EFFECTS OF PRE-HARVEST SPRAY OF PLANT GROWTH REGULATORS ON CORM AND CORMELS CHARACTERISTICS AND POST-HARVEST PERFORMANCE OF GLADIOLUS CUT FLOWERS CV. AMERICAN BEAUTY

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ABSTRACT

An experiment was conducted to determine the effect of plant growth regulators on corm characteristics and post harvest performance of gladiolus cv. American Beauty at the Agriculture and Forestry University, Rampur, Chitwan during September, 2013 to March, 2014. The study consisted of 10 treatments laid out in a randomized complete block design (RCBD) and replicated three times. Three levels of NAA (50 ppm, 100 ppm and 150 ppm), three levels of GA3 (50 ppm, 100 ppm and 150 ppm), three levels of Kinetin (50 ppm, 100 ppm and 150 ppm) and control (no PGR application) were applied as foliar sprays at 30 and 45 Days after planting. GA3 shows significantly promising results on corm, cormels characteristics, vase life and post harvest behavior of gladiolus spike. GA3 @ 150 ppm resulted maximum corm weight and corm diameter whereas both GA3 @ 100 ppm and NAA @ 150 ppm recorded significantly high number of cormels/plants. GA3 @150 ppm and NAA @ 150 ppm showed significantly maximum corm weight and days to the fist basal floret withering. However, the vase life of gladiolus spike was superior with GA3 @ 150 ppm.

Key words: gladiolus, NAA, GA3 and kinetin

INTRODUCTION

The name Gladiolus (Gladiolus grandiflorusL.) was derived from the Latin word Gladius meaning a sword due to its sword shaped foliage. Gladiolus is perennial bulbous flowering plant and belongs to the family Iridaceae. Gladiolus is also called as sword-lily and corn flag (Negi & Raghava 1997). There are more than 30,000 varieties and 240-300 species of gladiolus while about 200 varieties are added, and the same number is dropped every year because of degeneration due to fungi like Fusarium, Botrytis and viral diseases. Gladiolus is the first commercially grown cut flower crop in Nepal and the most dominating cut flowers in Nepalese cut flower market (Malla 1988 & Subedi 2004). It occupied first position in terms of cut flower production and consumption in Nepal for several years (Pun 2004) but lately it has been relegated to third position by carnation and gerbera and the demand of gladiolus spikes is 8000-10000 sticks per day in Kathmandu.

Plant growth and flowering along with senescence, are controlled through a balance between plant hormones interacting with each other and with other factors (Mayak & Halevy 1980). Plant Growth Regulator (PGR) are being used extensively in commercial flower production throughout the world. The growth parameters of gladiolus plants were significantly altered due to the application of plant growth regulators (Bhalla & Kumar 2008). Foliar applications of these regulators are becoming extremely important and valuable in the commercial floriculture for manipulating the growth and flowering of plants and also for improving the quality parameters of fruits and cut flowers (Sajid et al. 2009, Khalid et al. 2012). Plant growth regulators are the important compounds for the cut flower production as it results in effective plant growth and development and produce high quality flowers with long postharvest life.

In Nepal, American Beauty, Interpret, White Prosperity and Candymen are mostly grown varieties of gladiolus. Among them American Beauty is most demanding variety having good export quality. The varied temperature

range in different season creates potentiality for year round production of gladiolus in our context. Gladiolus prefer temperature regime between 10° and 25°C. It can, however, temporarily tolerate very high temperatures when the relative humidity is high and the soil is moist. It can be grown both in terai and mid hills of Nepal.

Various research workers have reported that the foliar sprays of growth regulators like GA3 and NAA help to produce good quality cut flowers as well as yield of gladiolus corms. Good quality planting material is crucial for the successful plant growth and production. Huge amount of gladiolus corm is required for massive production. Not only the production of spike but also the production of gladiolus corm is the big challenge to gladiolus grower. Production of planting material is one of the important economic characters in gladiolus cultivation, which has been reported to be influenced by the different PGRs and its concentrations. Treating the gladiolus cormels and foliar spray at 4 leaf stage with the GA3 helps to produce corm earlier with the highest values for percentage of cormels sprouted (Singh et al. 2002).

Plant physiologist defined auxin (NAA) as an organic compound characterized by their capacity to induce cell enlargement even at low concentration along the longitudinal axis (Moore 1989). Gibberellins are the strong growth promoters as they can increase internodal distance, induce flowering and can also modify sex expression in some plant species (Davies 1995). Gibberellins are the plant growth regulators that constitute a group of tetracyclic diterpenes and are known to stimulate physiological responses in plant which alter the source - sink metabolism through their effect on photosynthesis and sink formation (Iqbal et al. 2011). Cytokinin plays an important role in metabolic processes i.e. nucleic acid metabolism or protein metabolism. The cytokinins have influence on process of cell division (Francis & Sorrel, 2001), biosynthesis of chloroplast pigments (Bondok et al. 1995), nutrient uptake especially potassium (Guo et al. 1994) and increasing photosynthetic efficiency (Oosterhuis & Zhao, 1998).

METHODOLOGY

The experiment was conducted in a randomized complete block design (RCBD) with ten treatments which were replicated three times. The corms of cv. American Beauty were planted in the research field of Department of Horticulture, Agriculture and Forestry University, Rampur, Chitwan at 25 cm plant to plant and 25 cm row to row distance in September 2013. All the cultural practices including fertilization, irrigation, weeding and earthing up were done according to recommendations. The gladiolus plants were sprayed thoroughly with different concentrations (50, 100 and 150 ppm) of freshly prepared solution of nephthaleic acetic acid, gibberellic acid and kinetin in distilled water separately. Each treatment contained about 0.83 liter of solution. The sprays were applied at 30 days and 45 days after planting. Only distilled water was sprayed on control plots.

The parameters including corm weight (gm), corm diameter(cm), no. of cormels/plant, first basal floret withering (days), 50% withering of florets(days) and vase life(days) were recorded accordingly. The collected data were entered on MS- Excel sheet and analyzed for analysis of variance by using MSTATC software and treatment means were compared by Duncan's Multiple Range Test (DMRT) at 5% level of significance.

RESULTS AND DISCUSSION

Effect of plant growth regulators on corms and cormels characters of Cv. American Beauty

Corm weight

Weight of daughter corm was significantly maximum in GA3@150 ppm (38.61g) and NAA 150 ppm (36.50g) whereas it was the lowest in control (17.22g) (Table 1).Gibberellic acid is known to increase the plant height and number of leaves that might have led to increased rate of photosynthesis. As a result of this, availability of metabolites to the developing corm and cormels might have increased, thereby leading to increase in the weight of corm. (Sarkar et al. 2014) conducted a research at Horticulture farm, Sher-e-Bangla Agricultural University, Dhaka,

Bangladesh during the period from May 2011 to August 2011, who revealed that GA3 @ 150 ppm was most effective and produced highest weight of single corm.

Table 1.Effect of plant growth regulators on Corm weight, Corm diameter and Number of cormels per plant in Gladiolus cv. American Beauty grown under Chitwan condition (2013/2014)

Treatment	Corm weight (gm)	Corm diameter (cm)	Number of Cormels/ plant
NAA @ 50 ppm	26.65^{c}	4.473^{bcd}	25.46^{bc}
NAA @ 100 ppm	33.26^{b}	4.720^{bc}	27.90^{ab}
NAA @ 150 ppm	36.50^{ab}	5.113^{b}	29.66^{a}
GA_3 @ 50 ppm	27.55^{c}	4.457^{bcd}	27.61^{ab}
GA_3 @ 100 ppm	27.98^{c}	4.507^{bcd}	30.91^{a}
GA_3 @ 150 ppm	38.61^{a}	5.917^{a}	29.22^{ab}
Kinetin @ 50 ppm	28.12^{c}	4.567^{bc}	23.08^{cd}
Kinetin @ 100 ppm	23.36^{cd}	4.303^{cd}	22.47^{cd}
Kinetin @ 150 ppm	20.39^{de}	4.270^{cd}	22.23^{cd}
Control	17.22^{e}	3.860^{d}	20.74^{d}
Grand mean	27.964	4.619	25.927
SEM ±	1.4727	0.2013	1.2067
$LSD_{\text{at 5 \%}}$	4.375**	0.5992**	3.585**
CV (%)	9.12	7.55	8.06

GA3 when used as foliar application has increasing effects on corm yield and corm weight of gladiolus (Ved et al., 1998). Singh et al. (2002) and Naveen and Chandrashekar (2008) also observed that foliar application of gibberellic acid on gladiolus plant increased the corm weight.

Means within the column with the same letter for corm and cormel characters are not significantly different at 5% level of significance by DMRT. SEM = Standard Error of Mean, LSD = Least Significant Difference and CV = Coefficient of Variation. * Significant at 5% level and ** Significant at 1%level and NS = non significant

Corm diameter

The maximum corm diameter (5.917 cm) was recorded in GA3 @ 150 ppm followed by NAA @150 ppm (5.11 cm) but the lowest diameter was in control (3.86 cm) (Table 1). The result showed that the corm having maximum diameter had highest weight and corm having minimum diameter had lowest weight. Increased rate of photosynthesis due to maximum vegetative growth increased the metabolites to the developing corms and cormels which led to production of large size corm. Sarkar, et al. (2014), in gladiolus reported that GA3 @ 150 ppm was more effective to enhance diameter of corm. (Sajjad et al., 2014) conducted an experiment on White Prosperity in Institute of Horticultural Sciences, University of Agriculture, in October, 2011 and reported that foliar application of gibberellic acid at 1mM concentration increased the corm diameter. Yousif and Al-Safar (2006) also observed bigger corm diameter from the GA3 treated corms.

Number of cormels per plant

GA3 @ 100 ppm and NAA @ 150 ppm gave relatively high number of cormels (30.91 and 29.66/plant

respectively).In contrast, control gave the lowest number of cormels (20.74 per plant). Gibberellic acid is known to increase the vegetative growth that might have led to increased rate of photosynthesis. As a result of this, availability of metabolites to the developing bulblets might have increased, thereby leading to increase in the number of bulb count. Sajjad et al. (2014) revealed that foliar application of gibberellic acid increased the number of cormels and the total cormels weight. Dograet al. (2012) and Singh et al. (2002) also found that application of GA3 on gladiolus increased the number of cormels and cormels weight.

Effect of plant growth regulators on post- harvest performance

Days to first basal floret withering

Days to the first basal floret withering was found significantly maximum in GA3 @ 150 ppm (9.73 day)s ,GA3 @100 ppm (9.60 days) and NAA @ 150 ppm (9.50 days). Nevertheless, control took the fewest number of days (7.67 days) for the first basal floret withering (Table 2). Withering of floret is the most important quality attributes of cut flowers. Gibberellic acid application resulted in continuous supply of photosynthetic assimilate for longer duration due to high source strength at higher concentration so that the florets on the gladiolus spike remained for

Table 2.Effect of plant growth regulators on First basal floret withering, 50% withering of floret and Vase life in Gladiolus cv. American Beauty grown under Chitwan condition (2013/2014)

Treatment	First basal floret withering (days)	50% withering of floret (Days)	n Vase life (days)
NAA @ 50 ppm	8.967^{bc}	14.28^{cd}	16.34^{de}
NAA @ 100 ppm	8.967^{bc}	15.05^{bc}	17.33^{bcd}
NAA @ 150 ppm	9.500^{a}	15.22^{bc}	17.57^{bc}
GA_3 @ 50 ppm	9.233^{ab}	14.36^{cd}	16.56^{cde}
GA_3 @ 100 ppm	9.600^{a}	15.72^{b}	17.83^{b}
GA_3 @ 150 ppm	9.733^{a}	16.90^{a}	19.07^{a}
Kinetin @ 50 ppm	8.567^{c}	14.54^{cd}	16.66^{cde}
Kinetin @ 100 ppm	8.667^{c}	14.57^{cd}	16.66^{cde}
Kinetin @ 150 ppm	8.633^{c}	14.67^{cd}	16.81^{bcde}
Control	7.667^{d}	13.62^{d}	15.76^{e}
Grand mean	8.953	14.893	17.059
SEM ±	0.1642	0.3258	0.3193
LSD $_{\text{at 5 \%}}$	0.4882**	0.9673**	0.9489**
CV (%)	3.18	3.79	3.24

longer duration. Padmalatha et al. (2013) revealed that application of gibberellic acid increased the number of days to withering of the basal floret of gladiolus. Singh and Jitendra (2008) revealed that membrane stability of cut spike of gladiolus have been increased by using gibberellic acid.

Means within the column with the same letter for corm and cormel characters are not significantly different at 5% level of significance by DMRT. SEM = Standard Error of Mean, LSD = Least Significant Difference and CV = Coefficient of Variation. * Significant at 5% level and ** Significant at 1%level and NS = non significant and ** Significant at 1%level and NS = non significant.

Days to 50% florets withering

Spike from the treatment of GA3 @ 150 ppm resulted maximum days (16.90) to 50% florets withering (Table 2). Application of GA3 resulted in continuous supply of photosynthetic assimilates for longer duration due to high source strength at higher concentration. Kumar and Gupta (2014) observed the maximum longevity of whole gladiolus spike with foliar spray of GA3 @ 100 ppm. Rani and Singh (2013) also observed that application of GA3 increased the durability of flowers and maximum durability was observed at the highest concentration of GA3.

Vase life

GA3 @ 150 ppm gave the longest vase life (19.07 days) to the gladiolus spike (Table 2). Gibberellic acid might have significant response on alpha amylase synthesis so that the total soluble carbohydrate content increased and this could have contributed to improve the energy pool and increased the osmotic potential of flower thus the vase life of flower get increased (Sakine et al., 2011). Padmalatha et al. (2013) revealed that application of gibberellic acid increased the vase life of gladiolus var. Darsan at Rajendranagar, Hyderabad. It was also in accordance with the findings of Singh and Jitendra (2008) who revealed that vase life and membrane stability of cut spike of gladiolus have been increased by using gibberellic acid.

CONCLUSION

In context of Nepal, American Beauty is the most demanding variety for the cut flower production which has good export quality. But there is still lack of planting material (corm) to go on massive production. To meet the demand huge amount of corm has to be imported. So fulfill the demand, corms and cormels production is challenging which can be addressed through PGRs application. Based on the results obtained, it can be concluded that, PGRs application at 30 DAP and 45 DAP showed marked influence on the corm and cormels characteristics and postharvest behavior of gladiolus cut flowers (cv. American Beauty) in Chitwan district. GA3 resulted in the highest corm weight, maximum corm diameter, maximum no of cormels/plant and superior postharvest behavior with longer vase lifewhich are the major contributing traits for floriculture industries. Use of plant growth regulators may be an effective approach to increase corm and cormel production of commercially important cultivar. This is very important information that has been tested in our conditions and can be useful for rapid multiplication of our own gladiolus cultivars that are being released by Nepalese research organizations in next few years.

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