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IMPACT OF SALICYLIC ACID AND HUMIC ACID ON GROWTH AND QUALITY OF CUT IRIS *(Iris × Hollandica)*

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Abstract:

Iris (Iris × hollandica), a prominent species within the Iridaceae family, is widely recognized for its ornamental value and extensive range of flower colors. The Dutch Iris, in particular, holds significant commercial value due to its striking flowers with three distinct petals, making it a profitable crop for floriculture. Iris has been cultivated for ornamental purposes globally and is native to the Northern Hemisphere, with over 299 species documented. Iris flowers, including those found in northern Pakistan, are utilized in perfumes, cosmetics, and traditional medicine.

This study, conducted at the Horticulture Field Area of the National Agriculture Center in Islamabad during the 2020–2021 growing season, aimed to assess the effects of humic acid and salicylic acid on the growth and quality of Iris (Iris × hollandica). Six different concentrations of humic acid and salicylic acid were applied in a randomized complete block design (RCBD), consisting of six treatments (one control and five experimental treatments) with three biological replications. Parameters assessed included plant height, number of leaves, flowering time, stem diameter, spike length, flower count per plant, leaf length, bulb count per plant, bulb weight, bulb size, proline content, and vase life. The results revealed that treatment with salicylic acid and humic acid at a concentration of 0.75 mg/L resulted in significant improvements in key growth and quality parameters. Specifically, this treatment increased plant height (55.27cm), flower number by (2.88) and bulb weight by (30.44g) notably it also enhanced the vase life of the flowers by (10 days), which is critical for post-harvest quality. Among the tested concentrations (ranging from 0.25mg/L to 0.75 mg/L), 0.75 mg/L was found to be most effective in enhancing growth and quality parameters. Statistical analysis indicated that these results were significant at (0.05). These findings suggest that the combined application of salicylic acid and humic acid at this concentration can be an effective strategy to enhance both vegetative and reproductive growth, as well as the marketability of Iris flowers. The outcomes of this research provide valuable insights for improving the quality and yield of Iris production in commercial floriculture.

Introduction

Cut flowers is the world's largest market in the flowers world, worth US$ more than 49 billion annually. Pakistan earns US $126 million from external exchange, with 10-12 tons of flowers produced annually. The flower industry can be extended by raising the standards of floriculture products, Pakistan is blessing with a perfect weather and geographic place for growing flowers. It can be a money-making profession for small farmers with smallest cost. The cut flower Iris (Iris× hollandica) is a major Iridaceae family cut flora. Iris is very significant and has a wide range of colors. Therefore, commercially growing Iris cut flora can be a good source of income for farmers. Among the fall bulbs, because of it has perfect three great petals and showy-flowers, the Dutch Iris gives good price. Due to its attractive and multi-colored flowers, Iris has been used as an ornamental plant in gardens and parks since ancient times. In the north more than 299 species of iris were naturally circulated logically in the Northern Hemisphere (Ramzan, Hassan & Mushtaq, 2018). Germanic iris L. (Iridaceae) is distributed widely in most parts of the world and is also present in Pakistan's northern regions.

In perfumes and cosmetics, the essential oils of the plant find application. In folk medicine, various components of plants are used to treat different diseases. The plant's rhizome is used in traditional preparations. Rhizome juice is added to the sores and for the removal of skin freckles. In dropsy and as anti-spasmodic, emmenagogue, stimulants, diuretic, aperient and gallbladder diseases, decoction of the roots of the plant is used. Iridals found in the rhizomes demonstrated powerful pesticide activity at an absorption of less than 1 μg / mL and showed effective anti-cancer activity as well. It is sometimes used as a blood purifying component (Asghar, Aziz, Ahmed, Hussain & Choudhary, 2009).

There are more than 299 species of flowering plants in the north-temperate genus Iris. This genus is the biggest and most difficult in the family of Iridaceae. It is common all-over North America and Eurasia. Its distinction center is located in China and extends to the Middle East (Ancient Mediterranean region). However, 59 species are found in China, 37 in Turkey, 12 in India, 16 in Pakistan, and 3 in Egypt. Iris species have been cultivated since ancient times as ornamental flowers. These Irises had their attractive and typically perfumed blossoms in a large range of colors. Iris species have become very famous because of their sweet violet scent which is concerned in the scent and cosmetics businesses. Several members of the genus Iris were often use for treating various diseases as traditional folk medicine. In traditional European folk medicine, the use of the underground sections of many Iris species has been well known. Many Iris species' rhizomes (Iris pseudacarius and Iris germanica) have been used in Anatolian folk medicine as a diuretic drug, carminative and against stomachache and constipation. Some Iris species in China also have a long history of medical usage (Wang, Cui & Zhao, 2010).

Iris is beautiful cut flower and garden plants. It taken name from the Greek words from the rainbow. It referring the wide variety of flower color. Iris flower has an ornamental valuable flowering plant. It has a commercial value as a cut flower. However, it has short vase. Some abiotic and biotic factor are influence. Longevity exhaustion of carbohydrate and supply of sensitivity of ethylene xylem obstruction and infection by microorganism (Finger, & Bosa, 2006). It requires proper temperature for viability of cut flower. Temperature is very important factor which affect the quality and quantity of cut flowers (Ahmad, Tahir & Sharihi, 2013). Iris laevigata Fisch. (Iridaceae) belongs to a wide species containing 290 herbaceous types that flourish in the northern hemisphere's moderate regions (Wilson, 2006). Because geographically, Laevigata is limited to a very small number of locales in Korea, it is known as Particularly occasional and threatened as 2nd-grade of the country's plant species (Lee, Lee & Kim, 2018).

Salicylic acid is including to be important hormone because it has many function in plant metabolism (Popova, Pancheva & Uzunova, 1997). It is extracted primary from willow trees and named after Latin words salix. Salicylic acid is important factor they help in growing and

development of plant then in response against the environmental stresses. It also helps in ion transport and uptake (Mohammadi, Salehi & Shahdneghad, 2014). Iris (Iris hollandica) is an essential cut flower. In the cut flower industry, its exquisite petals have made a difference as others cut flowers, it has a problem of short vase life among another cut flower. So, using plant hormones may help to improve the vase life of cut flower. Salicylic acid is a plant hormone, takes different functions of plant physiological as well as biological processes. During the conditions of stresses, by controlling plant responses to pressures. (Ramzan, Hassan & Mushtaq., 2018). Salicylic acid (SA), is plant growing controller, has been originate to produce a broad range of plant metabolic and physical responses that influence plant growth and growth. We have concentrated in the present analysis on different inherent biosynthetic paths, Interplay between SA and MeSA, its transportation and signaling over long distances. The impact of SA's exogenic application on bio-productivity, development, photosynthesis, the relationship water plants, the different actions of enzymes, and their impact on plants (Hayat, Hayat, Irfana & Ahmad, 2010).

Carnation is one of most important cut flowers popular in world wise. Carnation is high ethylene sensitive and short cut life of carnation flower. The most importance problem of carnation cut flower is short vase life. Salicylic acid extends the vase life of cut flower they reduce the ethylene and ROS production. The permeability plasma membrane of florets cell and improve chloroplast structure which are badly damage by ethylene. Salicylic acid. (Kazemi, Hadavi & Hekmati., 2011). Humic acid is a hypothetically natural source that can be used to development the availability, growth, and produce yield of nutrients soil. It is a commercial product that can help plant growing by enhancing nutrient approval and hormonal effects. Its effects on gerbera's (*Gerbera jamesonii* L.) growth, function- and micro nutrients profile and shelf life. It substantially improves macro and micronutrient content of flowers leaves and scales counting nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), iron (Fe), and zinc (Zn). Higher levels of humic acid (HA) increase the flower vase life after harvested, and may avoid and postpone incidence of bent neck.

Most possibly, these response in postharvest due to the buildup of Ca in scapes and HA hormone-like activity (Nikbakht et al., 2008). The helpful effects by humic acid are exposed directly on the plant development and increase in absorption of nutrients from the soil by the plants. Humic acid is constant with nature and is not unsafe for the plant and atmosphere. Humic Acid application significantly improved photosynthetic productivity and chlorophyll level. It not only encourages the vegetative growth but also increase in floral growth as maximum number of florets per spike (Ali et al., 2017). The reason of the experiment was to improve the quality production of iris cut flower. The problem of crop is low quality production and short vase life of iris flower. The main objective of this research was to check the impacts of humic acid on vegetative and reproductive growth of iris flower and to evaluate the effect of salicylic acid on quality production of iris flower. The possible outcome is to increase the quality production of iris cut flowers.

Review of Literature

In the early 20th century, with rapid advances and improvements in cut flower processing, storage, classification and marketing, world flower processing gained great importance on a commercial scale. By means of this shift, new techniques and innovations are being used from production to consumption in the cut flower industry (Boran, 2008). Flower gardening has now become single of the main high-value cultivated businesses in several countries round the world. An annual foreign business in cut flower is round more than US$ 11 billion and flowers account for 59 percent of the world's floriculture trade. Global exports have risen more than tenfold, from 0.5 billion in 1990 to 5.2 billion in 2005, which is valued to double in 2025, compared to 0.5 billion in 1990 (Singh, Dwivedi & Dwivedi, 2008). The flower trade in Pakistan is mostly focused round the big cities such as Karachi, Lahore, Islamabad, etc. and is also rotating towards

a wealthy professional in Pakistan. Flower business is therefore likely to grow with increased demand for flowers for the number of values. But floriculture remained a quite neglected segment of agriculture, unfortunately in the country's agrarian economy (Manzoor, shahid & Baluch, 2001).

Iris (iris hollandica) is beautiful cut flower. Belong to the family of Iridaceae. Dutch iris has worth prices. Due to its large good petals and impressive flowers. Iris cut flower is used in footpath parks and gardens as ornamentals in the natural hemisphere. More than 300 species are distributed due to its beauty and multi colored flowers. The function of nutrient management is important from all over the factors affects the growth and development of plant good nutrient. Improve the growth and development of healthy plants by provide resistance against the disease pest and insects. The best care is need to provide suitable nutrient elements phosphorus nitrogen potassium. They are elementary element which play a main role in making of flowers production and quality (Parveen, Alizai, Shah, Ali & Kakar, 2015). Iris is beautiful cut flower and garden plants. It taken name from the Greek words from the rainbow. It referring the wide verity of flower color. Iris flower have an ornamental valuable flowering plant. It has a commercial value as a cut flower however it has short life and limited length storage and vase life. Some abiotic and biotic factor are attack. Longevity exhaustion of carbohydrate and supply of sensitivity of ethylene xylem obstruction and infection by microorganism (Finger & Barbosa, 2006). It requires proper temperature for viability of cut flower temperature is very important factor effect the quality and quantity of cut flowers (Ahmad, Tahir & Shahri, 2013).

Salicylic Acid

Salicylic acid (SA), is plant growing controller, has been originate to produce a broad range of plant metabolic and physical responses that influence plant growth and growth. We have concentrated in the present analysis on different inherent biosynthetic paths, Interplay between SA and MeSA, its transportation and signaling over long distances. The impact of SA's exogenic application on bio-productivity, development, photosynthesis, the relationship water plants, the different actions of enzymes, and their impact on plants (Hayat, Hayat, Irfan & Ahmad, 2009).

There has also been consideration of susceptibility to different biotic and abiotic stresses. Due to its numerous regulatory functions in plant metabolism, SA is known as a potent plant hormone. (Popova, Pancheva, lexandra, & Uzunova, 1997). "It was first taken from willow trees and named after the word" Salix "in Latin. SA has been originated to show a key part in controlling and the development, development and response of plants to environmental stresses. In answer to various infective attacks, it is considered to be a significant signaling molecule which is involved in home-grown and endemic disease fight in plants. (Enyedi, Yaipani, Silverman & Raskin, 1992).

In addition to providing the plants with disease resistance, it can control plant responses to a wide range of oxidative stresses. SA also suppressed the activities of ACC oxidase and ACC synthase and the ethylene biosynthesis and thus delayed the climatic increase in the production of ethylene in fruit of kiwi. (Zhang & Long, 2002). SA is shown to interfere with the biosynthesis or function of ethylene, cytokinin’s and abscisic acid in plants (Mohammadi, Salehi & Shahdadneghad, 2014).

Salicylic acid (SA) is new plant growth regulator that function as signaling molecule in plants under abiotic and biotic stresses. it has a stimulatory effect on a variety of physiological plant growth processes, but its relationship with leaf pigments and flowering is less well understood. Marigold is the most commonly grown ornamental plant, botanical it is belonging to family Asteraceae. These different concentrations of salicylic were used, SA was improved leaf pigments in Marigold flowers, according to these results based, it is recommended that marigold plants be sprayed exogenously with a 120 mg/L SA concentration earlier flowering, earlier sprayed help to improve growth and flower development of Marigold flower. (Basit, Shah, Rahman, Xing, Zuo, Han & Khalid., 2018).

Humic Acid

By enhancing uptake of nutrient as well as through impact of hormones, humic acid (HA) can promote plant growth and developments. Studies have been performed to examine the impact of a combination of calcium and HA on the calcium deficiency-sensitive Oriental lily. Two concentration of Ca amounts (3.5 and 7.0 meq/L) were combined with 500 mg/L of HA and added to the Lilium Oriental hybrid 'Sorbonne' nutrient solution. The Plant growth, and physical response and macro- and micro-nutrient content were measured for roots leaves, and stems. The outcomes display that plant growth and root development were encouraged significantly by low level of Ca (3.5 meq / L) and HA. Compared with the CK procedure, the flowering cycle began eight days earlier and the active absorption region of the surface roots was 29.41 percent developed. Often, the, Low amount of Ca can be help in increased the chlorophyll content of the leaves, and when low concentration Ca was combined with HA, the proline content increased dramatically. The Ca application successfully increased the leaf's iron and 'potassium content and increased the stems' phosphorus content. HA has amazingly increased the nitrogen level in the leaves and the zinc in the roots (le, Yung, yun, wei, Nikbakht & ping, 2012). Humic acid (HA) is a relatively stable product of organic matter decay and thus accumulates in environmental condition. The purpose of study was to monitor the impact of foliar application of humic acid on growth and characteristics of the flower Petunia hybrid L; such as dry and fresh weight of shoot and root of the flower, height, tillers and flowers, Leaf area index (LAI), chlorophyll content, and the relative water content (RWC) and absorption of micronutrient. (Fe, Zn, Cu, Mn). A pot trial was shown in a completely randomized design with five treatments of Humic acid. These are different concentration (0, 100, 300, 600 and 900 ppm) and three replications. Data was concentration, increased all assess growth traits and micronutrient absorption compare than control at statistical level of 1% and 5%, beneficially (Boogar, Shirmohammadi & Geikloo, 2014). HA application.

Materials and Methods

Experimental Site

The research was conducted field area of National Agriculture Research Center Islamabad, during the year 2020-2021.

Plant Material

Iris bulbs was obtained from NARC Islamabad, Pakistan. I was used white verity of iris cut flower.

Experimental Design

The experiment was carried out using Complete Randomize Block Design (RCBD) with six treatments and three replications.

Table -1 Treatments with Concentrations

Treatments	Chemicals	Concentrations (mg / L)
T_0	Control	Distill water
T_1	Humic acid	0.25
T_2	Humic acid	0.50
T_3	Humic acid	0.75
T_4	Salicylic acid	0.25
T_5	Salicylic acid	0.50
T_6	Salicylic acid	0.75

Parameters

Pre harvest Parameters

Plant height (cm)

Height of plant was measured from root surface level to tip in centimeter with the help of scale and later average was taken.

Spike length (cm)

The spike length was measured from the base of plant up to flower base. Spike length was measure with the help of scale.

Numbers of leaves

Number of leaves plant^{-1} was counted and then average was taken. And the number of leaves was counted of selected plants.

Leave length (cm)

Leaf length was calculated as length of the leaf from the base to the leaf tip leaves length was measure with the help of scale.

Stem diameter (mm)

The diameter of the leaves was measured with the help of a Vernier calliper

Days to flower

The number of days from planting till the initiation of flowers.

Number of flowers

Numbers of flower was counted and then the average will be calculated. Number of flowers was counted of selected plants.

Numbers of bulbs/ plant

Total number of bulbs per plant was counted.

Weight of bulb (g)

Fresh weight of each bulb was measured with the help of an electrical balance (mg).

Size of bulb (mm)

Size of each bulb was measured with the help of vernier caliper (cm).

Physiological Parameters

Prolein content (μ mol g^{-1})

Prolein was extract by nin hydrin base method

Post-Harvest Parameter

Vase life

Vase life of flower was counted after harvest, the flower shows wilting petals or lost their original appearance and which leads to senescence's of flower. Number of days was counted to estimate the vase life of iris cut flower.

Statistical Analysis

The experiment was conducted in Complete Randomize Design (CRD) with six treatments and three replications. Variables from different experiment was statistically analyze and studied by using software statistical 8.1, through Analysis of Variances (ANOVA) techniques and means was compared using Least Significant Difference (LSD) test at 5% level of significance.

Results and Discussion

The research was conducted at the field area of National Agriculture Research Center Islamabad, during the year 2020-2021. The study was carried out to study the impact of humic acid and salicylic acid on quality and growth of Iris (Iris × hollandica). Six levels of both humic acid and salicylic acid were used. The trails were planned in randomized complete block design. Results obtained for different parameters and collection observed during the study are discussed below.

Morphological Parameters

Plant Height (cm)

The data regarding plant height was shown in Table-1. The results exhibited that plant height was significantly affected by different levels of salicylic acid and humic acid. The results shows that the maximum plant height (56.667 cm) was observed in humic acid @ 0.75 mg/L followed by Salicylic acid (53.889 cm) at similar concentration. Salicylic acid also shown the better result at the level of 0.75 (53.889 cm). While the least plant height (39.33 cm) was observed at control. (48.556 cm). Among growth regulators, both salicylic acid and humic acid were efficient to increase plant height while among concentration comparison 0.75 mg/L were more efficient.

Application of HA increases soil aggregation, structure, fertility, and moisture holding capacity, and rises activity of microbial (Chen and Aviad, 1990), mirobial population, and cation exchange capacity (Marinari, Masciandaro, Ceccanti, & Grego, 2000). The positive effects of humic acid (HA) such as growing cell membrane permeability, oxygen uptake, respiration and photosynthesis, phosphate uptake, and help in roots elongation. In particular, the photosynthetic productivity and chlorophyll contents of Lolium perenne (rye-grass) were significantly improved by humic acid (HA) application (Russo and Berlyn, 1990), foliar application of humic acid. It was recorded that T_6 had maximum plant height which may be due to the application of salicylic acid (SA). It improves the height of plant.

Salicylic acid (SA) which had eventually not enough for growing process like cell division and cell enlargement that was shows that salicylic acid has a significant role in plant life. This result is related to (Hayat, Ali & Ahmad, 2007). He described that the exogenous use of salicylic acid (1 and 2 mM) improved shoot, root and total plant dry weight and salicylic acid defense the reproductive development. He was investigated exogenous application of salicylic acid. Salicylic acid applying different concentration of salicylic acid, at the level of 200 mg L^{-1} recorded the highest plant height, various concentration of salicylic acid enlarged plant height meaningfully in different cultivars of zinnia salicylic acid is a simple phenolic compound enable plant to withstand various soil and environmental condition and can be applied on many ways, which

plays an important role in regulation of plant growth and development and physiological processes as whole. Various treatments increased almost all contents of nutrients and hormonal regulation in plants. SA increased plant height and activity of photosynthetic rate and increased in plant (Misra & Saxena., 2009).

Table -1: Effect of humic acid, salicylic acid on plant height (cm) of iris flower

Concentration (mg/L)	Humic acid (cm)	Salicylic acid (cm)	Mean
Control	39.333^{d}	39.333^{d}	39.333^{c}
0.25	43.556^{c-d}	48.556^{b-c}	46.056^{b}
0.50	46.778^{b-c}	49.444^{a-b}	48.111^{b}
0.75	56.667^{a}	53.889^{ab}	55.278^{a}
Mean	**46.583^{a}**	**47.806^{a}**	

Spike Length (cm)

The presenting data for spike length that was shown in Table -2. The results exhibited that spike length was significantly affected by different levels of Salicylic acid and humic acid. The results shows that the maximum spike length (53.444 cm) was observed at the level 0.25mg/L salicylic acid and at 0.75mg/L humic acid also shown best results that is (44.889 cm). While the least spike length (32.222 cm) was observed at control. Among growth regulators, both salicylic acid and humic acid were efficient to increase spike length while among concentration comparison 0.75 mg/L were more efficient.

Salicylic acid plays an important role in flower stem length, while gave best result in growing stem elongation in different ornamental plants. The length of flower stem increased as level summarized of salicylic acid, occurred cell elongation and cell expansion. This hormone acting on contribution in the combination of specific different proteins like kinase protein that was played an important role in the regulation of cell division, variation and cell structural formation. (Yusuf, Hayat, Alyemeni, Fariduddin & Ahmad., 2013).

These results revealed to my research. The application HA increased spike length which established the role of HA in cultivating nutrient uptake and in turn improved spike length and whole flower quality. Similar results of improvement in nutrient uptake mainly of N, P, and S by the activity of HA have also been described by (Arancon, Lee, Edwards & Atiyeh, 2003).

Table -2 Effect of humic acid and salicylic acid on spike length of iris flower

Concentration mg/L	Humic acid (cm)	Salicylic acid (cm)	Mean
control	32.222^{f}	32.222^{f}	32.222^{b}
0.25	39.556^{e}	53.444^{a}	46.500^{a}
0.50	41.778^{de}	48.111^{bc}	44.944^{a}
0.75	44.889^{cd}	49.778^{ab}	47.333^{a}
Mean	**43.208^{a}**	**42.875^{a}**	

Number of Leaves Per Plant

The data regarding number of leaves per plant that was shown in Table -3. The results

exhibited that number of leaves per plant was affected by different concentration of salicylic acid and humic acid. The maximum result was shown at the level of 0.50 mg/L humic acid that is (7.777) and the minimum result was shown at control. Salicylic acid was shown better results at the concentration of 0.25 mg/L that is (7.4444). Among growth regulators and concentrations, highest result was recorded for number of leaves per plants 7.5556 at the level of 0.50 mg/L.

Salicylic acid was meaningfully affected number of flowers per plant it was apply different concentration of salicylic acid on different flower, 100 mg/L salicylic acid showed the beneficial result as compare to control. Maximum number of leave per plant were recorded at the level 100 mg/L and minimum result was found at control. Salicylic acid due to its self-protective feature induced a defensive mechanism under opposed environmental conditions in plant physiology, precise functions of certain directly enzyme directly or accelerate related genes responsible for defensive control induces specific changes in leaf number and chloroplast structure has vital contribute in the energy status of plants, subsequently plant use two photosystems in series to generate ATP and reduce NADPH enough energy are used to form organic molecules, translocation and storage of this assimilates enable plant caused in beneficial increased of leaf numbers. Using various concentrations produced prominent increased in leaves of soybean. (Fazal ullah., 2017)

Humic acid different levels showed an important variation in number of leaves per plant. It is due to the ability of humic acid to stimulate the activities of hormones in plants and also increase plant growth, number of leaves per plants, plant height, and nutrients uptakes and ability to tolerate stresses (Nardi, Pizzeghello, Muscolo, & Vianello, 2002).

Table-3 Effect of humic acid and salicylic acid on number of leaves per plant of iris flower.

Concentration mg/L	Humic acid	Salicylic acid	Mean
control	7.1111[a]	7.1111[a]	7.1111[a]
0.25	7.5556[a]	7.4444[a]	7.5000[a]
0.50	7.7778[a]	7.3333[a]	7.5556[a]
0.75	7.3333[a]	7.3333[a]	7.4444[a]
Mean	**7.5000[a]**	**7.3056[a]**	

Leaves Length (cm)

The data regarding leaves length was shown in Table 4.4. The results exhibited that leave length was significantly affected by different levels of salicylic acid and humic acid. The maximum leaves length was recorded at the level of 0.75 mg/L salicylic acid (51.333 cm) and humic acid also show the best result the value of 0.25 mg/L (45.444). While the least leaves length (34.000 cm) was observed at control. Among growth regulators, both salicylic acid and humic acid were efficient to increase leaves length while among concentration comparison 0.75 mg/L SA were more efficient.

The application of humic acid to plants provides sustenance for the growing plants, and it also results in productive and rich soil, which increases the soil's water holding capacity. It promotes in the resistance of plants to drought stress and also promotes germination. The use of humic acid minimizes the need for additional fertilizers. Humic also improves crop production, soil aeration, and drainage. The application of humic compounds can increase the protein and mineral content of most crops. Humic compounds were used to boost yields in soybeans, potatoes, and algae

cultures. (Syabryai, Reutov & Vigdergauz., 1965). He explained that the application of different concentration of humic acid on different vegetables.

The presented data regarding different concentration of SA. The maximum result showed at the level of SA 1Mm/L leaf length was (47.5). The satisfactory effects of SA could be due to auxin with synergism. Leaf length increased at high level of SA. These results is similar to my results as The macro and micro element content of leaves and roots were generally increased by the application of salicylic acid. Salicylic acid is more effective for growth and development of leaves length. (Tuna et al., 2007).

Table -4 Effect of humic acid and salicylic acid on leaves length of iris flower.

Concentration mg/L	Humic acid (cm)	Salicylic acid (cm)	Mean
Control	34.000^{b}	34.000^{b}	34.000^{b}
0.25	45.444^{ab}	45.333^{ab}	45.389^{a}
0.50	43.000^{ab}	48.556^{ab}	45.778^{a}
0.75	40.556^{ab}	51.333^{a}	45.944^{a}
Mean	**40.750^{a}**	**44.806^{a}**	

Stem Diameter (mm)

The data was regarding stem diameter of iris flower. The effect of salicylic acid and humic acid on stem diameter of Iris flower. Results were exhibited in Table 4.5. The maximum stem diameter was noted at SA @ 0.50 mg/L (10.124 mm). Followed by same concentration of humic acid 0.50 mg/L. At the level of 0.75 mg/L humic acid stem diameter is (8.154 mm) that was a good result and minimum result was recorded at T_0 control (4.498 mm) untreated. The stem diameter with response to the application of different levels of humic acid and salicylic acid. Among growth regulators, both salicylic acid and humic acid were efficient to increase stem diameter while among concentration comparison 0.75 mg/L were more efficient.

Salicylic acid plays an important role in flower stem length, while gave best result in growing stem elongation in different ornamental plants. The length of flower stem increased as level summarized of salicylic acid, occurred cell elongation and cell expansion. This hormone acting on contribution in the combination of specific different proteins like kinase protein that was played an important role in the regulation of cell division, variation and cell structural formation. (Zhang & Klessig, 1997).

It was seen that plant height, Leaf area and stem diameter increased gradually when increased humic acid concentration. These observations are in accordance with the findings of (Turkmen et al., 2004). who reported that there is a significance effect of different levels of humic acid (0, 500, 1000 and 2000 mg kg−1) on plant height and vegetative growth for stem elongation that improved by increasing the HA concentration as per plant requirement

Table -5 Effect of humic acid and salicylic acid on stem diameter of iris flower

Concentration mg/L	Humic acid (mm)	Salicylic acid (mm)	Mean
control	4.498^{c}	4.498^{c}	4.4977^{c}
0.25	5.252^{c}	9.777^{ab}	7.5147^{b}
0.50	5.266^{c}	10.124^{a}	7.6950^{b}
0.75	8.154^{b}	9.890^{ab}	9.0224^{a}
Mean	**5.7925^{b}**	**8.5724^{a}**	

Days to Flower

The data regarding to the foliar application of different levels of humic acid and salicylic acid. That was shown in table -6 The results exhibited days to flower. The maximum days to flower was recorded at T_0 control days was taken 155.33 there was treated of humic acid and salicylic acid. The maximum results at 0.75 mg/L SA days were taken 150.89. That was significant results with respect to other concentration of humic acid and salicylic acid. Salicylic acid. Among growth regulators, both salicylic acid and humic acid were efficient to days to flower while among concentration comparison 0.75 mg/L were more efficient.

Primary flowering and floral bud sprouts have been encouraged by salicylic acid concentrations because this stimulating representative accelerates biosynthesis of secondary metabolites. SA as a manager of blooming time, Interacts with both photoperiod-dependent and self-governing pathways. (Martínez, Pons, Prats & León, 2004). Salicylic acid stimulated start of flowers subsequently involved in the physiological developments. (Hayat, Hayat, Irfan & Ahmad, 2010). The molecular mechanisms of salicylic acid involved in the bud- stimulating actions just like phenolic nature substances because of this harmonic performance could act as natural regulators or act collected with growth substances, by the purpose metabolism of indole-3-acetic acid can be shifted in attendance of phenolic chemicals. SA applied as spray form promote formation of pods and flowers in the treated plant (Kumar, Dube & Chauhan, 1999).

Table-.6 Effect of humic acid and salicylic acid on days to flower of iris flower.

Concentration mg/L	Humic acid	Salicylic acid	Mean
Control	155.44[a]	155.33[a]	155.33[a]
0.25	155.11[a]	152.11[c]	153.11b
0.50	154.44[a]	151.68[cd]	153.56[b]
0.75	152.67[c]	150.89[d]	151.78[c]
Mean	**154.39[a]**	**152.50[b]**	

Number of Flowers Per Plant

There regarding data the number of flowers per plant. Results exhibited in the table 4.7. The highest number of flowers were noted at 0.25 mg/L SA and 0.75 mg/L SA number of flower (3.6667) both were exhibited the similar result. And humic acid was shown the better results at the level of 0.50 mg/L (2.6667). While the minimum number of flowers were recorded at T_0 control (1.5556). Among growth regulators, both salicylic acid and humic acid were efficient to increase number of flower per plant while among concentration comparison salicylic acid was efficient.

These findings exhibited that the humic acid and salicylic acid applied as foliar spray were needed for the plant's growth and contributed towards better growth of iris flower in terms of number of flowers per plant.

200 mg L^{-1} SA was applied Zinnia dahlia. Salicylic acid enhances immunity system of plants through nonstop supply of nutrients and well-acted responses to environmental stresses, an important signal molecule altered physiological regulation. Eventually it was documented that demonstrating in all species belonging to different families, it is also concluded that the use of this compound increased number of inflorescences in plants (Hayat, Ali & Ahmad, 2012).

Exogenous application stimulated large number of floral buds per plant (Bahat. Alirezaie, & Neamati., 2007). The use of like as salicylic acid substitutes a creditable crop management technique to improve the number of inflorescences in marigold plants, in reserve to the exceptional effect on inflorescence production. Humic acid was not only increased vegetative growth of flowers but also floral growth improved as high number of flowers per spike were

produced by plants applied with three applications of HA and NPK. These results were related with the findings of (Nikbakht et al., 2008).

Table -7 Effect of humic acid and salicylic acid on number of flowers per of iris flower.

Concentration mg/L	Humic acid	Salicylic acid	Mean
control	1.5556^{d}	1.5556^{d}	1.5556^{b}
0.25	2.2222^{c-d}	3.6667^{a}	2.9444^{a}
0.50	2.6667^{b-c}	3.0000^{a-b}	2.8333^{a}
0.75	2.1111^{c-d}	3.6667^{a}	2.8889^{a}
Mean	**2.1389^{b}**	**2.9722^{a}**	

Number of Bulbs per Plants

The regarding data for number of bulbs that was shown in Table -8. The results exhibited that number of bulbs was beneficially affected by different levels of Salicylic acid and humic acid. The results shows that the maximum number of bulbs (3.5556) was observed in salicylic acid @ 0.75 mg/L followed by humic acid (1.7778) at similar concentration. Humic acid also shown the best result at the level of 0.75 (20000). While the least number of bulbs (1.5556) was observed at control. Among growth regulators, both salicylic acid and humic acid were efficient to increase plant height while among concentration comparison salicylic acid was more efficient.

Table -8 Effect of humic acid and salicylic acid on number of bulbs of iris flower.

Concentration mg/L	Humic acid	Salicylic acid	Mean
Control	1.5556^{c}	1.7778^{b-c}	1.6667^{b}
0.25	1.7778^{b-c}	2.3333^{b-c}	2.0556^{b}
0.50	1.7778^{b-c}	2.5556^{b}	2.1667^{b}
0.75	2.0000^{b-c}	3.5556^{a}	2.7778^{a}
Mean	**1.7778^{b}**	**2.5556^{a}**	

Weight of Bulbs (g)

The data regarding for weight of bulbs. The data regarding was shown in the table-.9. The recorded data was pertaining to response the application of different concentration of humic acid and salicylic acid. The recorded data that was shows that the maximum result was exhibited at SA 0.50 mg/L bulb weight was (31.333 g). that was significant t result followed by control. The minimum result was noted at 0.50 mg/L HA weight of bulbs was (23.222 g). Among growth regulators, both salicylic acid and humic acid were efficient to weight of bulbs while among concentration comparison 0.75 mg/L were more efficient. Different level of salicylic acid was applied as foliar spray to lily plants. That was showed highly significant results for weight and size of bulbs. At the level of 50 mg L^{-1} largest weight and size of lily bulbs were recorded. Increase in weight and size of bulbs was found in response to salicylic acid treatment (Sudhakar and Kumar, 2012; Naveen and Chandrashekar, 2008).

Table -9 Effect of humic acid and salicylic acid on weight of bulbs of iris flower

Concentration mg/L	Humic acid (g)	Salicylic acid (g)	Mean
control	27.444^{b-c}	27.444^{b-c}	27.444^{b}
0.25	23.667^{d}	24.111^{c-d}	23.889^{c}
0.50	23.222^{d}	31.333^{a}	27.278^{b}
0.75	30.000^{a-b}	30.889^{a-b}	30.444^{a}
Mean	**26.083^{b}**	**28.444^{a}**	

Size of Bulbs (mm)

The data regarding was size of bulbs that was shown in Table -10. The results exhibited that size of bulbs was significantly affected by different levels of Salicylic acid and humic acid. The results shows that the maximum size of bulbs (37.111 mm) was observed in humic acid @ 0.25 mg/L followed by Salicylic acid (53.89) at similar concentration. Salicylic acid also shows the best result at the concentration of 0.75 mg/L (36.667 mm). While the least size of bulbs (31.444) mm was observed at control. Among growth regulators, both salicylic acid and humic acid were efficient to increase plant height while among concentration comparison 0.75 mg/L were more efficient. The Humic Acid enhanced nutrient absorption. The encouraging effects of Humic acid is directly on the plant growing and improve the shoots and roots development, absorption of, calcium, magnesium, phosphorus and nitrogen, potassium by plant. Humic acid is stable with nature and is not hazardous for the plant and environment (Haghighi, Nejad & Lack., 2011).

Table -10 Effect of humic acid and salicylic acid on size of bulbs of iris flower.

Concentration mg/L	Humic acid (mm)	Salicylic acid (mm)	Mean
control	31.444^{d}	31.444^{d}	31.444^{c}
0.25	32.333^{cd}	37.111^{a}	34.722^{b}
0.50	35.000^{ab}	34.222^{bc}	34.611^{b}
0.75	36.667^{ab}	36.889^{a}	36.778^{a}
Mean	**33.861^{b}**	**34.917^{a}**	

Physiological Parameter

Prolein Content (µ mol g^{-1})

The data regarding for the prolein content that was shows in Table -11, due the used of different levels of humuc acid salicylic acid. The highest prolein content was rcorded at treatment SA 0.25 @ prolein content was (4.3433) that was hight level of prolein and lowest results was recorded at 0.50 mg/L HA amount of prolein content was(0.962) and SA (0.50) mg/L amount of prolein was (0.9653) both concentration exhibited the similar results.T_0 control exhibited the

significant result as respect to 0.50 mg/L HA and 0.50 SA. Among growth regulators, both salicylic acid and humic acid were efficient to increase Prolein content while among concentration comparison salicylic acid were more efficient.

Table -11 Effect of humic acid and salicylic acid on Prolein content of iris flower.

Concentration mg	Humic acid (µ mol g^{-1})	Salicylic acid (µ mol g^{-1})	Mean
control	1.9637 ^{c}	1.9637 ^{c}	1.9637 ^{b}
0.25	1.7011 ^{c}	4.3433 ^{a}	3.0222^{a}
0.50	0.9622^{d}	0.9653 ^{d}	0.9638^{c}
0.75	1.4987^{cd}	2.9267^{b}	2.2127 ^{b}
Mean	**52.306 ^{a}**	**49.667 ^{a}**	

Post-Harvest Parameter

Vase Life

The regarding data response the various concentration of humic acid and salicylic acid. The maximum vase life of cut flower was recorded at SA 0.75 mg/L for 10.333 days followed by same concentration of humic acid and minimum results was recorded at T_0 control 6.775 days. Among growth regulators, both salicylic acid and humic acid were efficient to increase plant height while among concentration comparison salicylic acid was efficient.

Salicylic acid extends the vase life of cut flower they reduce the ethylene and ROS production. The permeability plasma membrane of florets cell and improve chloroplast structure which are badly damage by ethylene. Salicylic acid (Kazemi, M., Hadavi, E., & Hekmati, 2011).

Salicylic acid SA concentrations increased the highest vase life of cut flower that was observed in 300 mg/L. The addition of 300 mg/L SA to clean distilled water increased the vase life of different cut flowers, *Lilium asiaticum*, Polianthes tuberose Alstroemeria peruviana, Gerbera jamesonii. (Bayat and Aminifar, 2017). Application of salicylic acid at different concentrations increases the vase life in gerbera cut flowers (Kazemi, Zamani & Aran, 2011). Foliar application of salicylic acid at different levels increases the vase life of fresh cut rose flowers (Kazemi, Zamani & Aran, 2011). The application humic acid (HA) might significant growth of plants by improving uptake nutrient and effect of hormone. Higher HA levels improve the vase life of harvested Gerbera flowers by 2-3.66 days and could prevent and delay bent neck prevalence in flowers. (Nikbakht et al., 2008).

Table -12 Effect of humic acid and salicylic acid on vase life of iris flower

Concentration mg/L	Humic acid	Salicylic acid	Mean
control	6.778^{c}	6.778^{c}	6.7778^{c}
0.25	7.000^{c}	8.222^{b}	7.6111^{b}
0.50	7.222^{bc}	10.111^{a}	8.6667^{a}
0.75	7.222^{bc}	10.333^{a}	8.7778^{a}
Mean	**7.0556 ^{b}**	**8.8611^{a}**	

Conclusion

Iris cut flower (Iris× hollandica) is a major Iridaceae family. Iris is very significant and has a wide range of colors. Therefore, commercially growing Iris cut flora can be a good source of income for farmers. Among the fall bulbs, because of it has perfect three great petals and showy-flowers, the Dutch Iris gives good price. Due to its attractive and multi-colored flowers, Iris has been used as an ornamental plant in gardens and parks since ancient times. In the north more than 299 species of iris were naturally circulated logically in the Northern Hemisphere. Iris flower (Iridaceae) is distributed widely in most parts of the world and is also present in Pakistan's northern regions. In perfumes and cosmetics, the essential oils of the plant find application. In folk medicine, various components of plants are used to treat different diseases.

The research was conducted at Horticulture field area of National Agriculture Center Islamabad during the year 2020 – 2021. The study was carried out to study the impact of humic acid and salicylic acid on quality and growth of Iris (Iris × hollandica). Six levels of both humic acid and salicylic acid were used. The data was recorded on the following parameters.

Data was collected on plant height, number of leave, days of flower, stem diameter, spike length, number of flowers per plant, leave length, number of bulbs/plants, weight of bulb, size of bulb, proline content and vase life. The research will be laid out as Randomized Complete Block Design (RCBD) with six treatments, one control and three replications. The results were recorded and summarized.

The current research concluded that the application of salicylic acid and humic acid at the concentration 0.75mg/L in Iris flower showed the better results. It was perceived that treatments of salicylic acid and humic acid increases the vase life of Iris flower.

The results obtained from this study will be helpful in order to increase the quality production of flower and to increase the vegetative and reproductive growth of the flower.

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