2 per cent B–9 caused delay in flowering and the maximum flower production was noticed with 0.5 per cent.

Nagarajuna et al. (1988) reported that in chrysanthemum foliar spray of B–9 had greater influence in increasing the number of flowers per plant and storage life.

Mahalle et al. (2001) reported that application of all the concentrations of B-9 (1000, 2000, 3000 and 4000 ppm) to chrysanthemum were found effective in delaying flowering behaviour of all the varieties, and higher concentration recorded maximum biomass production and size of flower and 4000 ppm concentration was the most effective in prolonging normal flowering season, maximizing biomass production and size of flower as well.

2.2.10 Carnation

Wawrzynezak and Goszezynska (2003) investigated the effect of 24-hour pulse treatment with exogenous cytokinins BA and kinetin on the longevity of cut carnations (Dianthus caryophyllus) and observed that pulse treatment with Kinetin and BA improved the diameter and longevity of cut carnations compared to distilled water.