__Original Research Article__

Corm yield and economics of gladiolus cultivars affected by micronutrients grown under open field conditions in under subtropics of Jammu

ABSTRACT

A field experiment was conducted during the 2019-20 at the Experimental Farm, Division of Vegetable Science & Floriculture, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, to evaluate the effect of micronutrients on corm yield and economics of gladiolus (*Gladiolus grandiflorus*L.)cv. 'Nova Lux'. The experiment was laid out in Randomized Block Design with three replications and nineteen treatments. The results revealed that maximum number of corms per plant, corm weight per plant (118.31 g), diameterof corms (5.74 cm),Yield of corms perplot(1866.33 g), net income per hectare (Rs 7,18,463.9/ha) and cost benefit ratio (1:2.34) were obtained with the application of $ZnSO_4$ at 0.2 % and $FeSO_4$ at 0.2 %. However, maximumcormels weight per plant (8.67 g), number of cormels per plant(22.85)and yield of cormels per plot (178.73 g) were recorded with the application of $ZnSO_4$@ 0.4%+ $FeSO_4$@ 0.4%. Thus, foliar application of micronutrients i,e ZnSO4 at 0.2 % and FeSO4 at 0.2 % proved to be most effective in increasing the production and productivity in gladiolus.

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Key words: Micronutrients, Gladiolus, Iron, Zinc, Manganese, Yield and Economics

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INTRODUCTION:

Gladiolus (*Gladiolus grandiflorus*L.) which is known as Queen of bulbous flower is one of the most important bulbous flowering crops grown commercially for cut-flower trade in India. Gladiolus has prolongedvase lifeand ability to withstand long distance transport, Arora*et al*. 2002. Micronutrients application play important role in growth and development of plants, due to their stimulatory and catalytic effects on metabolic processes the flower yield (Lahijie, 2012) and quality (Khosa*et al*., 2011) will be enhanced. The deficiencies of micronutrients create various deficiency symptoms which can be corrected by the foliar spray of micronutrients. Foliar applied micronutrients have an efficiency of 20 – 40 % (Edward, 2009).

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The micronutrient iron is associated with chlorophyll formation, activity of several enzyme systems and plant compounds (catalase and cytochromeoxidase) causing shoot growth and helps improve the growth and flowering of gladiolus. Zinc is necessary for sugar regulation and various enzymatic activity related to plant growth (Khosa*et al*., 2011). Manganese is essential for the development of chlorophyll, photosynthesis, respiration, assimilation of nitrates and the action of several enzymes. It is also involved in evolution of oxygen during photosynthesis. Further, the deficiency of iron micronutrient impairs many plant physiological processes as it is involved in chlorophyll, protein synthesis and in root tip meristem growth Tagliavini and Rombola (2001) reported that iron deficiency causes serious yield and quality losses, demanding the implementation of suitable plant iron deficiency correction strategies. Thus, micronutrient applied through foliar spray is a common practice to cure nutrient deficiency (Mortvedt, 1991). Owing to the beneficial nutritional help, micronutrients are rapidly gaining momentum among flower growers and guarantees better harvest and returns at the same time. To increase the flower production, balanced amount of micro nutrients should be applied for crop growth and productivity. Keeping the above under consideration the study was planned to investigate the effect of different micronutrients on corm yield and economics in gladiolus under sub-tropics of Jammu.

Materials and Method

A field experiment was conducted during 2018-19 at the Experimental Farm, Division of Vegetable Science & Floriculture, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu. The experimental site is located at 32 °40'N latitude and 74° 58' E longitude at an elevation of 332 m above mean sea level falling in the sub-tropical foot hill lands of Shiwaliks in Jammu and Kashmir. The climate of this place is bestowed with hot and dry early summers followed by hot and humid monsoon season and cold winters. The soil at the experimental site was sandy loam in texture.

The experiment was conducted in a randomized block design with 19 micro nutrient treatments *i.e*., T_1- Control (Water spray) ,T_2- $ZnSO_4$ @0.2% , T_3 -$ZnSO_4$ @ 0.4% ,T_4- $FeSO_4$ @ 0.2% ,T_5 -FeSO4@ 0.4%, T_6- MnSO4 @ 0.2% ,T_7- MnSO4 @ 0.4% ,T_8- ZnSO4 @ 0.2% + $FeSO_4$ @ 0.2%, T_9- $ZnSO_4$ @ 0.2% + $FeSO_4$ @ 0.4% ,T_{10}- $ZnSO_4$ @ 0.4% + $FeSO_4$ @ 0.2% ,T_{11}- $ZnSO_4$ @ 0.4% +$FeSO_4$ @ 0.4%, T_{12}- $FeSO_4$ @ 0.2% + $MnSO_4$ @ 0.2%, T_{13}- $FeSO_4$ @ 0.2% +

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$MnSO_4$ @ 0.4%, T_{14}- $FeSO_4$ @ 0.4% + $MnSO_4$ @ 0.2%, T_{15}- $FeSO_4$ @ 0.4% + $MnSO_4$ @ 0.4%, T_{16}- $ZnSO_4$ @ 0.2% + $MnSO_4$ @ 0.2%, T_{17}- $ZnSO_4$ @ 0.2% + $MnSO_4$ @ 0.4%, T_{18}- $ZnSO_4$ @ 0.4% + $MnSO_4$ @ 0.2% and T_{19}- $ZnSO_4$ @ 0.4% + $MnSO_4$ @ 0.4% which were replicated thrice. The Foliar spraying of micronutrients was done after sowing at 3rd and 6th leaf stage. The micronutrients like Fe, Zn and Mn given in the form of $FeSO_4$, ZnSO4 .7H_2O and $MnSO_4$, respectively.

The field was prepared to a fine tilth and beds of the required dimension were made for the flower crop. The corms of uniform size were taken and dipped in 0.2 % bavistin solution for 30 minutes before planting at a spacing of 40 x 20 cm, at a depth of 5 cm, keeping the terminal buds upward followed by light irrigation to ensure the rapid sprouting of the corms. A 100 g P_2O_5per square meter was applied at the time of planting as basal dose and nitrogen at 5 g per square meter was applied in two equal split doses each at 3rd leaf stage and 6th leaf stage. All other intercultural operations were carried out as and when required during the crop growth. No disease incidence was recorded during the experiment.

The data related to various yield parameters were recorded at harvesting and Among economic parameters, net return per ha was calculated by deducting cultivation cost from gross returns. Benefit cost (B:C) ratio was calculated by dividing net returns with total cost of cultivation to evaluate the economic viability of treatments. The data were analyzed following the method described by Gomez and Gomez (1984). Significant difference of sources of variation was tested at the probability level of 0.05. The standard error of the mean (SEm±) and the CD value were indicated in the tables to compare the difference between the mean values.

Results and discussion

Corm yieldAttributes

The data with respect to various yield traits which were measured in terms of number of corms perplant, number of cormels per plant, corms weight per plant, cormels weight per plant,diameterofcorms,yieldofcorms andcormels per plot were presented in Table 1.

The foliar application of micronutrient had non significanteffect on number of corms per plant. However, maximum number of corms per plant were recorded with the application of $ZnSO_4$ at 0.4 % + $FeSO_4$ at 0.4 %. Thenumber of corms per plant was ranged from 1.4 to 1.5. The

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foliar application of micronutrients also reportedsignificant variation in numberof cormels per plant. The significantly highest number of corms was reported by foliarapplication of $ZnSO_4$ at 0.4 % + $FeSO_4$ at 0.4 % which was found to be statistically at par with application of $ZnSO_4$at0.4% +$FeSO_4$at0.2%, $FeSO_4$at0.2% and$ZnSO_4$at0.4%. Theincreasednumberofcormelsmayberelatedtotheimpactofzincandironinthetranslocation of constituents from one mother corm to daughter corm and thus highercormel output was obtained. Similar results were reported by Maurya and Kumar (2014), Subbareddy*et al*. (2014) andNaik*et al*. (2015) ingladiolus.

The data presented in Table 1 revealed that maximum corms weightper plant was obtainedby spraying$ZnSO_4$ with 0.2 % and$FeSO_4$ with 0.2 %. The increase in corm weight may be due to fact that micronutrients assist in protein assimilation and synthesisof nitrogen and also because of the catalytic role in enzyme activation (Chaturvedi*et al*,1986). The micronutrientsplay vitalrole insynthesisofcarbohydrates, protiens andstarch components which finally translocated tothe corms and may enhance the weightof corms. Similar results were reported by Naik*et al*.(2015) in gladiolus.

The effect of micronutrient application reported that significantly higher weight of cormelsper plant was observed in $ZnSO_4$ at 0.4 % + $FeSO_4$ at 0.4 % which is statistically at par with $ZnSO_4$ at 0.4 % and $FeSO_4$ at 0.2 %.Thevariationcould be due to application of essential micronutrients boosts the metabolic activity of the plantwhich results in enhanced growth and yield of cormels. Halder*et al*.(2007).

The various micronutrients foliar spray has affected significantly in diameter ofcorms.Thediameterofcormwasfoundmaximumwith$ZnSO_4$with0.2%and$FeSO_4$with0.2 % which is followed by $ZnSO_4$ at 0.4 % + $FeSO_4$ at 0.4 % and $ZnSO_4$ at 0.4 %. Thedevelopmentoflargercormswithmoreweightmaybedue to micronutrients that have helped in nitrogen assimilation and synthesis of proteinandalsobecause of theircatalytic role inenzyme activation.Similar results were reported by Subbareddy*et al*.(2014),Fahad*etal*. (2014)in gladiolus.

Yield of corms and cormels is economically beneficial as again used for nextgeneration.Amongthefoliarsprayofvariousmicronutrientsmaximumyieldofcormsperplotwasrecorded in$ZnSO_4$with0.2% and$FeSO_4$with0.2% . Variation with respect to corm andcormel yield

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may be due to application of micronutrients which play important role withrespect to synthesis and translocation of storage components that may develop the finalyield of corms and cormels. (MauryaandKumar (2014).

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Relative Economics

Various micronutrient application upon cultivar nova lux was studied effectivelyand the results revealed that, the foliar spray of $ZnSO_4$ with 0.2 % and$FeSO_4$with0.2%recorded highestnet income per hectare (Rs 7,18,463.9/ha) and cost benefit ratio (1:2.34) whichisclosely followedby$ZnSO_4$at 0.4 % and $ZnSO_4$ at 0.4 % + $FeSO_4$ at 0.4 %. This difference may be due tohigher yield of spikes, corms and cormels by the cultivar nova lux as compared to othertreatments. Similar results were reported by Alam*et al*. (2010) andNandeshwar*et al*. (2014) and Jadhav*et al*. (2014)

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Conclusion

Based on the result of the present study it is concluded that foliar application of$ZnSO_4$ at 0.2 % and $FeSO_4$ at 0.2 % increased corms weight per plant, diameter of corms, yield of corms per plot, gross income,net income and cost benefit ratio, followed by $ZnSO_4$ at 0.4 % and$FeSO_4$ at 0.4 %. Thus, application of $ZnSO_4$with 0.2 % and $FeSO_4$ with 0.2 % will enhance the corm yield and is economical for Gladiolus growing farmers of J&K.

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Table 1**. Effectofmicronutrienttreatments oncorm attributes and corm yield in gladiolus**

Treat ments	**Concentration of Micronutrients (mg/l)**	**Numbero fcormspe r plant**	**Corms weight perplant(g)**	**Cormels weight perplant (g)**	**Number of cormelsper plant**	**Diametero fcorms(cm)**	**Yield of corms perplot(g)**	**Yield of cormels perplot(g)**
T_1	Control(Waterspray)	1.47	79.13	3.59	16.63	4.06	1211.91	96.24
T_2	$ZnSO_4$ @0.2%	1.59	101.70	6.85	20.74	4.96	1597.58	138.68
T_3	$ZnSO_4$ @0.4%	1.66	103.30	8.09	21.02	5.26	1631.51	158.33
T_4	$FeSO_4$ @0.2%	1.64	107.27	7.92	21.30	4.77	1686.88	143.27
T_5	$FeSO_4$ @0.4%	1.53	110.13	7.44	17.99	4.89	1763.49	140.58
T_6	$MnSO_4$ @ 0.2%	1.51	93.78	5.85	19.73	5.07	1422.64	121.36
T_7	$MnSO_4$ @ 0.4%	1.53	91.35	5.48	19.17	4.62	1402.45	119.69
T_8	$ZnSO_4$ @0.2%+$FeSO_4$@0.2 %	1.71	118.31	6.46	19.23	5.74	1863.33	132.62
T_9	$ZnSO_4$ @0.2%+ $FeSO_4$@0.4%	1.51	90.47	5.16	18.90	4.57	1386.21	113.90
T_{10}	$ZnSO_4$ @0.4%+ $FeSO_4$@0.2%	1.50	88.45	4.93	22.10	4.51	1367.48	109.37
T_{11}	$ZnSO_4$@ 0.4%+$FeSO_4$@0.4%	1.66	99.65	8.67	22.85	5.36	1516.50	178.73
T_{12}	$FeSO_4$ @ 0.2%+$MnSO_4$@0.2 %	1.48	86.67	4.73	17.52	4.49	1347.14	105.33
T_{13}	$FeSO_4$ @ 0.2%+$MnSO_4$@0.4 %	1.44	86.34	4.56	17.08	4.34	1316.42	101.16
T_{14}	$FeSO_4$@ 0.4%+ $MnSO_4$@	1.59	98.04	6.29	19.68	4.86	1494.42	130.68
T_{15}	$FeSO_4$ @ 0.4%+$MnSO_4$@0.4 %	1.55	95.08	6.01	20.51	4.80	1467.92	125.76
T_{16}	$ZnSO_4$ @ 0.2%+$MnSO_4$@ 0.2%	1.43	85.23	4.27	16.99	4.27	1304.78	98.78
T_{17}	$ZnSO_4$ @ 0.2%+$MnSO_4$@ 0.4%	1.41	84.73	4.15	16.79	4.12	1276.33	98.21
T_{18}	$ZnSO_4$ @ 0.4%+$MnSO_4$@ 0.2%	1.45	81.30	3.77	16.74	4.06	1241.83	97.24
T_{19}	$ZnSO_4$ @ 0.4%+$MnSO_4$@ 0.4%	1.50	82.57	4.03	16.67	4.10	1258.97	97.33
S.Em±		0.10	1.50	0.29	0.73	0.22	10.44	1.50

C.D(0.05)	0.28	4.33	0.74	2.09	0.62	30.06	4.30

Table 2. Effectofmicronutrienttreatments onrelative economics of gladiolus

Treatments	Concentration of micronutrients (mg/l)	Total cost of cultivation (Rs perha)	Grossincome (Rs perha)	Netincome (Rsperha)	B:Cratio
T_1	Control(Waterspray)	3,94,805.00	10,06,806	6,12,000.6	1.55:1
T_2	$ZnSO_4$ @0.2%	3,97,335.00	12,25,583	8,28,248.3	2.08:1
T_3	$ZnSO_4$ @0.4%	4,01,545.00	12,53,417	8,51,871.7	2.12:1
T_4	$FeSO_4$ @0.2%	3,96,645.00	12,00,250	8,03,605.0	2.03:1
T_5	$FeSO_4$ @0.4%	3,98,485.00	12,34,917	8,36,431.7	2.10:1
T_6	$MnSO_4$ @ 0.2%	3,98,025.00	11,84,417	7,86,391.7	1.98:1
T_7	$MnSO_4$ @ 0.4%	4,01,245.00	12,02,750	8,01,505.0	2.00:1
T_8	$ZnSO_4$ @0.2%+ $FeSO_4$@0.2%	3,99,175.00	13,34,917	9,35,741.7	2.34:1
T_9	$ZnSO_4$ @0.2%+ $FeSO_4$@0.4%	4,01,015.00	11,74,917	7,73,901.7	1.93:1
T_{10}	$ZnSO_4$ @0.4%+ $FeSO_4$@0.2%	3,99,705.00	11,69,250	7,69,545.0	1.93:1
T_{11}	$ZnSO_4$@ 0.4%+$FeSO_4$@0.4%	3,97,865.00	12,84,583	8,86,718.3	2.23:1
T_{12}	$FeSO_4$ @ 0.2%+$MnSO_4$ @ 0.2%	3,99,865.00	11,20,917	7,21,051.7	1.80:1
T_{13}	$FeSO_4$ @ 0.2%+$MnSO_4$ @ 0.4%	4,03,085.00	11,15,083	7,11,998.3	1.77:1
T_{14}	$FeSO_4$@ 0.4%+$MnSO_4$@0.2%	4,01,705.00	12,05,250	8,03,545.0	2.00:1
T_{15}	$FeSO_4$ @ 0.4%+$MnSO_4$ @ 0.4%	4,04,925.00	11,92,583	7,87,658.3	1.95:1
T_{16}	$ZnSO_4$ @ 0.2%+$MnSO_4$@ 0.2%	4,00,555.00	11,13,917	7,13,361.7	1.78:1
T_{17}	$ZnSO_4$ @ 0.2%+$MnSO_4$@ 0.4%	4,03,775.00	11,10,250	7,06,475.0	1.75:1
T_{18}	$ZnSO_4$ @ 0.4%+$MnSO_4$@ 0.2%	4,01,085.00	10,71,583	6,70,498.3	1.67:1
T_{19}	$ZnSO_4$ @ 0.4%+$MnSO_4$@ 0.4%	4,04,305.00	10,60,722	6,56,417.2	1.62:1

Treatments	Concentration of Micronutrients (mg/l)	Days taken for spike emergence (days)	Days taken for 1st floretopening (days)
T_1	Control(Waterspray)	71.64	89.79
T_2	$ZnSO_4$ @0.2%	65.22	84.86
T_3	$ZnSO_4$ @0.4%	61.35	84.45
T_4	$FeSO_4$ @0.2%	68.74	87.29
T_5	$FeSO_4$ @0.4%	64.92	85.25
T_6	MnSO4 @ 0.2%	66.49	86.52
T_7	MnSO4 @ 0.4%	67.53	86.70
T_8	$ZnSO_4$ @0.2%+ $FeSO_4$@0.2%	64.94	80.96
T_9	$ZnSO_4$ @0.2%+ $FeSO_4$@0.4%	68.11	87.21
T_{10}	$ZnSO_4$ @0.4%+ $FeSO_4$@0.2%	61.99	83.28
T_{11}	$ZnSO_4$@ 0.4%+$FeSO_4$@0.4%	61.71	82.70
T_{12}	$FeSO_4$ @ 0.2%+MnSO4@0.2%	69.49	87.59
T_{13}	$FeSO_4$ @ 0.2%+MnSO4@0.4%	69.77	88.23
T_{14}	$FeSO_4$@ 0.4%+ MnSO4@ 0.2%	65.74	85.67
T_{15}	$FeSO_4$ @ 0.4%+MnSO4@0.4%	65.82	86.24
T_{16}	$ZnSO_4$ @ 0.2%+MnSO4@ 0.2%	70.77	88.76
T_{17}	$ZnSO_4$ @ 0.2%+MnSO4@ 0.4%	69.78	88.88
T_{18}	$ZnSO_4$ @ 0.4%+MnSO4@ 0.2%	70.93	88.51
T_{19}	$ZnSO_4$ @ 0.4%+MnSO4@ 0.4%	71.12	89.08
S.Em±		1.18	1.31
C.D(0.05)		3.40	3.77

Table 3. Effectofmicronutrienttreatments on flowering characteristics in gladiolus

Treatments	Concentration of Micronutrients (mg/l)	Spikelength(cm)	Rachislength(cm)	Number of florets perspike	Diameter of theflorets(cm)	Weight of the spike(g)	Vaselife(days)
T_1	Control(Waterspray)	63.44	43.27	14.15	10.01	65.72	8.96
T_2	$ZnSO_4$ @0.2%	73.44	50.73	15.75	10.12	71.89	10.82
T_3	$ZnSO_4$ @0.4%	79.56	53.60	17.60	10.54	73.64	12.01
T_4	$FeSO_4$ @0.2%	76.89	51.40	15.63	10.30	73.18	11.28
T_5	$FeSO_4$ @0.4%	78.02	49.27	15.70	10.45	73.53	10.39
T_6	MnSO4 @ 0.2%	76.33	46.90	15.26	10.51	69.53	10.73
T_7	MnSO4 @ 0.4%	77.11	46.23	15.83	10.37	69.29	10.91
T_8	$ZnSO_4$ @0.2%+ $FeSO_4$@0.2%	81.86	56.76	17.69	10.73	74.78	12.07
T_9	$ZnSO_4$ @0.2%+ $FeSO_4$@0.4%	78.10	46.23	15.73	10.09	68.66	10.82
T_{10}	$ZnSO_4$ @0.4%+ $FeSO_4$@0.2%	78.17	44.20	15.40	9.64	68.37	12.09
T_{11}	$ZnSO_4$@ 0.4%+$FeSO_4$@0.4%	80.78	54.73	16.53	10.31	70.99	12.27
T_{12}	$FeSO_4$ @ 0.2%+MnSO4@ 0.2%	66.11	44.20	15.15	10.25	68.15	11.02
T_{13}	$FeSO_4$ @ 0.2%+MnSO4@ 0.4%	73.67	43.80	15.25	10.32	67.80	10.56
T_{14}	$FeSO_4$@ 0.4%+ MnSO4@ 0.2%	74.22	48.70	15.19	10.16	70.56	10.03
T_{15}	$FeSO_4$ @ 0.4%+MnSO4@ 0.4%	77.11	47.37	15.69	10.06	70.67	10.97
T_{16}	$ZnSO_4$ @ 0.2%+MnSO4@ 0.2%	69.56	42.50	15.65	10.17	67.35	10.91
T_{17}	$ZnSO_4$ @ 0.2%+MnSO4@ 0.4%	71.44	45.43	15.62	10.16	67.12	10.01
T_{18}	$ZnSO_4$ @ 0.4%+MnSO4@ 0.2%	71.89	43.43	15.62	10.19	66.27	9.28
T_{19}	$ZnSO_4$ @ 0.4%+MnSO4@ 0.4%	74.89	44.03	14.42	10.33	66.79	9.89

S.Em±	1.06	1.37	0.57	0.28	0. 92	0.29
C.D(0.05)	3.04	3.94	1.63	0.82	2.66	0.84