Growth And Reproductive Response of Gladioulus to Exogenous Application of Salicylic Acid

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Abstracts: Salicylic acid (SA) is a phyto-hormone that acts as a key regulator for signaling defensive chemicals in plants under biotic and abiotic stresses. It also exerts stimulatory effects on various physiological processes related to plant growth and development. The present investigation entitled “Growth and reproductive response of Gladiolus to exogenous application of salicylic acid” was held at Department of Horticulture Research and Development (DHRD), National Agriculture Research Centre (NARC), ISLAMABAD during 2022. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The purpose of this study was to test the hypothesis that exogenous application of salicylic acid positively affects growth and flowering of gladiolus. Five levels (0, 50, 100, 150, and 200mg/L) of salicylic acid were sprayed on aerial parts of the plant. The studied traits were number of leaves plant-1, flower diameter, rachis length, days to spike emergence, number of florets spike-1, spike length and spike diameter. Results revealed that exogenous application of various concentrations of salicylic acid had a significant effect on all the recorded parameters. Salicylic acid at the rate of 200 mg L-1 reduced days to spike emergence and increased number of leaves plant-1, florets spike-1, spike length and rachis length. Second highest results regarding flower diameter and spike diameter were observed in gladiolus plants sprayed with 200 mg L-1 salicylic acid. Maximum flower diameter and spike dimeter were observed in gladiolus plots sprayed with 150 mg L-1 salicylic acid. Lowest results were observed in gladiolus crop that received no salicylic acid or salicylic acid in low concentrations. Hence concluded that high concentrations of salicylic acid improved both vegetative and reproductive characteristics of gladiolus crop. Based on results, it can be recommended that salicylic acid at 200 mg L-1 should be sprayed on gladiolus crop to achieve maximum and good quality yield of gladiolus.

Keywords: Salicylic Acid, Gladiolus, Vegetative Growth, Reproductive Growth.

1. INTRODUCTION

Cut flowers are the most lucrative product in floriculture industry (Solgi et al., 2009). Gladiolus (*Gladiolus grandiflorus* L), the queen of cormous flowers having wide range of colors, varying in size, attractive shapes and good shelf life of flowering spike and florets (Bhattacharjee and De, 2005). This perennial cut flower belongs to

Iridaceae family. The genus “gladiolus” consists of about 260 species among which 10 species are native to Eurasia and 250 belongs to sub-Saharan Africa.

Gladiolus is among top four commercial cut flowers in the world (Bai et al., 2009). It is grown as cut flower for its attractive spike having colorful florets and can also be grown as bedding flowers during summer (Mayak and Halevy, 1980). It is best suited for bouquet and basket arrangements and some other decoration as well. Gladiolus is considered as the queen of bulbous flowers worldwide (Ramach et al., 2009). The longevity and quality (long rachis, long spike and large florets) of this cut flowers means a lot to the florists.

Climate change, lack of sustainable practices and some other environmental stresses like dryness, cold, heat, heavy elements, diseases, insects and salts etc. affect the performance of flora. So, it is the basic of need of modern farming to introduce any chemical, microorganism etc. to tackle such harsh conditions for the crop to grow. Salicylic acid (SA) is considered as a potent plant hormone that have various roles in plant metabolism (Hayat et al., 2010). This plant growth regulator of phenolic nature is known to affect growth and bio productivity of crops (Hayat et al. 2010). This growth encouraging chemical (Ram et al., 2012) is involved in regulation of various processes in cell division, cell elongation, stomatal conductance, transportation, photosynthesis, transpiration, seed germination, sex polarization and disease resistance (Harper and Balke, 1981; Raskin, 1992; Khan et al., 2003; Zhang et al., 2003). Initially salicylic acid was extracted from willow and was named after it (Latin word Salix) by Rafacle Piria in 1938. Beside plant growth and development, SA also help plant to withstand environmental, disease and oxidative stresses ((Shirasu et al., 1997; Hayat et al, 2009). SA is considered to be an important signaling molecule which is involved in local and endemic disease resistance in plants in response to various pathogenic attacks (Enyedi et al., 1992; Alverez, 2000). To study the said effects of salicylic acid, an experiment was designed on gladiolus crop. The main objective of this study was to find out the most effective concentration of salicylic acid for good growth and flowering of gladiolus.

MATERIALS AND METHODS

This experiment was executed at Field of Directorate of Floriculture Department of Horticulture Research and Development (DHRD), National Agriculture Research Center (NARC), Islamabad during the summer 2022. The study trial was undertaken under the climatic conditions of Islamabad region which is humid to sub-tropical climate and fall under semi-arid zone with annual precipitation of about 1044mm, most of which occur during monsoon (June-august). The was experiment was designed to study the exogenous application of salicylic acid (0, 50, 100, 150 & 200 mg L^{-1}) on vegetative and reproductive attributes of gladiolus (*Gladiolus grandifloras* L). Aim of this study was to find out the most effective concentration of salicylic for maximum yield and better quality gladiolus cut flower. Gladiolus plants were planted in a Randomized Complete Block Design (RCBD) with three replications. Plant to plant and row to row distance were maintained 15 inches respectively. Gladiolus corms were planted on 20 May 2022. Parameters studied in this experiment were number of leaves $plant^{-1}$, days to spike emergence, number of florets $spike^{-1}$, spike length (cm), rachis length (cm), spike diameter (mm) and flower diameter.

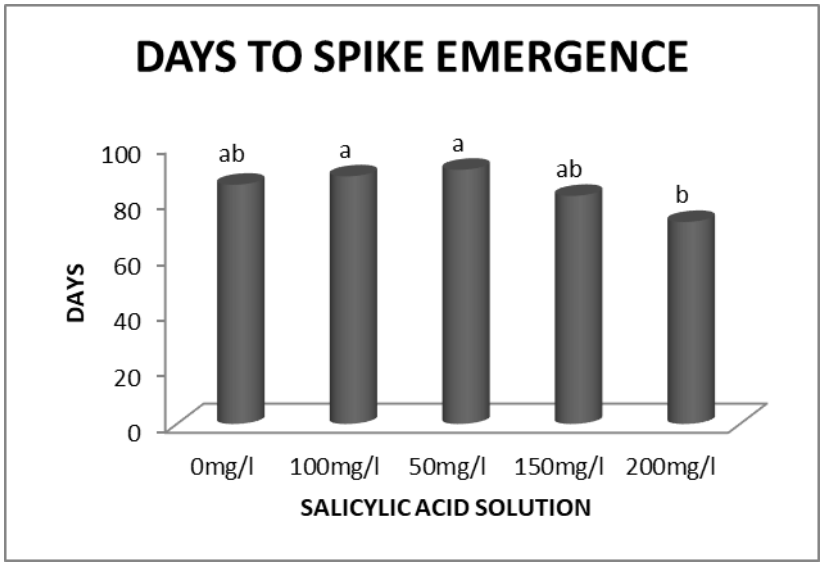
Statistical Analysis

The data was calculated and evaluated with analysis of variance (ANOVA). The significance level between different concentrations of salicylic acid was determined by using LSD test. This analysis was done by using Statistix 8.1 program. The $\alpha = 5\%$ significance level for data interpretation was taken into account.

RESULTS

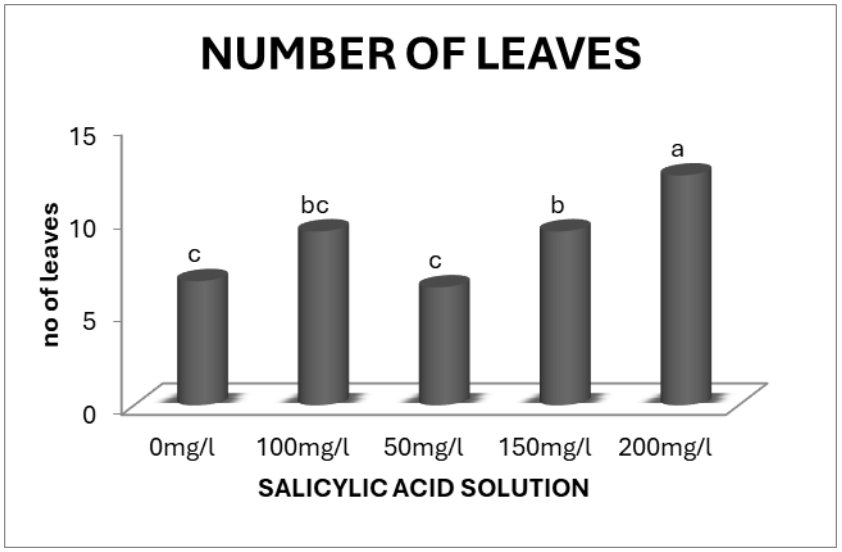
The different levels of salicylic acid had a significant effect on all the observed characteristics of gladiolus. Effect of salicylic acid on earliness of gladiolus spike is shown in the (figure 1). The analysis of variance (ANOVA) have shown highly significant result that is evident from the graph, minimum days to spike emergence (72.33 days) were taken by plants treated with 200mg L^{-1} of salicylic acid followed by 150mg L^{-1} salicylic acid that took 81.66 days. More number of days to spike emergence were observed in lower concentrations of salicylic acid and untreated plants. Number of leaves $plant^{-1}$ always play a positive role especially in stress conditions as they are the food

factory for plants. So application of high concentration (200 mg L^{-1}) of salicylic acid on gladiolus plants produced more number of leaves (11.78 leaves) that was followed by foliar application of solution containing 150mg salicylic per liter of water. The lowest (6.6 leaves) number of leaves were recorded in untreated plants (Figure 2).



Mean with different letters are significantly different (5% level of significance), CV= 6.01 and LSD= 9.33

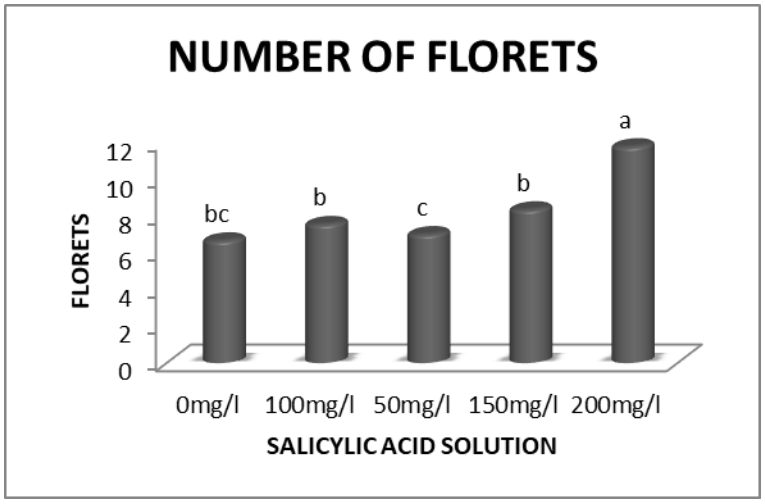
Fig 1. Days to spike emergence as affected by salicylic acid.



Mean with different letters are significantly different (5% level of significance), CV= 6.49and LSD= 0.93

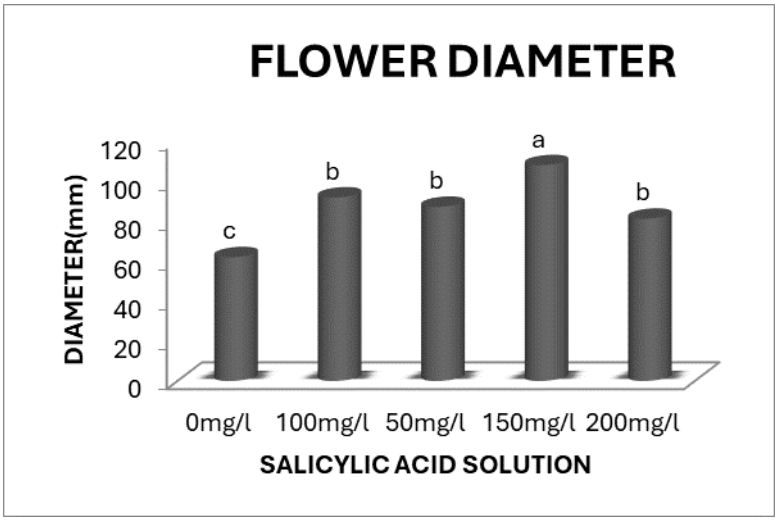
Fig 2. No. of leave/plant as affected by salicylic acid.

The statistical data regarding number of florets per spike revealed highly significant result**,** it is evident from graph (Figure 3). Maximum florets (12.33) were observed in treatment that have 200mg L^{-1} salicylic acid while remaining treatments that have salicylic acid in less amount or even lack salicylic acid recorded less number of florets. Concluded that highest level of SA produced significantly maximum number of florets $spike^{-1}$. One of the most demanding trait of gladiolus by florists is flower diameter. In regards to flower diameter, the statistical data reported highly significant result among salicylic acid levels that is clear from the graph shown in figure 4. Maximum diameter of flowers (108.14 mm) were observed in gladiolus plants sprayed with 150 salicylic acid followed by rest of solutions having 50, 100, 200 mg L^{-1} salicylic acid that were at par with each other. Minimum diameter of gladiolus flowers were produced in untreated plots.



Mean with different letters are significantly different (5% level of significance), CV= 22.17and LSD= 3.43

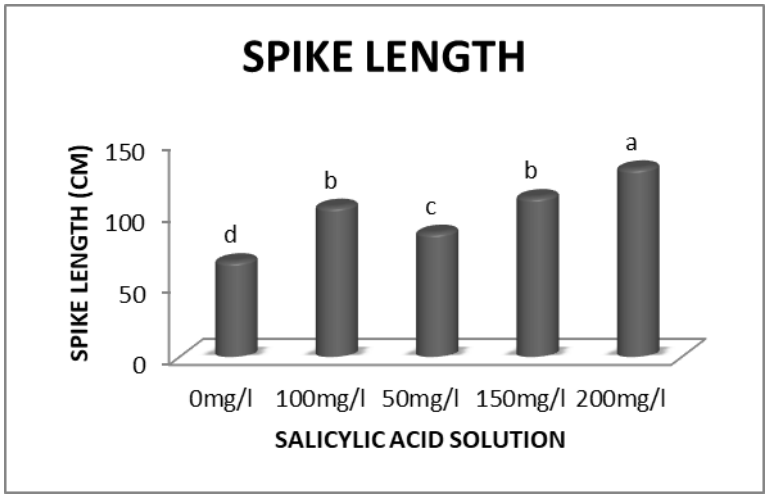
Fig 3. No. of florets as affected by salicylic acid.



Mean with different letters are significantly different (5% level of significance), CV= 7.72 and LSD= 0.94

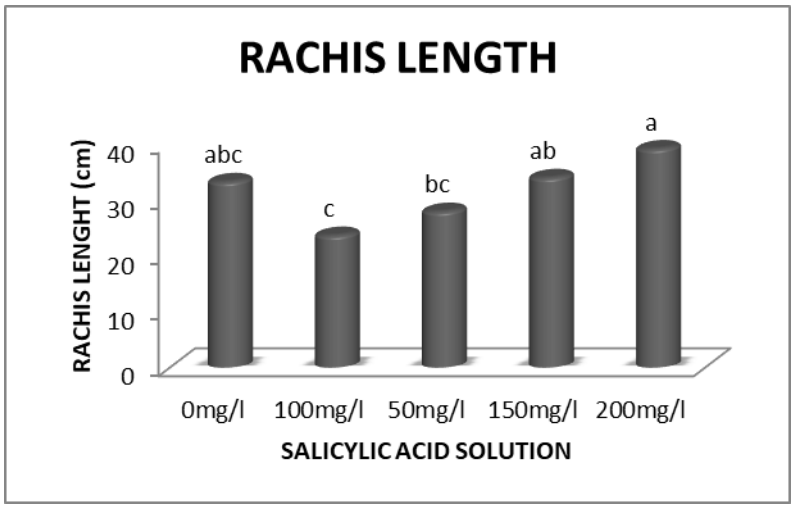
Fig 4. Flower diameter as affected by salicylic acid.

Spike length, rachis length and spike diameter magnifies the beauty of gladiolus cut flower. Large size florets of gladiolus with long spikes, long rachis and thick spikes are the main desire of florists. Application of salicylic acid at the concentration of 200 is fulfilling this desire of the florists, as this concentration of salicylic acid induced long spikes (131.62 cm) and long rachis (39.22 cm) while 150 gm L^{-1} salicylic acid produced maximum spike diameter (7.62 mm) in gladiolus crop. 200 gm L^{-1} salicylic acid produced second thickest spikes of gladiolus. T5 (solution having 200 gm L^{-1} salicylic acid) was followed by T4 (solution having 150 gm L^{-1} salicylic acid) in regards to spike length and rachis length. Solutions having no salicylic acid or salicylic acid in low concentrations recorded worst results regarding spike length, rachis length and spike diameter (Table 5, 6, 7).



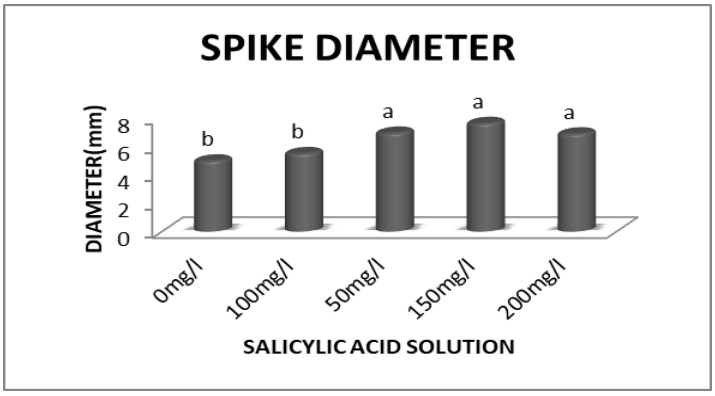
Mean with different letters are significantly different (5% level of significance), CV=9.60 and LSD= 18.45

Fig 5. Spike length as affected by salicylic acid.



Mean with different letters are significantly different (5% level of significance), CV= 13.49and LSD= 11.70

Fig 6. Rachis length as affected by salicylic acid.



Mean with different letters are significantly different (5% level of significance), CV= 7.85 and LSD= 4.45

Fig 7. Spike diameter as affected by salicylic acid.

DISCUSSION

Flora faces various biotic and abiotic stresses like drought, heat, flood, microbes and insects. Defense system of plants against these stresses can be boasted through various signaling pathways that can lead to the production of many defensive chemicals (War et. al., 2011; Vicent & Plasencia, 2011). Phyto-hormones like jasmonic acid, abscisic acid, ethylene and salicylic acid (SA) are the major components of various signaling pathways that are involved in defense system of a plant. Here in this study, various concentrations of salicylic acid exhibited significant effect on growth and flowering of gladiolus. Results unveiled that exogenous application of salicylic acid at high concentrations (200 mg L^{-1}) reduces days to spike emergence. This might be due to the ability of salicylic acid to facilitate plant in nutrients uptake, photosynthesis and stomatal management even under stress conditions (Hayat et al., 2009). When every process in a plant body is doing well without any hindrance then development of a plant may take less time, as Souri & Tohidloo (2019) observed salicylic acid as key regulator of developmental processes. Ram et al. 2012 investigated that increase in concentration of salicylic acid on gladiolus plant reduces days to spike visibility and days to first floret initiation. Moreover, similar effect of salicylic acid was recorded in Gazania by Saeed (2020), who recorded that Gazania plants sprayed with highest level (300 mg L^{-1}) of salicylic acid produced early flowering buds. Gladiolus plants sprayed with high concentrations (200 and 150 mg L^{-1}) produced maximum number of leaves. Similar results regarding number of leaves were observed in African violet by Martin-Mex et al. (2005), who observed 19% more number of leaves as compared to control. Furthermore, our results are also in lined with the outcomes of **Hashish et al. (2015**) and **Qureshi et al. (2015**), who observed similar effect of salicylic acid on *Calendula officinalis*, and *Dianthus caryophyllus*. It is obvious from fact that application of salicylic acid triggers various physiological and metabolic processes that regulate plant growth and development.

Salicylic acid plays a vital role in flower development and flower development related functions in both annual and perennial plants (Luo et al. 2022). Our results also indicates that salicylic acid had a significant effect on florets $plant^{-1}$ and flower diameter. Maximum number of florets and flower diameter were observed in gladiolus plants sprayed with highest concentrations (200 and 150 mg L^{-1}) of salicylic acid. These results might be due to the ability of salicylic acid to improve vegetative growth that can ultimately leads to manufacturing of more photo-assimilates through absorption of more nutrients and photosynthesis (Souri & Tohidloo 2019). Reproductive traits of salicylic acid sprayed plants were improved as salicylic acid leads to production of more auxin (Hayat et al. 2007). Similar results were recorded by Abdou et al. (2014), who observed increase in number of florets $spike^{-1}$ and floret girth of gladiolus with concentrated application of salicylic acid. Furthermore a couple of more findings by Pacheco et al. (2013) and Salehi et al. (2014) are also in agreement with ours, who recorded similar effect of salicylic acid on marigold and petunia flowers.

Salicylic acid also improved the most desirable traits i.e. spike length, rachis length and spike diameter of gladiolus. This might be due to positive effect of Salicylic acid in photosynthesis along with synergism between salicylic acid and auxins (Padmapriya and Chezhiyan, 2002), leads to increase in spike length, rachis length and spike diameter. It acts like a hormone that plays a vital role in plant growth and development along with reproductive attributes. Our results are in lined with the observations of Abdou et al., 2014, who observed that increasing the concentration of salicylic acid increased spike length, rachis length and spike diameter of Gladiolus grandiflorus var. White Prosperity. Similar result regarding spike length was also obtained by Anwar et al., (2014), who observed that highest concentration of salicylic acid produced maximum spike length in tuberose. Salicylic acid is responsible for rapid elongation, cell division and enlargement, so the short spike length and rachis length in control plots might be due to lack of such developmental processes. Regarding spike diameter, Sajjad et al., 2014 reported that increase in concentration of salicylic acid enhances spike diameter of gladiolus plant. 0.01 mm concentration of salicylic improved rosette diameter and flower buds of African violet (Jabbarzadeh et al., 2009), indicates that different concentrations of salicylic have a significant effect on various crops

CONCLUSION AND RECOMMENDATION

Based on results, it can be concluded that exogenous application of various concentrations of salicylic acid had a significant effect on all the observed traits. 200 mg l^{-1} salicylic reduced days to spike emergence and increased

number of leaves plant^{-1}, florets spike^{-1}, spike length and rachis length. Flower diameter and spike diameter were developed much better in 200 mg l^{-1} salicylic sprayed plots than control. But most superior results regarding flower diameter and spike dimeter were observed in gladiolus crop sprayed with 150 mg l^{-1} salicylic acid. Lowest results were observed in gladiolus crop that received weak salicylic dose or no salicylic acid. In short, high concentrations of salicylic acid improved both vegetative and reproductive growth of gladiolus. Based on results, it can be recommended that salicylic acid at 200 mg l^{-1} should be sprayed on gladiolus crop to achieve maximum and good quality yield of gladiolus.

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DOI: https://doi.org/10.15379/ijmst.v11i1.3747