Int.J.Curr.Microbiol.App.Sci (2018) *7*(4): 2289-2297

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 7 Number 04 (2018)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2018.704.262

Comparative Influence of Planting Density and Foliar Application of Nitrogen on Multiplication of Corms and Cormels of Gladiolus cv. Solan Mangla Grown During Summer and Rainy Season under the Mid-Hill Condition of Himachal Pradesh

Priyadarshini Salam*, Y.C. Gupta, S.R. Dhiman, P. Sharma and Priyanka Sharma

Department of Floriculture and Landscape Architecture, Dr. Y. S. Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh-173 230, India

**Corresponding author*

Keywords

Corms, Cormels, Planting density, Nitrogen, Foliar application

Article Info

Accepted:
20 March 2018
Available Online:
10 April 2018

A B S T R A C T

The present investigation was conducted to study the effect of planting density and foliar application of nitrogen on multiplication of corms and cormels of gladiolus cv. Solan Mangla planted during summer and rainy season. Three levels of planting density *viz.*, 100 cormels/m^2, 120 cormels/m^2 and 140 cormels/m^2 in combination with foliar application of 500 ppm nitrogen at different days interval *viz*., control, 3 days interval, 5 days interval and 7 days interval were tested in split plot design with three replications. The analysed data revealed that the planting density of 100 cormels/m^2 recorded maximum number of cormels/plant, weight of cormels/plant, size of cormels, weight of corms/plant and size of corm whereas highest planting density of 140 cormels/m^2 exhibited maximum number of cormels, corms, weight of corms and cormels/m^2 respectively. Corms and cormels parameters were significantly increased as a result of foliar application of nitrogen at different days interval as compared to control. The multiplication of corms and cormels were higher with the crop grown during summer season as compared to rainy season.

Introduction

Gladiolus (*Gladiolus hybrida* L.) commonly known as sword lily belongs to the family Iridaceae. It is easy to grow and commonly grown for garden use, cut flowers and also in floral arrangements for interior decoration as well as for making high quality bouquets (Aswath and Parathasarathy, 1996). It has second rank after tulip among the bulbous flowers in India and has occupied fourth position in the international trade of cut flowers (Katiyar *et al.*, 2012). Gladiolus cultivation is influenced by a number of factors among which spacing is important. Proper plant spacing is an important practice for providing good open position for sunlight, availability of moisture and nutrients which are vital for successful crop production and quality (Sanjib *et al.*, 2002). However, lack of quality planting material is one of the major bottleneck in commercial cultivation of gladiolus. As such, there is a great scope of establishing a commercial production of corm

and cormels as gladiolus is commercially propagated by corms. Therefore availability of planting materials is pre-requisite for commercial cultivation of gladiolus. Further, corms and cormels production plays an important role in conservation of desirable varieties for further multiplication. Foliar nutrition is recognized as an important method of fertilization as it penetrate the leaf cuticle or stomata and enter the cells facilitating easy and rapid utilization of nutrients. Foliar fertilization provides nutrients to plants by mist in a straight line onto foliage and flora. It is advantageous over soil application in specific occasions in certain crops. Inadequate plant nutrition causes serious disorders and may eventually lead to decline of plant vigour and yield.

The requirement of fertilizers for gladiolus, like other crops has vital role in growth, quality of flowers, corm and cormel production. So, application of suitable nutrients in an optimum amount at appropriate time is important. Nitrogen is considered to be most crucial among all the fertilizers because it is a constituent of protein and nucleic acid, which is helpful in plant growth (Haque and Jakhro, 2002). Keeping in view of all the above facts, the present research work was planned to investigate the effect of planting density and foliar application of nitrogen for best corms and cormels production through cormels within a short duration under the mid-hill condition of Himachal Pradesh.

Materials and Methods

The experiment was conducted during 2014-16 at the Experimental Farm, Department of Floriculture and Landscape Architecture, Dr Y S Parmar University of Horticulture & Forestry, Nauni, Solan, Himachal Pradesh. Newly released gladiolus cultivar 'Solan Mangla' from Department of Floriculture and Landscape Architecture, Solan was used to carry out the investigation. The cv. 'Solan Mangla' is a hybrid progeny of Interpid x White Dream bearing 16-17 florets/spike with bright red coloured florets. Split plot design was adopted to conduct the experiment with foliar spray of nitrogen as main plot treatment and planting density as sub-plot treatments. Uniform sized cormels of 0.75- 1.0 cm of gladiolus cv. 'Solan Mangla' was taken and planted at a depth of 3 cm at different planting densities *viz*., 100, 120 and 140 cormels/m^2. Cormel to cormel distance was kept constant at 5 cm in all the planting densities whereas, row to row spacing was kept 20 cm, 15 cm and 12 cm for 100 cormels/m^2, 120 cormels/m^2 and 140 cormels/m^2 respectively. Planting was done twice in a year i.e. 15th March (summer) and 15th July (rainy) for two successive years. Foliar application of nitrogen through urea was started after forty five days of planting. The plants were sprayed with 500 ppm nitrogen (1086 mg urea/litre) at 3, 5 and 7 days interval respectively up to 90 days of planting. Total number of sprays was 15 at 3 days, 9 at 5 days and 6 at 7 days interval respectively. Spraying was done up to the level of droplet formation. The sprays were done during morning hours (08:00-09:00 A.M) with the help of a hand sprayer. Routine intercultural operations like irrigation, mulching, weeding, earthing up, despiking and control of insect pest and diseases etc. were done as and when required. Planting done during summer season (March) were harvested in October while planting done during rainy season (July) were harvested in February (when the leaves start yellowing and get dried naturally). The data were recorded on various parameters of corms and cormels of gladiolus cv. 'Solan Mangla' for two consecutive years. The data of two years were pooled and analysed using analysis of variance (ANOVA) technique outline by Gomez and Gomez (1984) and treatments were compared by using tabulated 'F' value at 5% level of significance.

Results and Discussion

The results were explained on the basis of pooled data as presented in Table 1-5. The analysis reveals that during summer season the lowest plant density of 100 cormels/m^2 exhibited the highest number of cormels per plant (6.35), weight of cormels per plant (1.25 g) and size of cormel (0.89 cm). Whereas, the lowest number of cormels/plant (4.91), weight of cormels per plant (1.03 g) and size of cormel (0.80 cm) was registered when cormels were planted at a density of 140/m^2. In contrast, maximum weight of cormels/m^2 (91.66 g) was recorded when cormels were planted at a density of 140 cormels/m^2. An inquisition of data (Table 1) shows that in both the season, planting density did not influence number of cormels per square meter significantly. Among different numbers of foliar sprays of N (500 ppm), 15 number of sprays of N at 3 days interval registered maximum number of cormels/plant (7.51), number of cormels/m^2 (573.90), weight of cormels per plant (1.51 g), weight of cormels/m^2 (117.74 g), cormel size (0.92 cm), whereas, all the cormels parameter i.e. number of cormels per plant (3.54), number of cormels/m^2 (254.03), weight of cormels/plant (0.71 g), weight of cormels/m^2 (51.20 g), size of cormel (0.74 cm) was observed minimum in control *i.e.* no spray of N. Interaction between planting density and foliar spray of nitrogen was found to be non-significant in all the cormels parameter except size of cormels with maximum values (1.01 cm) attained at a combination of 100 cormels/m^2 planting density and foliar spray of nitrogen sprayed at 3 days interval.

Similar trends were observed with the cormels grown during rainy season. Among different planting density adopted, maximum number of cormels/plant (5.31), weight of cormels/plant (1.09 g), size of cormel (0.84 cm) was noted at 100 cormels/m^2 planting density and minimum number of cormels/plant (4.45), weight of cormels/plant (0.94 g), size of cormel (0.75 cm) was recorded at a density of 140 cormels/m^2. Foliar spray of N exerted a significant effect recording maximum number of cormels/plant (6.17), weight of cormels/plant (1.26 g), size of cormel (0.87 cm), number of cormels/m^2 (417.56), weight of cormels/m^2 (85.52 g) with 15 numbers of spray of nitrogen at 3 days interval as compared to other number of sprays. On the other hand, plants without foliar spray of nitrogen (control) exhibited minimum number of cormels/plant (3.27), cormels number/m^2 (212.79), cormels weight/ plant (0.65 g), cormels weight/m^2 (45.68 g) and size of cormels (0.68 cm). The interaction between planting density and foliar spray was found to be significant only in cormel size with biggest size (0.92 cm) obtained at combination of 100 cormels/m^2 planting density and N sprayed at 3 days interval which was found to be at par with the planting density of 100 cormels/m^2 with foliar spray of N at 5 days interval (0.89 cm) and smallest cormel size (0.67 cm) was observed in the interaction between 140 cormels/m^2 with no foliar spray of nitrogen (control).

The data generated on various corms parameters reflected a significant variation due to planting density and foliar application of nitrogen at different days interval (Table 3-5). For the cormels grown during summer season, maximum number of corms/m^2 (70.33), weight of corms/m^2 (1399.34 g), total weight of corms and cormels/m^2 (1491.04 g) was noted with the planting density of 140 cormels/m^2. Minimum corms number/m^2 (50.04), corms weight/m^2 (1232.94 g) and total corms & cormels weight/m^2 (1316.18 g) were recorded at 100 cormels/m^2 planting density. However, cormels planted at 100 cormels/m^2 density registered the heaviest weight of corms/plant (27.29 g), total weight of corms & cormels/plant (28.54 g).

Table.1 Effect of planting density and number of foliar sprays of N (500 ppm) on number of cormels/plant and number of cormels/m^2 of the planting stock of gladiolus cv. 'Solan Mangla' grown during summer and rainy season (Pooled data of two consecutive season 2014- 15 and 2015-16)

Planting density (cormels/m^2) / Number of foliar sprays	Number of cormels/plant								Number of cormels/m^2							
	15 March				15 July				15 March				15 July			
	100	120	140	Mean	100	120	140	Mean	100	120	140	Mean	100	120	140	Mean
No spray (control)	3.87	3.43	3.33	3.54	3.40	3.27	3.13	3.27	243.12	255.78	263.20	254.03	198.13	213.78	226.47	212.79
15 at 3 days interval	8.93	7.13	6.47	7.51	6.73	6.07	5.72	6.17	566.75	576.20	578.75	573.90	406.57	419.57	426.55	417.56
9 at 5 days interval	7.08	5.73	5.00	5.94	5.97	5.17	4.57	5.24	478.62	490.22	496.43	488.42	362.78	378.00	382.50	374.43
6 at 7 days interval	5.52	5.12	4.83	5.16	5.12	4.52	4.37	4.67	386.17	403.62	421.35	403.71	309.77	314.60	331.43	318.60
Mean	6.35	5.35	4.91	5.54	5.31	4.76	4.45	4.84	418.67	431.46	439.93	430.02	319.31	331.49	341.74	330.85
Planting density (P)				0.49				0.22				NS				NS
Foliar spray (F)				0.51				0.23				22.48				31.01
P × F				NS				NS				NS				NS

Table.2 Effect of planting density and number of foliar sprays of N (500 ppm) on weight of cormels/plant and weight of cormels/m^2 of the planting stock of gladiolus cv. 'Solan Mangla' grown during summer and rainy season (Pooled data of two consecutive season 2014- 15 and 2015-16)

Planting density (cormels/m^2) / Number of foliar sprays	Weight of cormels/plant (g)								Weight of cormels/m^2 (g)							
	15 March				15 July				15 March				15 July			
	100	120	140	Mean	100	120	140	Mean	100	120	140	Mean	100	120	140	Mean
No spray (control)	0.78	0.69	0.66	0.71	0.68	0.65	0.62	0.65	48.43	52.34	52.82	51.20	39.35	47.04	50.65	45.68
15 at 3 days interval	1.75	1.44	1.34	1.51	1.37	1.24	1.17	1.26	112.46	117.29	123.46	117.74	80.26	86.26	90.03	85.52
9 at 5 days interval	1.39	1.15	1.09	1.21	1.21	1.08	1.00	1.10	94.41	96.97	101.98	97.79	70.01	80.58	86.79	79.13
6 at 7 days interval	1.09	1.05	1.03	1.06	1.10	1.03	0.98	1.04	77.68	84.38	88.37	83.48	65.62	72.19	75.22	71.01
Mean	1.25	1.08	1.03	1.12	1.09	1.00	0.94	1.01	83.25	87.75	91.66	87.55	63.81	71.52	75.67	70.33
Planting density (P)				0.10				0.05				3.34				5.87
Foliar spray (F)				0.11				0.04				4.04				5.90
P × F				NS				NS				NS				NS

Table.3 Effect of planting density and number of foliar sprays of N (500 ppm) on Size of cormels, Size of corms and number of corms/m^2 of the planting stock of gladiolus cv. 'Solan Mangla' grown during summer and rainy season (Pooled data of two consecutive season 2014- 15 and 2015-16)

Planting density (cormels/m^2)	Size of cormels (cm)								Size of corms (cm)								Number of corms/m^2							
	15 March				15 July				15 March				15 July				15 March				15 July			
Number of foliar sprays	100	120	140	Mean	100	120	140	Mean	100	120	140	Mean	100	120	140	Mean	100	120	140	Mean	100	120	140	Mean
No spray (control)	0.75	0.74	0.73	0.74	0.69	0.68	0.67	0.68	2.97	2.89	2.79	2.88	2.38	2.27	2.11	2.25	38.17	40.50	43.83	40.83	37.83	40.00	43.33	40.39
15 at 3 days interval	1.01	0.90	0.84	0.92	0.92	0.87	0.82	0.87	3.97	3.87	3.76	3.87	3.32	3.17	3.08	3.19	58.50	68.67	85.33	70.83	50.83	54.67	58.17	54.56
9 at 5 days interval	0.93	0.87	0.81	0.87	0.89	0.86	0.77	0.84	3.74	3.64	3.46	3.61	3.10	3.01	2.93	3.01	53.33	64.33	79.50	65.72	48.00	52.33	55.67	52.00
6 at 7 days interval	0.88	0.83	0.80	0.84	0.84	0.81	0.75	0.80	3.57	3.22	3.09	3.29	3.02	2.88	2.72	2.87	50.17	57.67	72.67	60.17	45.67	49.67	54.00	49.78
Mean	0.89	0.84	0.80	0.84	0.84	0.81	0.75	0.80	3.56	3.41	3.28	3.41	2.96	2.83	2.71	2.83	50.04	57.79	70.33	59.39	45.58	49.17	52.79	49.18
Planting density (P)				0.01				0.02				0.05				0.02				4.73				1.43
Foliar spray (F)				0.04				0.05				0.20				0.07				6.71				1.59
P × F				0.02				0.03				0.11				0.05				NS				NS

Table.4 Effect of planting density and number of foliar sprays of N (500 ppm) on Weight of corms/plant and Weight of corms/m^2 of the planting stock of gladiolus cv. 'Solan Mangla' grown during summer and rainy season (Pooled data of two consecutive season 2014- 15 and 2015-16)

Planting density (cormels/m^2)	Weight of corms/plant (g)								Weight of corms/m^2 (g)							
	15 March				15 July				15 March				15 July			
Number of foliar sprays	100	120	140	Mean	100	120	140	Mean	100	120	140	Mean	100	120	140	Mean
No spray (control)	25.29	25.09	24.86	25.08	23.92	23.64	23.20	23.59	994.68	1030.35	1086.42	1037.15	857.56	897.29	982.65	912.50
15 at 3 days interval	28.92	28.43	27.87	28.41	26.07	25.68	25.50	25.75	1456.18	1590.61	1662.52	1569.77	1235.25	1303.90	1392.66	1310.60
9 at 5 days interval	27.85	27.35	26.85	27.35	25.55	25.33	25.15	25.34	1279.54	1402.23	1527.74	1403.17	1122.87	1223.81	1318.83	1221.84
6 at 7 days interval	27.09	25.92	25.57	26.19	25.32	25.08	24.74	25.05	1201.34	1256.78	1320.68	1259.60	1084.50	1169.09	1217.90	1157.16
Mean	27.29	26.70	26.29	26.76	25.22	24.93	24.65	24.93	1232.94	1319.99	1399.34	1317.42	1075.05	1148.52	1228.01	1150.53
Planting density (P)				0.15				0.06				74.12				43.81
Foliar spray (F)				0.30				0.14				133.15				50.55
P × F				0.31				0.12				NS				NS

Table.5 Effect of planting density and number of foliar sprays of N (500 ppm) on Total weight of corms and cormels/plant & Total weight of corms and cormels/m^2 of the planting stock of gladiolus cv. 'Solan Mangla' grown during summer and rainy season (Pooled data of two consecutive season 2014- 15 and 2015-16)

Planting density (cormels/m^2)	Total weight of corms and cormels/plant (g)								Total weight of corms and cormels/m^2 (g)							
	15 March				15 July				15 March				15 July			
Number of foliar sprays	100	120	140	Mean	100	120	140	Mean	100	120	140	Mean	100	120	140	Mean
No spray (control)	26.07	25.79	25.53	25.80	24.60	24.29	23.82	24.24	1043.11	1082.69	1139.24	1088.35	896.91	944.33	1033.30	958.18
15 at 3 days interval	30.67	29.86	29.20	29.91	27.44	26.92	26.67	27.01	1568.64	1709.06	1786.15	1687.95	1315.51	1390.16	1482.69	1396.12
9 at 5 days interval	29.24	28.50	27.93	28.56	26.76	26.41	26.14	26.44	1373.94	1499.19	1629.71	1500.95	1192.88	1304.40	1405.62	1300.97
6 at 7 days interval	28.16	26.97	26.59	27.24	26.42	26.11	25.71	26.08	1279.02	1341.16	1409.05	1343.08	1150.12	1241.28	1293.12	1228.17
Mean	28.54	27.78	27.31	27.88	26.31	25.93	25.59	25.94	1316.18	1408.03	1491.04	1405.08	1138.86	1220.04	1303.68	1220.86
Planting density (P)				0.19				0.09				73.54				47.63
Foliar spray (F)				0.50				0.14				135.05				52.91
P × F				0.38				NS				NS				NS

As for corm size, biggest size (3.56 cm) was attained with the planting density of 100 cormels/m^2 as against the minimum corms weight/plant (26.29 g), corms size (3.28 cm) noted at 140 cormels/m^2 planting density. With regards to the effect of foliar spray of nitrogen, corms number/m^2 (70.83), weight of corms/plant (28.41 g), weight of corms/m^2 (1569.77 g) corms size (3.87 cm) was observed maximum when sprayed at 3 days interval. Interaction between these two factors reveals highest weight of corms/plant (28.92 g) at 100 cormels/m^2 planting density with foliar spray of nitrogen (500 ppm) at 3 days interval. Interaction effect reveals that maximum corm size of 3.97 cm was noted at a planting density of 100 cormels/m^2 with foliar spray of nitrogen at 3 days interval which was found to be statistically at par with the combined effect of 120 cormels/m^2 planting density and nitrogen sprayed at 3 days interval (3.87 cm). Similar results were observed during rainy season where highest number of corms/m^2 (52.79), corms weight/m^2 (1228.01 g), weight of corms and cormels per square meter (1303.68 g) was recorded at 140 cormels/m^2 planting density. However, cormels planted at a low density of 140/m^2 exhibited lowest weight of corms/plant (24.65 g), corm size (2.71 cm), total weight of corms and cormels/ plant (25.59 g).

In contrast, maximum weight of corms/plant (25.22 g), corms size (2.96 cm), total weight of corms and cormels per plant (26.31 g) was recorded at 100 cormels/m^2 planting density. Foliar spray of nitrogen at 3 days interval exerted highest number of corms/m^2 (54.56), weight of corms/plant (25.75 g), corms weight/m^2 (1310.60 g), total weight of corms and cormels/plant (27.01 g) and total weight of corms and cormels/m^2 (1396.12 g), whereas, the plant receiving no foliar spray of nitrogen (control) registered lowest values of all the corms parameter.

Amongst the different planting density tested, lowest planting density *i.e.* 100 cormels/m^2 resulted in maximum weight of corms and cormels/plant, corms and cormel size. This may be due to the fact that in lowest planting density plants face less competition from each other for light, water and nutrients and as a consequences show better physiological activity, which in turn is reflected in improvement of cormels yield. The result of present study is in accordance with the findings of Mukhopadhyay and Yadav (1984), Singh and Singh (2000), Sharma and Gupta (2003), Sharma and Talukdar (2003, Shalini *et al.*, (2004) and Kumar and Yadav (2006) in gladiolus. The highest planting density of 140 cormels/m^2 displayed lesser multiplication of corms and cormels. This decreasing trend in cormel production per plant in closer spacing was due to less space availability per cormels for the production of corms and cormels hence lesser utilization of nutrients as compared to the cormels grown in wider spacing where the space, sunlight and nutrient availability was optimum. Similar trends have also been reported by Arora and Khanna (1987) in gladiolus. However, weight of cormels & corms per square meter, number of corms/m^2 was maximum with the highest plant density of 140 cormels/m^2 as more number of cormels were accommodated per square meter as compared to other plant densities hence it produced more number of corms per square meter and ultimately more number of cormels per square meter resulting in highest weight of cormels per square meter.

A similar response of planting density on bulb production was reported by Rees *et al.*, (1968) in narcissus, Rees and Turquand (1969) in tulip, Mukhopadhyay and Yadav (1984) and Kumar and Yadav (2006) in gladiolus. Incalcaterra (1992) observed that increasing the planting density increased corm yield but reduced the corm quality. Klasman *et al.*, (1995) reported similar views in gladiolus.

An overall improvement in corms and cormels production by the foliar application of nitrogen has been noticed. The increasing frequency of foliar spray of nitrogen was found to have marked improvement on the overall corms and cormels parameter. The highest number of foliar sprays of N registered maximum values in corms and cormel production as with the highest number of foliar sprays the plants receive N at regular intervals resulting in more uptake of N by the plants which leads to rapid vegetative growth of the plant producing tallest plant and more number of leaves which thereby increases the photosynthesis where the photosynthates are translocated from the leaves to corms which then helps in producing more numbers of corms and cormels and bigger size corms and cormels etc. However, it would be worthwhile to mention that foliar spray of N might have increased the translocation efficiency of treated plants which are eventually responsible for higher production of corms and cormels since N is an essential constituent of metabolically active compound such as amino acids, proteins, enzymes, nucleic acids, nucleotides, purines and pyrimidines and a part of the chlorophyll molecule and also of the enzyme rubisco which actively participates in protein synthesis. Beneficial effects of higher doses of nitrogen on corm characters have also been reported by Baboo and Singh (2006), Kumar *et al.,* (2006) and Sharma and Singh (2007). The findings are also in consonance with the findings of Khalaj *et al.,* (2012) in tuberose. Devi and Singh (2010) and Khan *et al.,* (2012) also reported that increasing nitrogen levels resulted in superior yield of bulbs in tuberose and cormels in freesia.

The investigation was conducted with three levels of planting density *viz.* 100 cormels/m^2, 120 cormels/m^2 and 140 cormels/m^2 in combination with foliar application of 500 ppm nitrogen at different days interval. The analysed data revealed that the lowest planting density of 100 cormels/m^2 in combination with highest number of sprays of nitrogen i.e. 15 at 3 days interval recorded higher number of cormels/plant, weight of cormels/plant, size of cormels, weight of corms/plant and size of corm whereas the highest planting density of 140 cormels/m^2 exhibited maximum number of cormels, corms, weight of corms and cormels/m^2 of gladiolus cv. 'Solan Mangla'. Corms and cormels parameters were significantly increased as a result of foliar application of nitrogen at different days interval as compared to control. In general, the performance and multiplication of corms and cormels of gladiolus cv. Solan Mangla was found to be superior in summer season to rainy season.

References

Arora, J.S., and Khanna K. 1987. Spacing effects on flower and corm production of gladiolus cv. Sylvia. *Indian Journal of Horticulture* 44: 96-99.

Aswath, C., and Parathasarathy, V.A. 1996. Evaluation of gladiolus cultivars. *Journal of Hill Research*. 9 (1): 147-149.

Baboo, R., and Singh, R.D. 2006. Response of nitrogen, phosphorus and corm size on flowering and corm production in gladiolus. *Journal of Ornamental Horticulture.* 9: 66-68.

Devi, K.L., and Singh, U.C. 2010. Effect of nitrogen on growth, flowering and yield of tuberose cv. Single. *Journal of Ornamental Horticulture.* 13 (3): 228-32.

Gomez, K.A. and Gomez, A.A.1984. *Statistical Procedure for Agriculture Research,* 2nd edition. John Willey and Sons, Singapore.

Haque, I. and Jakhro, A.A. 2002. Soil and fertilizer. National Book Foundation,

Islamabad, Pakistan, Hend, E.W. pp 261–263.

Incalcaterra, G., 1992. Effects of planting depth and density on gladiolus corm production. *Colture Protetee*. 21: 83-94.

Katiyar, P., Chaturvedi, O.P., and Katiyar, D. 2012. Effect of foliar spray of zinc, calcium and boron on spike production of gladiolus cv. Eurovision. *Hortflora Research Spectrum.* 11 (4): 334-338.

Khalaj, M.A., Edrisi, A., and Amiri M. 2012. Effect of Nitrogen and Plant Spacing on Nutrients Uptake, Yield and Growth of Tuberose (*Polianthes tuberosa* L.). *Journal of Ornamental and Horticultural Plants*. 2 (1): 45-54.

Khan M.K., Sajid, M., Rab, A., Jan, I., Zada, H., Zamin, M., Haq, I., Zaman, A., Shah, S.T., and Rehman, A. 2012. Influence of nitrogen and phosphorus on flower and corm production of freesia. *African Journal of Biotechnology*. 11 (56): 11936-42.

Klasman, R., Molinarij and Benetedteo, A.P. 1995. Green house cultivation of cut gladiolus at four planting densities. *Horticulture Argentia.* 14 (36): 65-68.

Kumar, R., Yadav, D.S., and Roy, A.R. 2006. Effect of nitrogen, phosphorus and potassium on growth, flowering and corm production of gladiolus cv. Pusa Shabnum under Meghalaya conditions. *Environment Ecology*. 24S: 939-42.

Mukhopadhyay, T.K., and Yadav, L.P. 1984. Effect of corm size and spacing on growth, flowering and corm production in gladiolus. *Haryana Journal of Horticulture Science*. 13: 95-99.

Rees, A.R., and Turquand, E.D. 1969. Effect of planting density on bulb yield in the tulip. *Journal of Applied Ecology*. 6: 349-58.

Sanjib, S., Talukdar, M.C., Sharma, S., Misra, R.L., and Sanyat, M. 2002. Effect of time, spacing, and depth of planting on gladiolus. *Floriculture Research Trend in India*. 7: 243-245.

Shalini, P., Kohale, S.K., Belorkar, P.V., and Madhuri, K. 2004. Effect of spacing and corm size on growth, flowering and corm production in gladiolus cv. 'Debora'. *Journal of Soil and Crops*. 14 (2): 394-96.

Sharma, G., and Singh, P. 2007. Response of N, P and K on vegetative growth, flowering and corm production in gladiolus under mango orchards. *Journal of Ornamental Horticulture.* 10: 52-54.

Sharma, J.R., and Gupta, R.B. 2003. Effect of corm size and spacing on growth, flowering and corm production in gladiolus. *Journal of Ornamental Horticulture*. 6 (4): 352-56.

Sharma, S., and Talukdar, M.C. 2003. Effect of time, spacing and depth of planting on gladiolus multiplication. *Journal of Ornamental Horticulture*. 6 (2): 139-140.

Singh, A.K., and Singh, C. 2000. Effect of spacing and zinc on production of corms and cormlets in gladiolus (*Gladiolus grandiflorus*) cv. Sylvia. *Horticultural Journal*. 13 (2): 61-64.

How to cite this article:

Priyadarshini Salam, Y.C. Gupta, S.R. Dhiman, P. Sharma and Priyanka Sharma. 2018. Comparative Influence of Planting Density and Foliar Application of Nitrogen on Multiplication of Corms and Cormels of Gladiolus cv. Solan Mangla Grown During Summer and Rainy Season under the Mid-Hill Condition of Himachal Pradesh. *Int.J.Curr.Microbiol.App.Sci.* 7(04): 2289-2297. doi: https://doi.org/10.20546/ijcmas.2018.704.262