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Plant Growth and Post-harvest Life of Cut Gladiolus as Influenced by Zinc Level and Corm Grade

A. K. Singh [a], Sakshi Santosh Vyas [a*], Anjana Sisodia [a] and Kalyan Barman [a]

[a] Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi-221 005, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Gladiolus is one of the most beautiful, attractive, widely cultivated and economically important flowering plants worldwide including India. The research work was carried out to investigate the effect of corm grade and soil application of zinc sulphate on growth and post-harvest parameters of gladiolus cv. Malaviya Kundan at the Horticulture Research Farm and Post-Harvest Laboratory of Department of Horticulture, Banaras Hindu University, Varanasi. In an experiment seven different grades of mother corm (1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0 cm) and zinc sulphate at three levels (15 and 30 kg/ha) along with control were used. Zinc was applied in soil at the time of field preparation. Experiment was replicated four times in Randomized Block Design. Application of $ZnSO_4$ at 15 kg/ha was found beneficial for various growth parameters, whereas, 30 kg/ha was found beneficial for most of the post-harvest parameters. Maximum plant height and duration of flowering was achieved with $ZnSO_4$ at 15 kg/ha, whereas, application of $ZnSO_4$ at 30 kg/ha resulted in maximum length of the spike, total number of florets opened and total uptake of water in vase. Among the

**Corresponding author: E-mail: sakshisvyas@gmail.com;*

various grades, the largest corm grade, i.e. 4.0 cm was found to be the best for growth parameters. Whereas, corm grade 3.0 cm was found to be the best in respect of various post-harvest parameters. Lowest corm grade i.e. 1.0 cm failed to exhibit flower due to small size of propagule.

Keywords: Gladiolus; zinc sulphate; corm grade; plant height; vase-life.

1. INTRODUCTION

Gladiolus was introduced into cultivation towards the end of 16th century. It is good for flower arrangements, interior decoration and making bouquet [1]. Micronutrients play a key role in plants for their proper growth and development, thus, enhancing the growth as well as vase life of cut spikes. Senescence of cut flowers commence after harvest [2] which, then, leads to oxidative stress and leakage of membrane of cut flowers in vase that accelerates degradation of flowers [3]. All these factors determine the postharvest quality of the spike by influencing its vase life. Application of micronutrients in plants ultimately improves various growth and flowering characteristics of gladioli including their vase life [4]. Zinc controls super oxide dismutase activity [5] and hence it regulates the membrane integrity with the purification of reactive oxygen species (ROS) and prevention of oxidative damage of cells. On the other hand, it binds the membrane proteins as well as prevents the membrane leakage thus maintaining its integrity and extends the vase life of cut flowers [6]. Therefore, provision of adequate amount of nutrients in soil and plants is imperative for achieving good quality flowers. The use of appropriate size of mother corm grade is also of utmost importance as it majorly affects further growth and development of plant. The present research work was carried out to elucidate the response of corm grades of newly evolved variety Malaviya Kundan and the soil application of zinc sulphate on growth parameters and post-harvest quality of gladiolus.

2. MATERIALS AND METHODS

The present investigation was carried out at the Horticulture Research Farm and Post-Harvest Laboratory of Department of Horticulture, Banaras Hindu University, Varanasi, Uttar Pradesh. The site is geographically located at the centre of North-Gangetic alluvial plain, on the left bank of river Ganga, at 25°15' north latitude, 83°03' east longitude at an elevation of 129.23 meters above mean sea level (MSL). The climate of Varanasi is humid-subtropical having dry summers with cold winters. The average annual rainfall of this region is 998 mm with the wide range of temperature which ranges between 22 to 46°C. The trial was conducted on gladiolus cv. Malaviya Kundan by applying zinc sulphate ($ZnSO_{4)}$ and corm grades in various possible combinations. There were 21 plots whose individual bed was sizing of 3×2 m. Good quality corm grades of varying sizes (1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0 cm) were selected and planted at the spacing of row to row 30 cm and corm to corm 20 cm. Zinc sulphate at three different levels were taken i.e. control (no zinc), 15 kg/ha and 30 kg/ha, which were incorporated in soil at the time of field preparation. The experiment was laid out in Randomized Block Design and were replicated four times. For post-harvest study, spikes of gladiolus were harvested during morning hours with the help of sharp knife when basal floret started to show its colour and after harvesting immediately placed in the bucket containing water. It was then brought to the Post-Harvest Laboratory immediately. Base of the floral spike were given a slant cut in order to increase the surface area for absorption of vase solution and then placed in the 500 ml conical flask containing distilled water. Various growth and post-harvest parameters were taken into consideration like plant height, leaf width, number of sprouts per hill, water uptake in vase, floret diameter, spike length, rachis length, longevity of floret in vase, vase life, etc. The data was recorded carefully and Analysis of Variance (ANOVA) was performed as per the procedure suggested by Assaad et al. [7].

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

Application of zinc and corm grades significantly affected the height of plant (Table 1). The results indicated that the largest sized corm grade produced maximum plant height stating from 40 DAP (days after planting) to 80 DAP due to adequate supply of carbohydrates to newly emerged plants of gladioli. Plant height was found to be maximum in largest corm grade (4.0 cm) according to the data taken on 40 DAP (38.52 cm), 60 DAP (42.97 cm) and 80 DAP (45.44 cm). Whereas, it was minimum in the

smallest grade used (1.0 cm). Among zinc treatments, it was maximum with $ZnSO_4$ 15 kg/ha at 60 DAP (34.42 cm). Interaction among corm grade 4.0 cm × $ZnSO_4$ 0 kg/ha (control) achieved maximum plant height at 40 and 60 DAP (39.60 cm and 43.08 cm) which was significantly at par with grade 4.0 cm × $ZnSO_4$ 15 kg/ha and grade 4.0 cm × $ZnSO_4$ 30 kg/ha. An increment in plant height is possibly due to the application of zinc which is involved in the activities like synthesis of auxin, synthesis of protein and RNA and also carbohydrate metabolism which results in internodal elongation and ultimately causes stem growth. This element, zinc, slightly enhances the activity of tryptophan synthesis when used even at minute concentration (0.01 ppm) which leads to biosynthesis of auxin [8]. Singh et al. [9] and Singh et al. [10] also observed improved growth characteristics in gladiolus particularly in plant height due to the application of zinc. Increased plant height with the application of zinc was also in close conformity with the findings of Singh et al. [11] and Singh *et al.* [12] in lilium and Hussain et al. [13] in marigold. Effect of corm grade has shown significant results for leaf width. Maximum leaf width was observed in corm grade 4.0 cm as per the data taken on 40, 60 and 80 DAP (2.21 cm, 2.53 cm and 2.63 cm, respectively). Treatment of zinc sulphate on the width of leaves showed non-significant results. Number of sprouts produced per hill was significantly affected by corm grade where largest corm grade resulted in maximum number of sprouts per hill (1.87). Zinc was failed to exert any significant effect on number of sprouts per hill. Above results are also supported by Memon et al. (2009), Kamal et al. [14] and Bhande et al. [15] who obtained the improved growth parameters with the use of larger mother corm grades of gladiolus.

3.2 Post-harvest Parameters

Postharvest parameters were significantly influenced by corm grades and soil application of zinc sulphate in the gladiolus cv. Malaviya Kundan. Weight of the spike was observed on 1st, 4th, 7th day as well as after senescence in vase (Table 2), which was found to be maximum in corm grade 3.0 cm i.e. 40.82, 45.93, 35.39 and 21.78 g, respectively. Among zinc treatments, control plants had maximum weight of spike on 1st (36.21 g) and 4th day (39.42 g) in vase, whereas, spike weight on 7th day and weight after senescence was maximum in $ZnSO_4$ 30 kg/ha i.e. 30.43 g and 18.86 g, respectively. Interaction among corm grade 3.0 cm × $ZnSO_4$ 0 kg/ha has found with maximum weight of spike as per the observations recorded on day 1, day 7 and after senescence. Lowest grade of corm (1.0 cm) did not produce any flower probably due to small size and less stored food i.e. carbohydrates, etc. Application of zinc and corm grade resulted in significant results on the uptake of water in vase. Total water uptake by the spike was maximum in corm grade 3.0 cm (60.33 ml), $ZnSO_4$ 30 kg/ha (47.50 ml) and interaction of grade 3.0 cm × $ZnSO_4$ 0 kg/ha (72 ml). Length of spike was also affected by zinc and corm grade where longest spike length was achieved in corm grade 3.0 cm, zinc at 30 kg/ha and the interaction among 3.0 cm × 30 kg/ha in all the data observed at day 1, day 4 and day 7 in vase, whereas, it was shortest in grade 1.5 cm, zinc at 0 kg/ha and corm grade 1.5 cm × zinc 30 kg/ha. Similar results were also obtained in case of length of rachis which was maximum in corm grade 3.0 cm, zinc at 30 kg/ha and the interaction of 3.0 cm × 30 kg/ha. Minimum rachis length was observed in grade 1.5 cm, zinc at 0 kg/ha and corm grade 1.5 cm × zinc 0 kg/ha. Diameter and length of floret was also significantly affected by corm grade and zinc (Table 3). Diameter of the floret was maximum in smaller corm grades. Corm grade 2.0 cm resulted in maximum diameter of 1st, 5th and last floret (9.57, 8.43, 7.00 cm) and maximum length of 3rd floret (9.80 cm). Among zinc treatments, zinc at 0 kg/ha resulted in maximum diameter of 1st, 3rd, last floret (9.18, 8.52, 6.88 cm) as well as length of 1st floret. Whereas, zinc at higher dose (30 kg/ha) resulted in maximum length of 3rd, 5th and last floret (9.27, 9.03, 9.02 cm). Longevity of florets in vase was influenced with the corm grade and the application of zinc (Table 4). Longevity of 3rd floret was maximum in grade 1.5 cm (2.33 cm), 5th floret in grade 3.0 cm (3.33 cm) and of last floret in grade 4.0 cm (3.67 cm). Zinc at 15 kg/ha significantly affected the longevity of 5th and last floret (3.0, 3.0 cm). Total number of florets per spike and opened florets was maximum in grade 3.5 cm (14.33 and 12.33) and in zinc at 30 kg/ha (13.50 and 11.68). Maximum vase life was obtained (Table 4) with the corm grade 3.0 cm (11 days) and treatment $ZnSO_4$ 15 kg/ha (10.67 days), whereas, minimum vase life was recorded with smaller corm grade i.e. 1.5 cm (9.33 days) and control (no zinc) (9.67 days). This might be due to the presence of zinc which is responsible to regulate the membrane integrity with the purification of reactive oxygen species (ROS) which prevents of oxidative damage of cells. It also binds the membrane proteins as well as prevents the membrane leakage thus

maintaining its integrity and ultimately extends the vase life of cut flowers. The above results were also in lent credence with the finding of Joshi et al. [16], Saeed et al. [17], Ara et al. [18], Kumar [19], Kashyap and Tikey [20] and Sisodia et al. [21] in gladiolus. Singh et al. [11] and [22] worked on lilium and found the similar result [23].

Table 1. Effect of corm grades and zinc sulphate on number of plants/hill, plant height and leaf width at 20 days interval in gladiolus var. Malaviya Kundan

Treatment	No. of plants/hill			Plant height (cm)			Leaf width (cm)		
	40 DAP	60 DAP	80 DAP	40 DAP	60 DAP	80 DAP	40 DAP	60 DAP	80 DAP
Corm grades									
4.0 cm	1.87	1.87	1.87	38.52	42.97	45.44	2.21	2.53	2.63
3.5 cm	1.33	1.33	1.33	34.13	39.87	43.77	2.21	2.51	2.60
3.0 cm	1.16	1.16	1.16	30.32	34.79	39.28	1.97	2.25	2.39
2.5 cm	1.06	1.06	1.06	27.23	32.32	38.16	1.80	2.23	2.30
2.0 cm	1.00	1.00	1.00	26.23	30.46	35.70	1.61	1.96	2.12
1.5 cm	1.00	1.00	1.00	26.94	28.18	34.03	1.42	1.61	1.79
1.0 cm	1.00	1.00	1.00	22.89	26.17	28.14	0.90	0.95	1.11
C.D. at 5%	0.14	0.14	0.14	01.66	01.45	01.32	0.14	0.13	0.19
Zinc doses									
0 kg/ha (Control)	1.23	1.23	1.23	29.07	33.12	37.58	1.67	2.04	2.41
15 kg/ha	1.17	1.17	1.17	29.92	34.42	38.02	1.76	1.99	2.14
30 kg/ha	1.20	1.20	1.20	29.41	33.08	37.77	1.76	1.99	2.13
C.D. at 5%	NS	NS	NS	NS	0.95	NS	NS	NS	NS
Interaction (corm grade × zinc dose)									
4.0 cm × 0 kg/ha (Control)	1.87	1.87	1.87	39.60	43.08	45.27	2.21	2.54	2.59
4.0 cm × 15 kg/ha	1.81	1.81	1.81	38.85	42.99	46.45	2.28	2.55	2.67
4.0 cm × 30 kg/ha	1.87	1.87	1.87	37.11	42.85	44.59	2.15	2.49	2.56
3.5 cm × 0 kg/ha (Control)	1.37	1.37	1.37	32.98	39.39	44.24	2.28	2.61	2.67
3.5 cm × 15 kg/ha	1.37	1.37	1.37	35.93	41.81	42.96	2.09	2.31	2.49
3.5 cm × 30 kg/ha	1.25	1.25	1.25	33.48	38.42	44.12	2.26	2.60	2.74
3.0 cm × 0 kg/ha (Control)	1.25	1.25	1.25	29.99	34.62	38.79	1.84	2.21	2.42
3.0 cm × 15 kg/ha	1.12	1.12	1.12	29.64	37.21	39.62	2.02	2.30	2.39
3.0 cm × 30 kg/ha	1.12	1.12	1.12	31.35	32.56	39.44	2.03	2.23	2.37
2.5 cm × 0 kg/ha (Control)	1.00	1.00	1.00	27.84	33.00	37.52	1.80	2.31	2.29
2.5 cm × 15 kg/ha	1.00	1.00	1.00	27.88	31.69	37.91	1.80	2.34	2.35
2.5 cm × 30 kg/ha	1.06	1.06	1.06	25.96	32.27	39.03	1.81	2.04	2.25
2.0 cm × 0 kg/ha (Control)	1.00	1.00	1.00	25.02	28.96	35.20	1.56	2.02	2.09
2.0 cm × 15 kg/ha	1.00	1.00	1.00	27.59	32.11	35.99	1.75	1.82	2.08
2.0 cm × 30 kg/ha	1.00	1.00	1.00	26.08	30.33	35.90	1.52	2.05	2.19
1.5 cm × 0 kg/ha (Control)	1.00	1.00	1.00	24.39	25.68	33.01	1.16	1.63	1.82
1.5 cm × 15 kg/ha	1.00	1.00	1.00	27.70	28.32	35.59	1.51	1.63	1.87
1.5 cm × 30 kg/ha	1.00	1.00	1.00	28.74	30.54	33.49	1.58	1.59	1.70
1.0 cm × 0 kg/ha (Control)	1.00	1.00	1.00	23.69	27.11	29.03	0.84	0.95	1.08
1.0 cm × 15 kg/ha	1.00	1.00	1.00	21.82	26.83	27.59	0.89	0.95	1.12
1.0 cm × 30 kg/ha	1.00	1.00	1.00	23.17	24.57	27.82	0.96	0.94	1.14
C.D. at 5%	NS	NS	NS	2.88	2.52	NS	NS	NS	NS

Table 2. Effect of corm grades and zinc sulphate on weight of spike and length of spike till withering at 3 days interval with total water uptake in vase in gladiolus var. Malaviya Kundan

Treatment	Weight of spike (g)				Length of spike (cm)			Total water uptake (ml)
	Day 1	Day 4	Day 7	After withering	Day 1	Day 4	Day 7	
Corm grades								
4.0 cm	35.46	39.88	30.78	17.94	64.33	66.60	66.77	44.33
3.5 cm	37.65	41.64	33.68	20.40	66.33	68.73	68.83	48.67
3.0 cm	40.82	45.93	35.39	21.78	69.37	72.33	72.43	60.33
2.5 cm	38.07	40.16	30.92	19.87	64.33	66.40	66.43	47.33
2.0 cm	31.22	33.66	25.76	15.60	61.50	62.83	63.00	35.67
1.5 cm	27.01	27.95	20.45	12.28	52.63	54.97	55.10	37.67
1.0 cm	-	-	-	-	-	-	-	-
C.D. at 5%	0.02	0.03	0.01	0.01	0.01	0.03	0.05	0.23
Zinc doses								
0 kg/ha (Control)	36.31	39.42	29.47	18.12	62.08	64.12	64.27	45.67
15 kg/ha	33.63	36.24	28.59	16.95	62.75	64.77	64.82	43.83
30 kg/ha	35.17	38.94	30.43	18.86	64.42	67.05	67.20	47.50
C.D. at 5%	0.01	0.02	0.01	0.01	0.01	0.02	0.03	0.16
Interaction (corm grade × zinc dose)								
4.0 cm × 0 kg/ha (Control)	34.86	40.61	31.55	18.15	64.50	68.00	68.00	50.00
4.0 cm × 15 kg/ha	33.47	37.96	28.31	14.99	62.50	64.50	64.50	40.00
4.0 cm × 30 kg/ha	38.05	41.09	32.49	20.68	66.00	67.30	67.80	43.00
3.5 cm × 0 kg/ha (Control)	38.36	42.80	33.34	20.93	65.50	67.70	67.80	51.00
3.5 cm × 15 kg/ha	38.00	41.20	35.4	21.23	65.50	67.70	67.70	46.00
3.5 cm × 30 kg/ha	36.59	40.92	32.32	19.03	68.00	70.80	71.00	49.00
3.0 cm × 0 kg/ha (Control)	43.56	51.59	39.99	24.62	71.10	74.50	74.70	72.00
3.0 cm × 15 kg/ha	37.46	37.73	29.83	18.43	62.50	64.20	64.30	65.00
3.0 cm × 30 kg/ha	41.45	48.47	36.37	22.30	74.50	78.30	78.30	64.00
2.5 cm × 0 kg/ha (Control)	39.30	41.31	31.66	20.42	62.10	63.20	63.30	54.00
2.5 cm × 15 kg/ha	37.10	38.45	29.37	18.44	65.70	67.90	67.90	47.00
2.5 cm × 30 kg/ha	37.82	40.72	31.73	20.75	65.20	68.10	68.10	41.00
2.0 cm × 0 kg/ha (Control)	28.61	28.11	19.97	12.60	56.50	57.00	57.30	17.00
2.0 cm × 15 kg/ha	32.59	36.04	28.14	16.69	65.20	66.00	66.20	45.00
2.0 cm × 30 kg/ha	32.47	36.84	29.19	17.50	62.80	65.50	65.50	45.00
1.5 cm × 0 kg/ha (Control)	33.20	32.15	20.33	12.01	52.80	54.30	54.50	30.00
1.5 cm × 15 kg/ha	23.20	26.10	20.53	11.90	55.10	58.30	58.30	40.00
1.5 cm × 30 kg/ha	24.64	25.62	20.51	12.93	50.00	52.30	52.50	43.00
1.0 cm × 0 kg/ha (Control)	-	-	-	-	-	-	-	-

Treatment	Weight of spike (g)				Length of spike (cm)			Total water uptake (ml)
	Day 1	Day 4	Day 7	After withering	Day 1	Day 4	Day 7	
1.0 cm × 15 kg/ha	-	-	-	-	-	-	-	-
1.0 cm × 30 kg/ha	-	-	-	-	-	-	-	-
C.D. at 5%	0.04	0.06	0.02	0.03	0.02	0.05	0.08	0.39

Table 3. Effect of corm grades and zinc sulphate on length of rachis, diameter and length of floret in vase till withering at 3 days interval in gladiolus var. Malaviya Kundan

Treatment	Length of rachis (cm)			Diameter of floret (cm)				Length of floret (cm)			
	Day 1	Day 4	Day 7	1st floret	3rd floret	5th floret	Last floret	1st floret	3rd floret	5th floret	Last floret
Corm grades											
4.0 cm	36.37	37.33	37.57	8.43	7.87	8.27	6.57	9.03	8.57	9.17	8.70
3.5 cm	40.73	41.67	41.73	8.53	8.23	7.60	6.30	9.27	7.70	8.30	8.03
3.0 cm	42.37	43.03	43.17	8.13	8.40	8.40	7.00	7.83	9.40	8.90	9.17
2.5 cm	38.97	40.63	40.70	9.07	8.10	8.20	7.00	9.57	8.63	9.50	8.60
2.0 cm	38.63	39.30	39.37	9.57	8.53	8.43	7.00	9.13	9.80	8.83	9.13
1.5 cm	31.93	32.93	33.03	9.00	8.60	7.67	5.90	8.20	9.60	8.60	8.27
1.0 cm	-	-	-	-	-	-	-	-	-	-	-
C.D. at 5%	0.23	0.03	0.03	0.02	0.01	0.02	0.07	0.02	0.07	0.05	0.05
Zinc doses											
0 kg/ha (Control)	37.07	38.03	38.20	9.18	8.52	8.12	6.88	9.83	9.13	8.68	8.38
15 kg/ha	38.38	39.12	39.22	8.47	7.98	8.00	6.27	8.57	8.45	8.93	8.55
30 kg/ha	39.05	40.30	40.37	8.72	8.37	8.17	6.73	8.12	9.27	9.03	9.02
C.D. at 5%	0.16	0.02	0.02	0.02	0.00	0.02	0.05	0.02	0.05	0.03	0.03
Interaction (corm grade × zinc dose)											
4.0 cm × 0 kg/ha (Control)	40.10	40.50	40.50	8.60	9.10	8.20	6.60	9.60	10.00	9.30	8.10
4.0 cm × 15 kg/ha	34.40	35.00	35.50	8.10	7.70	8.40	6.50	8.70	9.20	8.70	9.00
4.0 cm × 30 kg/ha	34.60	36.50	36.70	8.50	6.80	8.20	6.60	8.80	6.50	9.50	9.00
3.5 cm × 0 kg/ha (Control)	41.50	42.70	42.80	8.40	7.70	7.50	6.00	9.30	6.70	8.30	7.80
3.5 cm × 15 kg/ha	40.20	41.30	41.30	8.50	8.00	7.00	6.20	9.20	7.00	8.10	7.60
3.5 cm × 30 kg/ha	40.50	41.00	41.10	8.70	9.00	8.30	6.70	9.30	9.40	8.50	8.70
3.0 cm × 0 kg/ha (Control)	41.20	41.90	42.20	8.60	8.50	8.60	7.30	8.60	9.50	9.20	9.50
3.0 cm × 15 kg/ha	40.20	40.90	41.00	7.60	8.00	7.80	7.10	8.40	9.30	8.80	9.00
3.0 cm × 30 kg/ha	45.70	46.30	46.30	8.20	8.70	8.80	6.60	6.50	9.40	8.70	9.00
2.5 cm × 0 kg/ha (Control)	37.00	37.80	38.00	9.10	7.70	8.20	8.50	9.80	9.20	9.00	7.90
2.5 cm × 15 kg/ha	40.40	41.50	41.50	9.70	7.60	8.20	6.00	11.00	6.70	9.50	9.30
2.5 cm × 30 kg/ha	39.50	42.60	42.60	8.40	9.00	8.20	6.50	7.90	10.00	10.00	8.60

Treatment	Length of rachis (cm)			Diameter of floret (cm)				Length of floret (cm)			
	Day 1	Day 4	Day 7	1st floret	3rd floret	5th floret	Last floret	1st floret	3rd floret	5th floret	Last floret
2.0 cm × 0 kg/ha (Control)	34.80	35.60	35.80	10.20	8.90	8.40	6.80	11.20	9.20	7.80	8.90
2.0 cm × 15 kg/ha	40.10	40.60	40.60	8.60	8.00	8.40	7.20	7.40	9.20	9.20	8.70
2.0 cm × 30 kg/ha	41.00	41.70	41.70	9.90	8.70	8.50	7.00	8.80	11.00	9.50	9.80
1.5 cm × 0 kg/ha (Control)	27.80	29.70	29.90	10.20	9.20	7.80	6.10	10.50	10.20	8.50	8.10
1.5 cm × 15 kg/ha	35.00	35.40	35.40	8.20	8.60	8.20	4.60	6.70	9.30	9.30	7.70
1.5 cm × 30 kg/ha	33.00	33.70	33.80	8.60	8.00	7.00	7.00	7.40	9.30	8.00	9.00
1.0 cm × 0 kg/ha (Control)	-	-	-	-	-	-	-	-	-	-	-
1.0 cm × 15 kg/ha	-	-	-	-	-	-	-	-	-	-	-
1.0 cm × 30 kg/ha	-	-	-	-	-	-	-	-	-	-	-
C.D. at 5%	0.40	0.05	0.05	0.04	0.01	0.04	0.13	0.04	0.13	0.08	0.07

Table 4. Effect of corm grades and zinc sulphate on longevity of floret, number of florets per spike, number of opened florets per spike and total duration of flowering in gladiolus var. Malaviya Kundan in vase

Treatment	Longevity of floret in vase (days)				No. of florets/spike	No. of opened florets/spike	Duration of flowering (days)
	1st floret	3rd floret	5th floret	Last floret			
Corm grades							
4.0 cm	2.00	2.00	2.67	3.67	13.00	10.67	9.67
3.5 cm	2.00	2.00	3.00	2.00	14.33	12.33	10.33
3.0 cm	2.00	2.00	3.33	3.33	13.67	12.33	11.00
2.5 cm	2.00	2.00	3.00	2.33	13.67	12.00	10.67
2.0 cm	2.00	1.67	2.00	2.33	12.33	10.67	10.33
1.5 cm	2.00	2.33	2.33	2.33	11.00	9.71	9.33
1.0 cm	-	-	-	-	-	-	-
C.D. at 5%	NS	0.23	0.00	0.23	0.23	0.03	0.23
Zinc doses							
0 kg/ha (Control)	2.00	2.00	2.33	2.33	13.00	11.17	9.67
15 kg/ha	2.00	2.00	3.00	3.00	12.50	11.01	10.67
30 kg/ha	2.00	2.00	2.83	2.67	13.50	11.68	10.33
C.D. at 5%	NS	NS	0.00	0.16	0.16	0.02	0.16
Interaction (corm grade × zinc dose)							
4.0 cm × 0 kg/ha (Control)	2.00	2.00	2.00	3.00	13.00	10.00	9.00
4.0 cm × 15 kg/ha	2.00	2.00	3.00	4.00	12.00	10.00	10.00
4.0 cm × 30 kg/ha	2.00	2.00	3.00	4.00	14.00	12.00	10.00
3.5 cm × 0 kg/ha (Control)	2.00	2.00	3.00	2.00	15.00	13.00	10.00
3.5 cm × 15 kg/ha	2.00	2.00	3.00	2.00	14.00	12.00	11.00

Treatment	Longevity of floret in vase (days)				No. of florets/spike	No. of opened florets/spike	Duration of flowering (days)
	1st floret	3rd floret	5th floret	Last floret			
3.5 cm × 30 kg/ha	2.00	2.00	3.00	2.00	14.00	12.00	10.00
3.0 cm × 0 kg/ha (Control)	2.00	2.00	3.00	2.00	14.00	13.00	11.00
3.0 cm × 15 kg/ha	2.00	2.00	4.00	4.00	13.00	12.00	11.00
3.0 cm × 30 kg/ha	2.00	2.00	3.00	4.00	14.00	12.00	11.00
2.5 cm × 0 kg/ha (Control)	2.00	2.00	2.00	3.00	14.00	11.00	10.00
2.5 cm × 15 kg/ha	2.00	2.00	4.00	2.00	13.00	12.00	11.00
2.5 cm × 30 kg/ha	2.00	2.00	3.00	2.00	14.00	13.00	11.00
2.0 cm × 0 kg/ha (Control)	2.00	1.00	2.00	2.00	11.00	10.00	10.00
2.0 cm × 15 kg/ha	2.00	2.00	2.00	3.00	13.00	11.00	11.00
2.0 cm × 30 kg/ha	2.00	2.00	2.00	2.00	13.00	11.00	10.00
1.5 cm × 0 kg/ha (Control)	2.00	3.00	2.00	2.00	11.00	10.00	8.00
1.5 cm × 15 kg/ha	2.00	2.00	2.00	3.00	10.00	9.00	10.00
1.5 cm × 30 kg/ha	2.00	2.00	3.00	2.00	12.00	10.00	10.00
1.0 cm × 0 kg/ha (Control)	-	-	-	-	-	-	-
1.0 cm × 15 kg/ha	-	-	-	-	-	-	-
1.0 cm × 30 kg/ha	-	-	-	-	-	-	-
C.D. at 5%	NS	0.39	0.00	0.39	0.39	0.04	0.39

4. CONCLUSION

On the basis of the experimental findings it may be concluded that the application of $ZnSO_4$ at 15 kg/ha was found beneficial for various growth parameters, whereas, post-harvest life of cut gladiolus was greatly influenced by zinc at 30 kg/ha. Among the various grades, the largest corm grade, i.e. 4.0 cm was found to be the best for growth parameters, such as, plant height. Whereas, corm grade 3.0 cm was found to be the best in respect of various post-harvest parameters, such as, weight of spike, length of spike, water uptake, length of rachis, length of the last floret, number of opened florets per spike and duration of flowering. Lowest corm grade (1.0 cm) failed to produce flower might be due to small size of propagule. Among interactions of corm grade and zinc, 3.0 cm × 30 kg/ha found beneficial on most of the post-harvest characters.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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