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Impact of salicylic acid and humic acid on vegetative and flower bud production of *Lilium* asiatic hybrid Tresor

Pooja Pahare and Dr. S Beura

Abstract
The present investigation the Study the impact of Salicylic Acid and Humic Acid on vegetative and flower bud production of Lilium Asiatic hybrid Tresor was carried out during the year 2018-19 and 2019-20, rainy season under the poly shade net structure of RKVY project, Department of Floriculture & Landscaping at Biotechnology-cum-Tissue Culture Centre Campus, O.U.A.T., Bhubaneswar. The trial was conducted separately for each cultivar with fourteen treatments and the treatments comprised of foliar application of Salicylic acid at T_1 (control), T_2 (250 ppm Humic acid), T_3 (500ppm HA), T_4 (750ppm HA), T_5 (1000ppm HA), T_6 (1250 ppm HA), T_7 (1500ppm HA), T_8 (50ppm Salicylic acid), T_9 (75 ppm SA), T_{10} (100ppm SA), T_{11} (125ppm SA), T_{12} (150ppm SA), T_{13} (175ppm SA), T_{14} (200 ppm SA). The whole experiment was carried out following Randomized Block Design with four replications. Results revealed that T_{14} 200 ppm SA recorded significantly vegetative and flower bud growth. Days for 100% sprouting of bulb, plant height (cm), number of leaves per plant, leaf area, leaf area index, total chlorophyll content, Days to appearance flower bud, Day to colour visibility in bud, Days to bud break, flower bud length (cm), flower bud width (cm) and initial weight of bud (g).

Keywords: Salicylic acid, humic acid, vegetative and flower bud Production

Introduction

Flower is one of the God's beautiful creation in the world. They are symbol of beauty, love, passion and tranquillity. They are the soul of garden and convey the message of nature to mankind. Flowers have a very important role in our life. The importance is not only restricted to beautification but also hold an influential role in the worldwide economy. In India floriculture is a high growth industry and the government has identified this section as a sunrise industry which claim to be 100% export oriented status.

Lilium is an important ornamental bulbous plant. It is known for ages as evident from Shekels stamped by Palestinian coin marker in 143 BC (Bose *et al*., 2003) [4]. Lilium is a symbol of fertility, clarity, chastity and utility. In Christianity lily is a symbol of love that the Archangel Gabrid and the parents Virgin Mary are often depicted holding a lily (Anon, 2005). Romans and Greeks crowned their bride with lilies. Lilium is one of the six major genera of flower bulbs produced worldwide (Hertogh and Le Nard, 1993) [22]. They are produced both as potted and cut flowers and are used in landscaping (Dole & Wilkins, 1999) [6]. It is a species of great economic importance in production and commercialization of cut flower in the international market (Jimenez *et al.*, 2012). Due to its size, beauty and longevity Lilium is one of the ten most superior cut flowers in the world (Thakur *et al.*, 2005) [27].

Lily has been used for different purposes including bouquet formation, decoration of hotels, houses, luxury buildings, marriages and religious ceremonies for over 2000 years (Ramsay *et al.*, 2003) [24]. Besides having ornamental value they also have medicinal properties. Bulb are used for treating tumors, ulcers and inflammations. Dioscorides of ancient Greek signified that lily leaves are emplaced around burns, injury and snake bite. White lily was also used as a cosmetic.

Lilium is native of northern hemisphere upto South Canada and Siberia and their southern limit is Florida and India. At present 100 species of lilium are found in temperate and sub tropical zone of northern India (Nhut, 1998) [23]. The genus lilium belongs to family Liliaceae and comprises over 80 species (Lim *et al.*, 2003) [18]. They are excellent as cut flowers and occupy 4th position followed by Rose, Carnation and Chrysanthemum in the international market. Asiatic hybrids are derived from hybridization of at least 12 species (*viz.*, *Lilium* *amabile. L. bulbiferum, L. concolor, L. dauricum, L. davidii, L. hollandicum, L. maculatum, L. leichtlinii, L. pumilum and L. tigrinum)* of hybrid lily. (Sheikh 2015) [26].

Quality of flower bud production is limited due to soil conditions that are not favourable in many arid and semi-arid parts of the world. High PH values of soil which hinder the absorption of nutrients, and protect to abiotic stress also pose a problem for quality flower production. Foliar application is one of the methods to overcome this problem by providing nutrients necessary for optimal growth. Soil health is a crucial factor for obtaining higher yields of floricultural crops. Poor soil health and structure reduced microbial activities may result in poor crop stand, reduced plant growth and development. Among various management practices followed for higher yield and quality of flowers, nutritional management plays a significant role. Apart from micronutrient (B, Fe, Zn, Cu, Cl, Mn, Mo, Na, I and Co.) and macronutrient (N, P, K, Ca, Mg and S) are equally important which are involved in all metabolic and cellular functions influencing various growth and floral characters plants Macronutrients and micronutrient are to be necessarily taken up by the plants from soil or supplemented through foliar application for good growth and yield of crops and maximizing the efficient use of applied N, P and k. Most of the acid have been found to act as growth regulators. Humic acid (HA) may facilitate plant growth and there were relatively large responses at foliar application by improving the nutrient uptake as well as through hormonal effect in Lilium (Chang 2012) [5]. Salicylic acid (SA) increases the plants response to tolerance and resistance to various diseases affecting plants as it is found that increasing its internal concentration activates the protective role of pathogenic pathogens. (Raskin 1992).

Materials and Methods

The experiment was conducted in the poly shade net structure of RKVY project, Dept. of Floriculture & Landscaping at Biotechnology-cum-Tissue Culture Centre, O.U.A.T., Bhubaneswar during the year 2018-19 and 2019-20, in rainy season. The experiment was conducted on Lilium Cv. Tresor with 14 treatment and four replication in Randomized block design. The experiments were space at 25 cm x 25 cm.

One gram each of active substance of salicylic acid was dissolved in 10 ml of alcohol (C_2H_5OH) and final volume was made up to 1000 ml by adding distilled water and thus Stock solution of 1000 ppm salicylic acid was prepared. The stock solution thus prepared was used by adding distilled water to prepare the required concentration of salicylic acid as per the treatments (SA -50, 75, 100, 125, 150, 175 and 200 ppm) for foliar spray. Care has been taken that all the foliage parts of the plants got uniform application.

Stock solution of desired quantity of HA (5500 mg) was dissolved directly in 5500 ml of distilled water. After that stock solution was made into different parts (0.25, 0.5, 0.75, 1, 1.25 and 1.5 ml) as it is readily soluble in 1000 ml water to make the required concentrations of HA (250, 500,750,1000,1250 and 1500 ppm). These prepared solutions were also applied on plants as foliar spray. Care has been taken that all the foliage parts of the plants got uniform application.

Foliar spray of salicylic acid and humic acid in prescribed concentration of the treatments was undertaken on 30th day of planting of bulbs. The growth substances were sprayed with the help of hand sprayer. The whole plant was sprayed completely by taking precaution to avoid the mixing of sprays from one treatment to another.

Statistical analysis was done by using method of analysis of variance (ANOVA) for randomized block design (RBD) by Fischer and Yates (1963) [7]. Whenever 'F' test was found significant for comparing the means of two treatments, critical difference (C. D. at 5%) was worked.

Results and Discussion

The plant morphological characteristics like Days for 100% sprouting of bulb, plant height (cm), No.of leaves per plant, leaf area (cm), leaf area index (cm), total chlorophyll content and days to appearance flower bud, days to colour visibility in bud, days to bud break, flower bud length (cm), flower bud width (cm), initial weight of bud (g) florets per spike were recorded. All parts of the plants expressively performed well by the foliar spray of HA and SA as well as their combination.

The data on presented in Table 1 the result indicated that all the levels of salicylic acid and humic acid showed significantly earlier 100% sprouting of bulb in comparison to control. However, out of 14 treatments studied, the maximum time (27.00 days during year 2018-19, 25.41 days during year 2019-20 and 25.33 days in case of pooled mean) for sprouting of bulb was recorded under control treatment during both the years of study as well as in pooled Helgl and Rolfe (2005) [11]. Among the different levels of humic acid and salicylic acid, the minimum number of days 100% for sprouting of bulb (21.00, 19.53 and 19.39 days during first, second year and in pooled mean, respectively) were recorded under T_{14} (salicylic acid @ 200 ppm) which was found statistically at par with its higher concentration *i.e.* HA 1500 ppm (T_7). However, both these concentration of SA 200 ppm and HA 1500 ppm) showed their significant superiority over rest of humic acid and salicylic acid concentrations for sprouting of bulb during both the years of study and in pooled mean. The much longer time for 100% sprouting of bulb (27.00, 25.41 and 25.33 days during first, second year and in pooled mean, respectively) was recorded in treatment T_1 (control).

Plant height was significantly improved by all the levels of salicylic acid and humic acid during year 2018-19, 2019-20 and in pooled mean as compared to control. However out of 14 treatment combinations studied, the lowest plant height during first year (61.39 cm at), second year (57.12 cm) and in pooled mean (59.19 cm) was obtained under control T_1 treatment during both the years of study as well as in pooled mean Arya *et al*., (2010) [1]. Among the different concentrations of salicylic acid and humic acid, the tallest plants (76.45, 72.02 and 74.16 cm in first and second year as well as on pooled mean, respectively) were recorded in SA @ 200 ppm (T_{14}) which was found significantly superior in improving plant height to rest of humic acid and salicylic acid concentrations except its lower SA (75 ppm) and higher concentration (200 ppm). However, the minimum plant height (61.39 cm in first year, 57.12 cm in second year and 59.19 cm in pooled mean) was observed in the treatment control (T_1).

The number of leaves per plant at days after planting, number of leaves per plant ranged from 84.83 to 98.71 during first year, 85.00 to 98.88 in second year and 84.92 to 98.79 in pooled analysis. The maximum number of leaves per plant was recorded under treatment T_{14} (98.71, 98.88 and 98.79 in first and second year as well as on pooled mean, respectively) were recorded in SA @ 200 ppm (T_{14}) followed by T_{13} (97.21, 97.38 and 97.29 in first and second year as well as on pooled mean, respectively) were recorded in SA @ 175 ppm Birade *et al*., (2003) [3]. However, the minimum the number of leaves per plant (84.83 in first year, 85.00 in second year and 84.92 in pooled mean) was observed in the treatment control (T_1).

The data on presented in Table 2 the result indicated that the different levels of humic acid and salicylic acid the maximum number of Leaf area, was recorded under treatment T_{14} (10.96, 11.18 and 11.07 cm in first and second year as well as on pooled mean, respectively) were recorded in SA @ 200 ppm (T_{14}) followed by T_7 (10.70, 10.92 and 10.81) were recorded in HA @ 1500 ppm. However, the minimum Leaf area, (6.68 cm in first year, 6.90 cm in second year and 6.79 cm in pooled mean) was observed in the treatment control (T_1).

The Leaf area index, the maximum number of Leaf area index, was recorded under treatment T_{14} (0.36, 0.37 and 0.37 cm in first and second year as well as on pooled mean, respectively) were recorded in SA @ 200 ppm (T_{14}) followed by T_7 (0.34, 0.35 and 0.34) were recorded in HA @ 1500 ppm. However, the minimum Leaf area index, (0.120 cm in first year, 0.21 cm in second year and 0.21 cm in pooled mean) was observed in the treatment control (T_1).

The data with respect chlorophyll content is presented in Table 2. The maximum chlorophyll content was recorded under treatment T_{14} (104.56, 73.09 and 88.82 SPAD in first and second year as well as on pooled mean, respectively) were recorded in SA @ 200 ppm (T_{14}) followed by T_7 (80.61, 66.29 and 73.45) SPAD were recorded in HA @ 1500 ppm in first and second year as well as on pooled mean, respectively). However, the minimum chlorophyll content 61.13 SPAD in first year, 47.45 SPAD in second year and 54.29 SPAD in pooled mean) was observed in the treatment control (T_1). The increased total leaf chlorophyll contents might be due the acceleration of N and NO_3 uptake, enhancing N metabolism and production of protein by HA that ultimately increase chlorophyll contents (Haghighi *et al*., 2012) [8] or due to other functions of HA such as increasing cell membrane permeability, oxygen uptake, respiration and photosynthesis, phosphate uptake, and root elongation (Russo and Berlyn, 1990) [25].

Table 1: Impact of salicylic acid and humic acid on vegetative growth of Lilium cv. Tresor

		2018-2019 Rainy Season			2019-2020 Rainy Season			Pooled Rainy Season		
Treatment \ Character		Days for 100% sprouting of bulb	Plant height (cm) 120 days	No. of leaves per plant 120 days	Days for 100% sprouting of bulb	Plant height (cm) 120 days	No. of leaves per plant 120 days	Days for 100% sprouting of bulb	Plant height (cm) 120 days	No. of leaves per plant 120 days
T_1	Control	27.00	61.39	84.83	25.41	57.12	85.00	25.33	59.19	84.92
T_2	250 ppm Humic Acid	26.00	64.16	90.54	23.93	60.49	90.71	23.34	62.27	90.63
T_3	500 ppm HA	24.25	66.33	91.67	23.00	62.53	91.83	22.38	64.37	91.75
T_4	750 ppm HA	24.00	68.04	92.96	22.63	64.13	93.13	22.19	66.02	93.04
T_5	1000 ppm HA	23.75	70.18	94.08	20.57	66.14	94.25	20.66	68.10	94.17
T_6	1250 ppm HA	24.50	72.18	95.08	21.24	68.02	95.25	20.75	70.03	95.17
T_7	1500 ppm HA	22.25	73.45	96.67	19.19	69.20	96.83	19.47	71.26	96.75
T_8	50 ppm Salicylic Acid	24.50	68.46	91.33	24.00	64.52	91.50	23.25	66.42	91.42
T_9	75 ppm SA	25.25	70.31	92.29	23.16	66.26	92.46	22.58	68.22	92.38
T_{10}	100 ppm SA	24.25	71.60	92.96	21.25	67.47	93.13	21.12	69.47	93.04
T_{11}	125 ppm SA	24.00	72.93	94.12	22.88	68.71	94.29	21.82	70.75	94.21
T_{12}	150 ppm SA	24.25	74.01	95.46	22.19	69.73	95.63	21.22	71.80	95.54
T_{13}	175 ppm SA	22.75	75.33	97.21	20.38	70.96	97.38	19.94	73.07	97.29
T_{14}	200 ppm SA	21.00	76.45	98.71	19.53	72.02	98.88	19.39	74.16	98.79
S.Em		0.64	2.07	2.34	0.56	0.71	0.37	0.34	1.37	1.35
C.D. 5%		1.82	5.93	6.69	1.60	1.90	1.04	0.95	3.92	3.87

Plants treated with Spray of Humic acid and Salicylic acid, significantly influenced basal stem diameter (cm), plants spray with SA @ 200 ppm (T_{14}) recorded significantly higher basal stem diameter in first year (1.64 cm), second year (1.79 cm) as well as in pooled data (1.79 cm) followed by T_7 (1.50, 1.64 and 1.64 cm in first and second year as well as on pooled mean, respectively) were recorded in HA @ 1500 ppm as compared to untreated plants control. (T_1) (1.31, 1.44 and 1.44 cm respectively).

The data on presented in Table 3 the result indicated that the different levels of humic acid and salicylic acid, the minimum number days to appearance flower bud (38.01, 38.58 and 37.50 days during first, second year and in pooled mean, respectively) were recorded under T_{14} (salicylic acid @ 200 ppm) which was found statistically at par with its lower concentration *i.e.* 175 ppm (T_{13}). However, both these concentration of SA, (200 and 175 ppm) showed their significant superiority over rest of humic acid and salicylic acid concentrations for days to appearance flower bud during both the years of study and in pooled mean (Dole and Wilkins 1996). The much longer time days to appearance flower bud (45.80, 44.83 and 44.75 days during first, second year and in pooled mean, respectively) was recorded in treatment T_1 (control).

The result indicated that all the levels of Salicylic Acid and Humic Acid showed significantly earlier days to colour visibility in bud in comparison to control. However, out of 14 treatments studied, the minimum days to colour visibility in bud of bulb (42.40, 46.45 and 44.73 days during first, second year and in pooled mean, respectively) were recorded under T_{14} (salicylic acid @ 200 ppm) which was found statistically at par with its lower concentration *i.e.* 175 ppm (T_{13}) (Kumar *et al*., 2005) [16]. However, both these concentration of SA, (200 and 175 ppm) showed their significant superiority over rest of humic acid and salicylic acid concentrations for days to colour visibility in bud during both the years of study and in pooled mean. The much longer time for days to colour visibility in bud (50.80, 51.30 and 51.05 days during first, second year and in pooled mean, respectively) was recorded in treatment T_1 (control).

Table 2: Impact of Salicylic Acid (SA) and Humic Acid (HA) on vegetative growth of Lilium Asiatic hybrid cv. Tresor

Treatment	Character	2018-2019 Rainy Season				2019-2020 Rainy Season				Pooled Rainy Season			
		Leaf area (cm)	Leaf area index (cm)	Total chlorophyll content	Basal stem diameter (cm)	Leaf area (cm)	Leaf area index (cm)	Total chlorophyll content	Basal stem diameter (cm)	Leaf area (cm)	Leaf area index (cm)	Total chlorophyll content	Basal stem diameter (cm)
T_1	Control	6.68	0.20	61.13	1.31	6.90	0.21	47.45	1.44	6.79	0.21	54.29	1.44
T_2	250 ppm HA	8.87	0.22	65.32	1.34	9.09	0.23	51.14	1.47	8.98	0.23	58.23	1.47
T_3	500 ppm HA	9.55	0.24	67.85	1.37	9.77	0.25	54.79	1.51	9.66	0.24	61.32	1.50
T_4	750 ppm HA	9.85	0.26	71.07	1.40	10.08	0.27	57.53	1.54	9.96	0.26	64.30	1.53
T_5	1000 ppm HA	10.03	0.28	74.44	1.42	10.25	0.29	60.46	1.55	10.14	0.29	67.45	1.55
T_6	1250 ppm HA	10.47	0.30	78.00	1.45	10.68	0.31	63.30	1.60	10.57	0.30	70.65	1.59
T_7	1500 ppm HA	10.70	0.34	80.61	1.50	10.92	0.35	66.29	1.64	10.81	0.34	73.45	1.64
T_8	50 ppm SA	9.50	0.19	74.59	1.43	9.71	0.20	51.22	1.57	9.60	0.20	62.90	1.56
T_9	75 ppm SA	9.64	0.21	80.24	1.46	9.86	0.22	55.03	1.60	9.75	0.22	67.63	1.60
T_{10}	100 ppm SA	9.90	0.25	84.12	1.51	10.12	0.26	58.77	1.66	10.01	0.25	71.45	1.65
T_{11}	125 ppm SA	10.13	0.26	87.62	1.54	10.35	0.27	61.41	1.69	10.24	0.27	74.52	1.68
T_{12}	150 ppm SA	10.54	0.28	90.95	1.56	10.76	0.29	65.46	1.74	10.65	0.29	78.21	1.72
T_{13}	175 ppm SA	10.74	0.30	95.60	1.61	10.96	0.31	69.54	1.76	10.85	0.31	82.57	1.76
T_{14}	200 ppm SA	10.96	0.36	104.56	1.64	11.18	0.37	73.09	1.79	11.07	0.37	88.82	1.79
S.E(m) +		0.34	0.01	2.31	0.06	0.16	0.01	0.81	0.07	0.25	0.01	1.56	0.04
C.D. at 5%		0.98	0.02	6.61	0.17	0.46	0.02	2.31	0.21	0.72	0.02	4.46	0.11

Among the different levels of humic acid and salicylic acid, the minimum number of days 100% for days to bud break (51.19, 53.51 and 52.15 days during first, second year and in pooled mean, respectively) were recorded under T_{14} (salicylic acid @ 200 ppm) which was found statistically at par with its lower concentration *i.e.* 175 ppm (T_{13}). However, both these concentration of SA, (200 and 175 ppm) showed their significant superiority over rest of humic acid and salicylic acid concentrations for days to bud break both the years of study and in pooled mean (Kumar *et al*., 2005) [16]. The much longer time for days to bud break (65.76, 63.62 and 64.13 days during first, second year and in pooled mean, respectively) was recorded in treatment T_1 (control).

Data on flower bud length (cm), flower bud width (cm) and initial weight of bud (g) are presented in Table 4. The data also revealed that the flower bud length (cm), was significantly affected due to Humic acid and Salicylic acid during both the years and in pooled. The maximum flower bud length (cm), (12.80 cm during 2018-19, 10.68 cm during 2019-20 and 11.74 cm in pooled mean) were noted in SA @ 200 ppm (T_{14}) which was found significantly better for obtaining higher flower bud length (cm), than rest of the Humic acid and Salicylic acid except HA 250 ppm (T_2) and SA 75 ppm (T_9) during both the years as well as in pooled mean. However, the minimum flower bud length (cm), (5.45 cm during 2018-19, 5.55 cm during 2019-20 and 5.50 cm in pooled mean) was observed in treatment control (T_1) during both the years as well as in, pooled, mean.

Table 3: Impact of salicylic acid and humic acid on flower bud of Lilium cv. Tresor

Treatment	Character	2018-2019 Rainy Season			2019-2020 Rainy Season			Pooled Rainy Season		
		Days To Appearance Flower Bud	Days To Colour Visibility In Bud	Days To Bud Break	Days To Appearance Flower Bud	Days To Colour Visibility In Bud	Days To Bud Break	Days To Appearance Flower Bud	Days To Colour Visibility In Bud	Days To Bud Break
T_1	Control	45.80	50.80	65.76	44.83	51.30	63.62	44.75	51.05	64.13
T_2	250 ppm Humic Acid	43.35	47.60	60.92	43.92	50.45	61.99	42.46	49.03	60.28
T_3	500 ppm HA	41.83	46.90	58.12	43.08	49.85	59.76	42.13	48.38	58.61
T_4	750 ppm HA	40.80	46.00	56.48	42.50	49.30	58.68	41.08	47.65	57.01
T_5	1000 ppm HA	40.14	45.45	55.10	41.75	48.45	57.66	40.13	46.95	55.47
T_6	1250 ppm HA	39.73	44.50	54.05	41.08	47.75	56.89	39.96	46.13	54.71
T_7	1500 ppm HA	39.06	43.95	53.02	40.33	46.75	55.88	39.42	45.35	53.96
T_8	50 ppm Salicylic Acid	42.73	45.55	59.66	43.00	50.05	59.64	41.97	47.80	58.86
T_9	75 ppm SA	41.52	45.15	57.77	42.42	49.35	58.67	41.50	47.25	57.75
T_{10}	100 ppm SA	40.46	44.50	56.17	41.75	48.65	57.68	40.88	46.58	56.70
T_{11}	125 ppm SA	39.26	44.05	55.22	41.08	47.75	56.44	40.63	45.90	56.19
T_{12}	150 ppm SA	39.12	43.10	53.58	40.25	47.15	55.32	40.27	42.78	55.54
T_{13}	175 ppm SA	38.31	43.00	52.13	39.67	46.45	55.17	39.96	44.73	54.92
T_{14}	200 ppm SA	38.01	42.40	51.19	38.58	45.55	53.51	37.50	43.83	52.15
S.Em		0.51	1.69	1.38	0.80	1.71	1.35	0.59	1.08	0.79
C.D. 5%		1.45	4.83	3.95	1.59	4.86	3.86	1.66	3.02	2.21

The data also revealed that the flower bud width (cm) was significantly affected due to Humic acid and Salicylic acid during both the years and in pooled. The maximum flower bud width (cm), (1.96 cm during 2018-19, 1.86 cm during 2019-20 and 1.91 cm in pooled mean) were noted in SA @ 200 ppm (T_{14}) which was found significantly better for obtaining higher flower bud width (cm), than rest of the Humic acid and Salicylic acid except HA 250 ppm (T_2) and

SA 75 ppm (T_9) during both the years as well as in pooled mean. However, the minimum flower bud width (cm), (1.09 cm during 2018-19, 1.01cm during 2019-20 and 1.05 cm in pooled mean) was observed in treatment control (T_1) during both the years as well as in, pooled. Mean.

The data also revealed that the initial weight of bud (g) was significantly affected due to Humic acid and Salicylic acid during both the years and in pooled. The maximum initial weight of bud (g), (10.48 g during 2018-19, 10.95 g during 2019-20 and 10.71 in pooled mean) were noted in SA @ 200 ppm (T_{14}) which was found significantly better for obtaining higher initial weight of bud (g), than rest of the Humic acid and Salicylic acid except HA 250 ppm (T_2) and SA 75 ppm (T_9) during both the years as well as in pooled mean. However, the minimum initial weight of bud (g), (5.75 g during 2018-19, 5.59 g during 2019-20 and 5.67 g in pooled mean) was observed in treatment control (T_1) during both the years as well as in pooled mean.

Humic acid is a potential compound that can be used for increasing nutrient availability and crop production. It plays a vital role in the transport and availability of micronutrients, which are otherwise fixed in soils with higher pH. Many beneficial effects of HA have been documented by the researchers on different crops. Generally, it is absorbed through plant roots, and translocated to shoots and other plant parts, and enhances plant growth responses (Lulakis and Petsas, 1995) [19]. Hence application of all those nutrient have land mark effect on bud development and growth in cv. Nashville. Hence application of all those nutrients have land mark effect on vegetative growth in cv. Nashville. Li and Evens (2000) [17], who reported better seedling growth with HA application. Among cultivars, earlier sprouting in might be due to differential genetic make-up of the cultivars or HA interaction with the environmental conditions and/or different cultivars that helped plants supplied with HA sprout earlier compared to untreated plants. Humic acid not only promoted the vegetative growth but also floral growth was improved as higher number of florets per spike were produced by plants provided with three application of HA and NPK. These results are in line with the findings of Kaya *et al*. (2005) [13]; Nikbakht *et al*. (2008); and Baldotto and Baldotto (2013) [2], who reported that HA increased flowering and yield of common bean, gerbera, and gladiolus, when applied at higher concentrations, and Haghighi *et al*. (2012) [8] who reported improved lettuce yield by stimulating N metabolism and photosynthetic activity, which ultimately increased yield. For stem length of gladiolus, two or three applications of HA and NPK produced longer stems.

Salicylic acid (SA) or ortho-hydroxy benzoic acid and other salicylates are known to affect various physiological and biochemical activities of plants and may play a key role in regulating their growth and productivity and in the responses to environmental stresses (Hayat *et al*., 2010) [10]. Further, its role is evident in seed germination, fruit yield, glycolysis, flowering in thermogenic plants (Klessig and Malamy, 1994) [15], ion uptake and transport (Harper and Balke, 1981) [9], photosynthetic rate, stomatal conductance and transpiration (Khan *et al*., 2003) [14]. SA has been reported to induce flowering in a number of plants. Different plant species including ornamental plant *Sinningia speciosa* flowered much earlier as compared to the untreated control, when they received an exogenous foliar spray of SA (Martin-Max *et al*., 2005) [21]. SA plant growth regulator during application on plants affects a variety of physiological processes, such as stomatal closure, flowering induction, and other processes. The inner salicylic acid of the plant improves the flowering process in the plants. In addition, the external application of this plant growth regulator in the culture medium also results in the flowering of the Lemna. Also spraying this hormone leads to a significant increase in leaf area, length and diameter of flower buds, stalk length, and also increase the fresh and dry weight of the plant and improve the quality of rose cut flowers (Mansouri *et al*., 2015) [20].

Table 4: Impact of Salicylic Acid (SA) and humic Acid (HA) on flower bud of Lilium Asiatic hybrid cv. Tresor

		2018-2019 Rainy Season			2019-2020 Rainy Season			Pooled Rainy Season		
Treatment	Character	Flower bud length (cm)	Flower bud width (cm)	initial weight of bud (g)	Flower bud length (cm)	Flower bud width (cm)	initial weight of bud (g)	Flower bud length (cm)	Flower bud width (cm)	initial weight of bud (g)
T_1	Control	5.45	1.09	5.75	5.55	1.01	5.59	5.50	1.05	5.67
T_2	250 ppm HA	6.08	1.12	6.78	6.18	1.07	6.72	6.13	1.09	6.75
T_3	500 ppm HA	6.60	1.37	9.47	6.75	1.18	6.96	6.68	1.27	8.21
T_4	750 ppm HA	6.10	1.44	9.53	7.28	1.30	7.40	6.69	1.37	8.46
T_5	1000 ppm HA	6.53	1.52	9.67	7.83	1.39	8.64	7.18	1.46	9.16
T_6	1250 ppm HA	6.25	1.58	9.71	8.40	1.51	9.63	7.32	1.54	9.67
T_7	1500 ppm HA	6.43	1.68	9.76	8.98	1.66	10.14	7.70	1.67	9.95
T_8	50 ppm SA	6.55	1.07	9.82	6.10	1.14	7.85	6.33	1.10	8.83
T_9	75 ppm SA	6.28	1.16	9.90	6.70	1.25	8.56	6.49	1.20	9.23
T_{10}	100 ppm SA	6.55	1.43	10.04	7.53	1.36	8.94	7.04	1.39	9.49
T_{11}	125 ppm SA	8.25	1.52	10.24	8.20	1.48	9.32	8.23	1.50	9.78
T_{12}	150 ppm SA	11.80	1.66	10.27	8.95	1.55	9.94	10.38	1.60	10.10
T_{13}	175 ppm SA	12.50	1.83	10.29	10.05	1.66	10.40	11.28	1.75	10.35
T_{14}	200 ppm SA	12.80	1.96	10.48	10.68	1.86	10.95	11.74	1.91	10.71
S.E(m) +		0.46	0.09	0.47	0.17	0.03	0.14	0.31	0.06	0.30
C.D. at 5%		1.31	0.24	1.35	0.48	0.07	0.39	0.90	0.16	0.87

Conclusion

The outcome of this research highlighted the importance of growth regulators and their impact on vegetative as well as floral growth of lilium plants. Present investigation revealed that the all the levels of salicylic acid and humic acid showed significantly affecting vegetative growth, flower bud performance and quality. The Impact of salicylic acid 200 ppm (T_{14}) were found superior for on vegetative growth and flower bud. Spray of salicylic acid 200 ppm (T_{14}) was found the better to Days for 100% sprouting of bulb, plant height (cm), Number of leaves per plant, leaf area, leaf area index, total chlorophyll content, Days to appearance flower bud, Day to colour visibility in bud and Days to bud break as compared to control (T_1). Thus, the use of growth regulators on gladiolus plants helps to improve the vegetative and floral traits which would ultimately lead to fetch more prices in local and international markets.

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