Short communication

Ameliorative Impact of Silicon on Growth of Underground Corms and Cormels in Gladiolus (*Gladiolus grandiflorus* Hort.)

ABSTRACT

The objective of present study was to assess the impact of different doses and method of silicon application on growth of underground corms and cormels in gladiolus (*Gladiolus grandiflorus* Hort.) cv. White Prosperity. The experiment was conductedat Punjab Agricultural University, Ludhiana, Punjab, India during 2021-22. The experiment was designed in split plot randomized block design with three replications. It encompassed five basal doses of silicon (0, 25, 50, 75 and 100 kgha^{-1} as SiO_2) along with four foliar sprays at 3rd and 6th leaf stage (water spray, 1%, 2% and 3% as SiO_2). The results showed that corm and cormel production was enhanced with linear increase in silicon dose as basal as well as foliar application with maximum at 100 kgha^{-1}(1.40 and 28.74) and 3% (1.42 and 29.42). However, combined application recorded maximum number of corms and cormels per plant (1.80 and 37.12) with 75 kgha^{-1}+ 3% and 100 kgha^{-1}+ 3%. Combined application of silicon @75 kgha^{-1}as basal and 2% as foliar produced maximum corm weight (38.46 g), whereas cormels weight per plant (28.47 g) was observed maximum with 100 kgha^{-1}basal application along with 3% foliar spray. Basal application of silicon dioxide gave more values for corm traits as compared to foliar application. Hence, it was concluded that silicon application at 100 kgha^{-1}as basal along with 3% foliar spray at 3rd and 6th leaf stage could be recommended to improve underground corm and cormel production in gladiolus.

Keywords: Gladiolus, Silicon, Soil analysis, Plant nutrition, Foliar spray

1. INTRODUCTION

Gladiolus (*Gladiolus grandiflorus* Hort.) is a bulbous flowering ornamental crop known for its magnificent inflorescence. It is known as the "Queen of Bulbous flowers," and belongs to Iridaceae family, indigenous to the Cape region of South Africa. It is used for landscaping, gardening and highly valued for commercial cut-flower and corms production [1].

The underground corms are used for propagation in gladiolus with optimum size between 3.5 cm to 4.5 cm. The corm size is the most crucial variable in the development of high-quality flowers. There is competition for assimilates for the development of the corm and cormels as cormels grow in clusters on stolons between mother and daughter corms. The corm size is the only variable associated with flowering, the larger the corm, the higher the quality of the flowers. Smaller cormels must mature physiologically and achieve a specific corm size before they can be used commercially for high-quality spikes.

Although, silicon is a non-essential nutrient for most plants, but it is known to affect plants growth, production, quality and metabolism and enhance plants resistance. It also strengthens the epidermal wall of plant stem to reduce the cell breakdown and maintains the cell shape [2], increases heavy metal tolerance as well as disease and drought resistance [3]. The application of silicon dioxide is also known to improve growth, flower quality and vase life of flowers.Silicon compound is applied by adding them to the root zone or by foliar application [4].

The farmers have inadequate knowledge about micronutrient elements and their significant impact in increasing output and productions, thus leading to micronutrient-deficient soils which further hinder the plants ability to produce optimal corm and cormel size for commercial flower production in gladiolus.

The recorded documenting about role of silicon application has been reported in some ornamentals like rose, anthurium, pansy and French marigold [5]. However, there is a lack of information regarding optimum dose and method of silicon dioxide application in gladiolus and its effect on corm production. Keeping this in view, the present study was undertaken to investigate the ameliorative impact of silicon application on growth of underground corm and cormelsin gladiolus.

2. MATERIAL AND METHODS

A field experiment was carried out to determine the impact of silicon on underground corm and cormel production and soil propertiesin gladiolus cv. White Prosperity during 2022-23 at Research farm, Department of Floriculture and Landscaping, Punjab Agricultural University, Ludhiana. The corms of uniform size 3- 4 cm diameter were selected and treated with 0.2% Bavistine solution for 30 minutes before planting. The experiment was laid out in split plot randomized block design with twenty treatment combinations of five doses of silicon dioxide as basal doses along with four foliar sprays of silicon dioxide. The powdered active silicon was broadcasted at five different rates i.e. 0, 25, 50, 75, 100 kgha^{-1}as basal application on the prepared beds before planting of corms. After corm sprouting, at 3rd and 6th leaf stage, foliar spray of powdered silicon dissolved in water at four doses i.e. control, 1%, 2% and 3% was done with a pressurized portable sprayer of 1 L covering the entire plant. The control of foliar application was sprayed with deionized water at the same time. Then corms were planted at spacing of 30×20 cm under open field conditions in last week of October, 2022. The recommended dose of NPK fertilizers @ 200:100:100 kgha^{-1}were applied in the form of Urea (half as basal dose and half as top dressing at 3rd and 6th leaf stage) whereas, Single Superphosphate and Muriate of Potash entire dose was applied as basal before planting. The other cultural practices were followed as per the recommendations. The corms were lifted from the ground 4-6 weeks after spike harvesting when leaves turn yellow. These corms were cleaned and dried in shade for 4-5 days and packed in gunny bags for cold storage at 4^{O}C. The data pertaining to corm and cormel traits along with physiological parameters and soil analysis were collected, compiled and statistically analyzed. The multivariate analysis was done for all the observations recorded by using OP-STAT computer software. The split plot two way analysis of variance was used to test the effect of silicon as basal, foliar and their interaction on corm development in gladiolus. The mean difference between a pair of treatments was evaluated by CD at 5% level of significance.

Table 1. Analysis of soil properties at start of experiment

Sr. No.	Soil Property	Mean	Method used
1	Soil pH	8.07	[6]
2	Electrical conductivity	0.024 (dS/m)	[7]
3	Available N	123.35 (kgha^{-1})	[8]
4	Available P	66.84 (kgha^{-1})	[9]
5	Available K	171.81 (kgha^{-1})	[7]
6	Micronutrients: Zn	7.25 (mgkg^{-1})	[10]
	Mn	11.03 (mgkg^{-1})	[10]
	Fe	12.16 (mgkg^{-1})	[10]
	Cu	2.12 (mgkg^{-1})	[10]

3. RESULT AND DISCUSSION

3.1. Corm and Cormel traits

The data regarding impact of silicon as basal application, foliar spray and their interactions suggest significant difference ($p<0.05$) on number of corms and cormels per plant, corm size, corm and cormel weight (Fig 1, 2, 3, 4 and Table 2).

The corm and cormel production was enhanced with linear increase in silicon dose as basal as well as foliar application with maximum at 100kgha^{-1}(1.40 and 28.74) and 3% (1.42 and 29.42). Among the interactions, the maximum number of corms per plant (1.80) was recorded in 75kgha^{-1} + 3%, however, the maximum number of cormels per plant (37.12) was recorded in 100kgha^{-1} + 3%. Basal application of silicon @ 75kgha^{-1} produced largest size corms (4.31cm) at par with 100kgha^{-1}(4.21 cm), however, largest corms (3.93cm) with foliar spray was reported with 3% statistically at par with 2% (3.90 cm). As per combined effect of basal and foliar application, largest corms (4.87cm) were produced with 75 kgha^{-1}

basal application along with 3% foliar spray.The heaviest corms per plant were produced with basal application of silicon @ 75 kgha^{-1}(33.90 g), however heaviest cormels per plant were reported with 100 kgha^{-1}(22.65 g). Significantly heaviest corms and cormels per plant were observed with foliar spray @3% (32.34 and 17.58 g). Combined application of silicon @75 kgha^{-1} as basal and 2% as foliar produced maximum corm weight (38.46 g), whereas cormels weight per plant (28.47 g) was observed maximum with 100 kgha^{-1} basal application along with 3% foliar spray.

The present study concluded that corms and cormelsproduction per plant was enhanced proportionally with increase in application of silicon dose which might be due to the synthesis of additional assimilates (carbohydrates) stored in corms and cormels which result in the production of new corms and cormels per plant. The enhanced corm size and weight with increase in dose of silicon application is due to role of silicon in improving the production of additional assimilates stored in the young corms and making them larger and heavier. Additionally, silicon's role in water retention and cell wall metabolism enhances the turgor and cell wall's capacity to expand, thus increase size of corms. The results are in conformity with study in gladiolus [11]and *Narcissus tazetta*[12].

3.2. Physiological effect: Moisture content (%) and Partitioning coefficient

Combined application of silicon as basal and foliar significantly (p>0.05) influenced moisture content (%) with highest (89.50 %) with 100 k kgha^{-1} basal and 3% foliar spray, however individual effect was non-significant (Fig.5). Basal application of silicon had non-significant effect on partitioning coefficient; however, foliar and combined application effect was significant (Fig 6). Foliar spray @ 3% gave maximum value for partitioning coefficient (0.26), however, the highest partitioning coefficient (0.33) under combined application was observed with 100 k gha^{-1}basal along with 2% foliar spray.

This might be due to the role of silicon in regulating polyamines and ACC to increase root growth and thus improving root water uptake [13] and enhance capability of water retention. It was observed that increased dose of silicon application increases the partitioning coefficient which might be due to the fact that silicon promotes photosynthesis, strengthens plant tissue and ultimately increase partitioning coefficient. The findingsin zinnia [14] and carnation [15] provided support for these conclusions.

3.3. Analysis for available nutrients in soil

The soil analysis for macro-nutrients (nitrogen and phosphorus) and micro-nutrients (Zn, Mn, Fe &Cu) showed non-significant difference (p>0.05) withbasal application of silicon except for potassium (Table 3). The highest available potassium content (204.96 kgha^{-1}) was recorded with basal application of silicon @ 25 kgha^{-1} which was significantly different from other treatments.

4. CONCLUSION

In the present study, basal application of silicon @100 kgha^{-1}along with foliar spray @3% at 3rd and 6thleaf stage resulted in ameliorative growth of corms in gladiolus *w.r.t.*more number of corm and cormels, corm and cormels weight per plant, moisture content and available potassium in soil. It was observed that basal application of silicon dioxide gave more values for corm traits as compared to foliar application. However, it was concluded that combined application of silicon as basal silicon dioxide @100kgha^{-1}along with the foliar spray @ 3% at 3rd and 6th leaf stage could be recommended to improve corm and cormel production in gladiolus.

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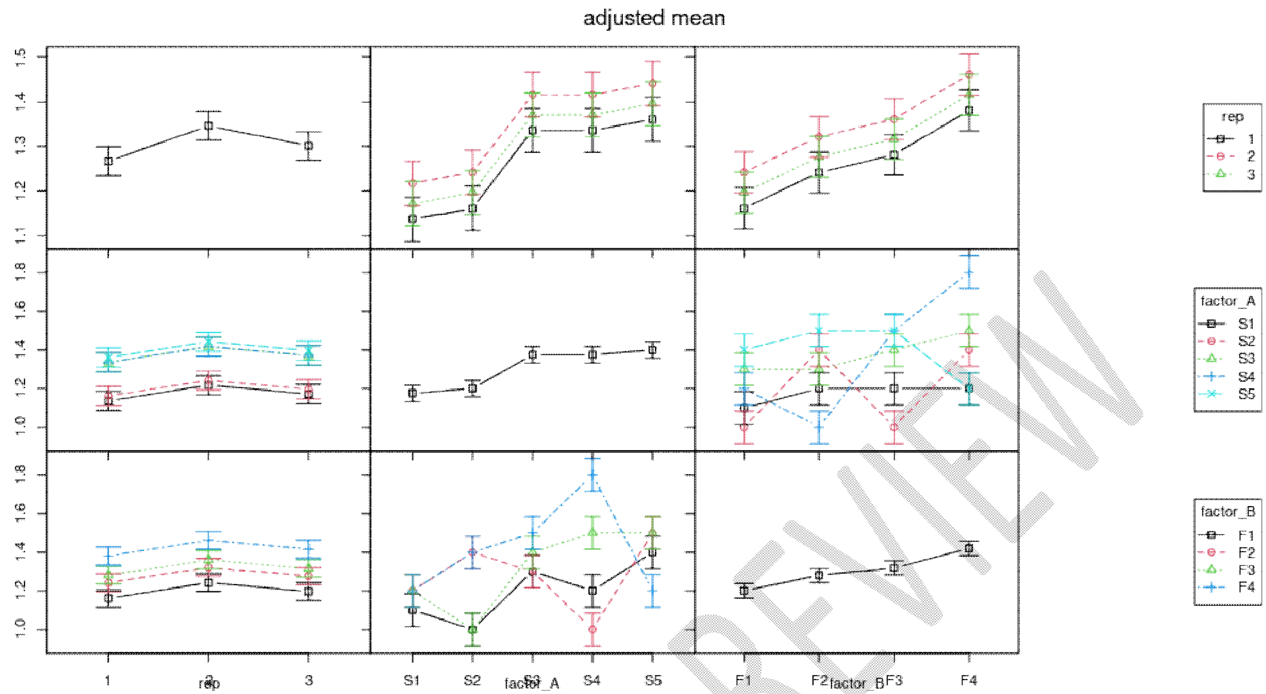

Fig.1.Effect of silicon application on number of corms per plant in gladiolus

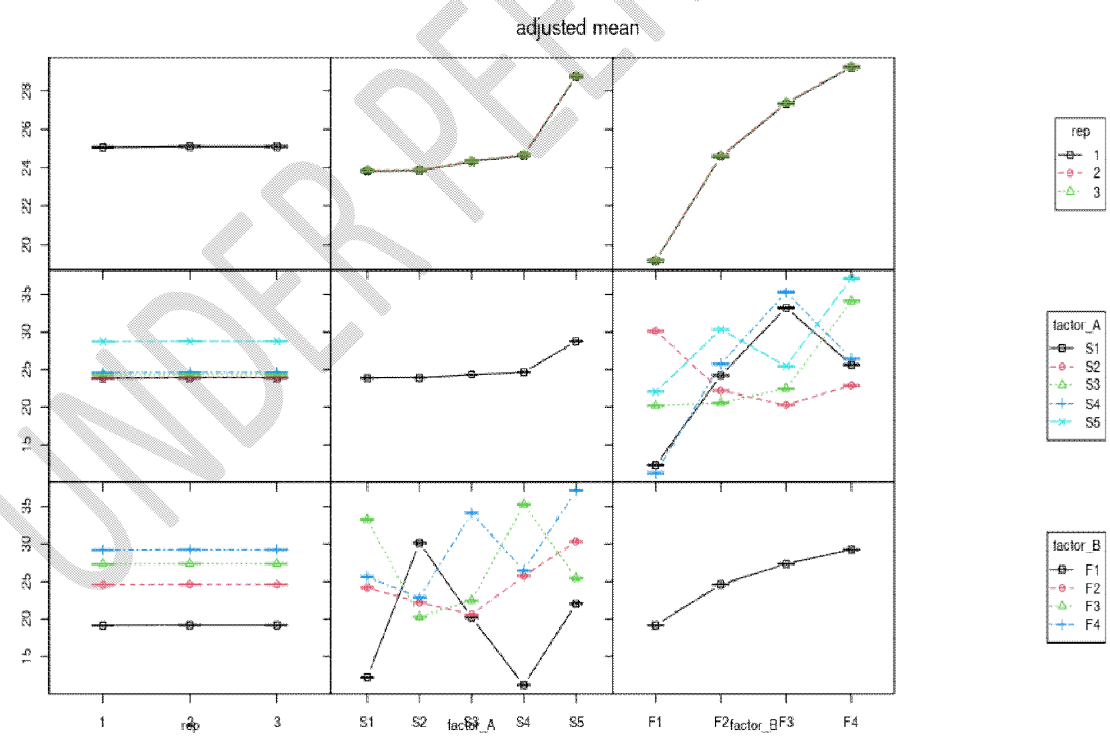

Fig.2.Effect of silicon application on number of cormels per plant in gladiolus

S1: 0, S2: 25, S3: 50, S4: 75, S5: 100 kgha^{-1}SiO_2 F1: 0, F2: 1, F3: 2, F4: 3% SiO_2

Table 2. Effect of silicon application on corm size per plant (cm) in gladiolus

Foliar Spray (SiO_2 %) / Basal application (Si @ kg/ha)	0	1%	2%	3%	Mean (Basal)
0	3.16	3.65	3.21	3.25	3.31[d]
25	3.65	3.80	3.14	3.55	3.53[c]
50	3.80	3.56	3.89	3.56	3.70[b]
75	3.97	3.89	4.54	4.87	4.31[a]
100kg/ha	3.60	4.06	4.75	4.44	4.21[a]
Mean (Foliar)	3.63[c]	3.79[b]	3.90[a]	3.93[a]	
$CD_{(0.05)}$		Soil (S)		0.13	
		Foliar (F)		0.12	
		Factor (F) at same level of S		0.29	
		Factor (S) at same level of F		0.28	

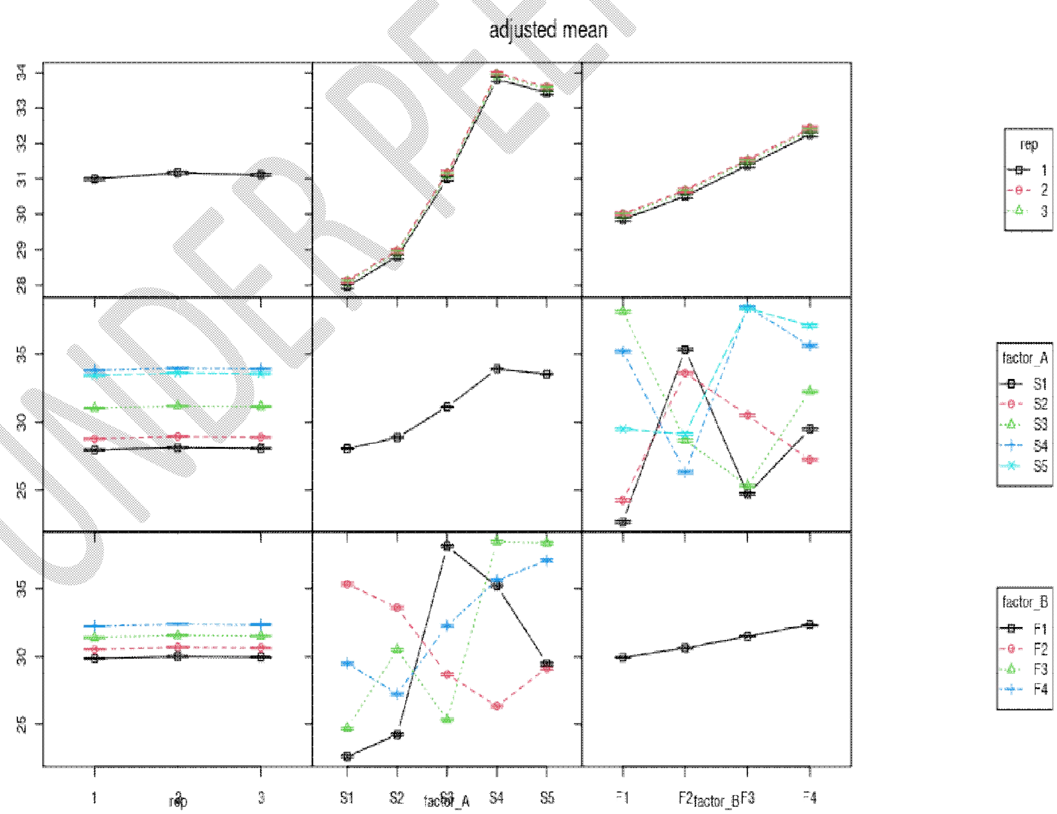

Fig.3.Effect of silicon application on corm weight per plant (g) in gladiolus

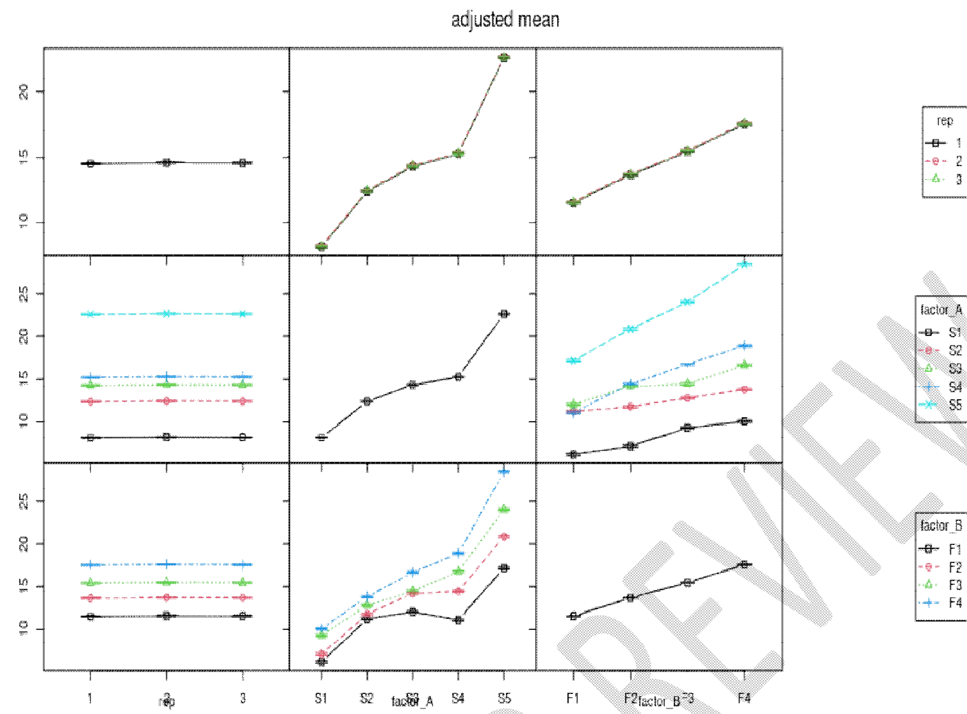

Fig.4.Effect of silicon application on cormels weight per plant (g) in gladiolus

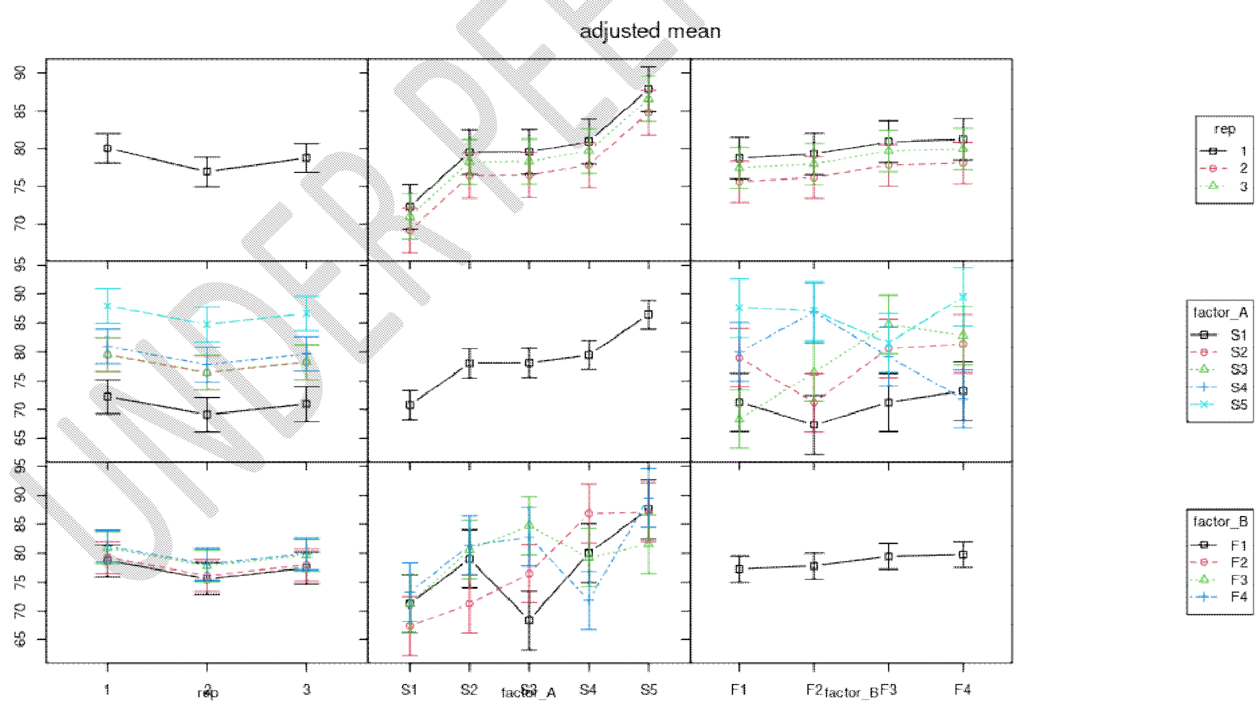

Fig. 5.Effect of silicon application on moisture content (%) in gladiolus

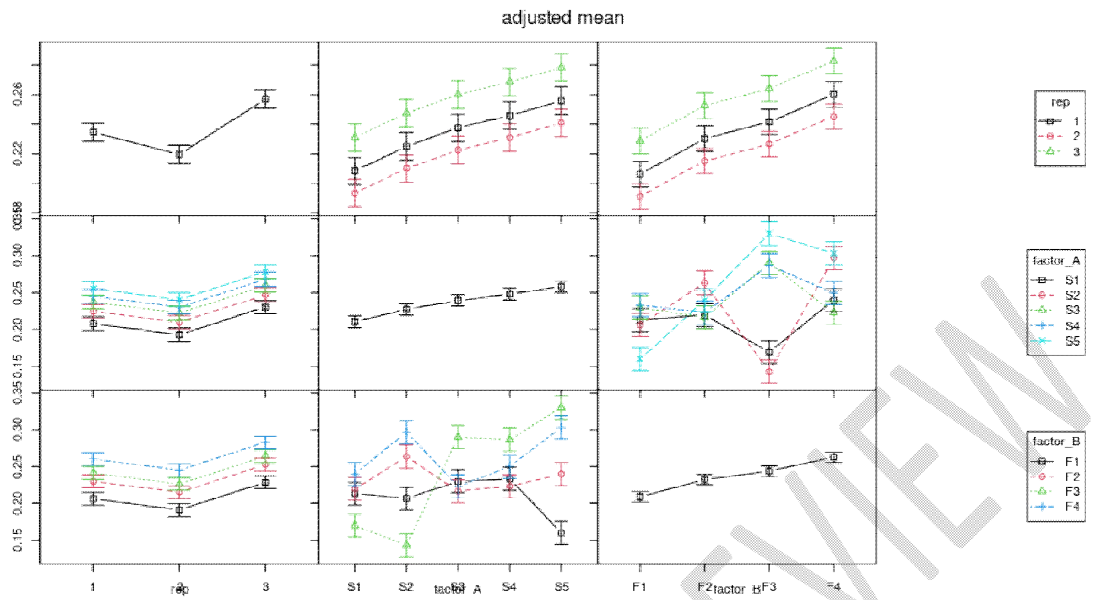

Fig.6. Effect of silicon application on partitioning coefficient of gladiolus

Table 3.Analysis of available in soil (at end of experiment)

Basal application (Si @ kgha^{-1})	Available N (kg ha^{-1})	AvailableP (kg ha^{-1})	Available K (kg ha^{-1})	Available Zn (mgkg^{-1})	Available Mn (mgkg^{-1})	Available Fe (mgkg^{-1})	Available Cu (mgkg^{-1})
0	112.90	57.98	170.33^{b}	7.67	11.81	13.80	2.50
25	121.78	59.20	204.96^{a}	6.78	11.14	14.27	2.30
50	123.98	63.17	181.44^{b}	6.86	11.77	14.12	2.32
75	126.48	67.46	175.84^{b}	7.07	12.06	14.63	2.48
100	128.58	70.29	180.32^{b}	7.09	12.04	15.22	2.22
CD $_{(0.05)}$	NS	NS	19.91	NS	NS	NS	NS