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 the maximum number of corms per plant, corm weight per plant (118.31 g), diameter of corms (5.74 cm),Yield of corms per plot (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, maximum cormels 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 of gladiolus.

Keywords: Micronutrients, Gladiolus, Iron, Zinc, Manganese, Yield and Economics

INTRODUCTION:

Gladiolus (*Gladiolus grandiflorus* L.) which is known as the Queen of bulbous flower is one of the most important bulbous flowering crops grown commercially for cut-flower trade in India. Gladiolus has prolonged vase life and the ability to withstand long-distance transport, Arora *et al*. 2002. Micronutrients application play important role in the 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).

The micronutrient iron is associated with chlorophyll formation, the activity of several enzyme systems and plant compounds (catalase and cytochromeoxidase) causing shoot growth and helping to improve the growth and flowering of gladiolus. Zinc is necessary for sugar regulation and various enzymatic activities 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 the 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 guarantee better harvest and returns at the same time. To increase the flower production, a balanced amount of micronutrients 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 the 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 foothill 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% + $MnSO_4$ @ 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_5 per square meter was applied at the time of planting as a 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 relating of 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 yield Attributes

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

The foliar application of micronutrient had non significant effect 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 %. The number of corms per plant was ranged from 1.4 to 1.5. The foliar application of micronutrients also reported significant variation in number of cormels per plant. The significantly highest number of corms was reported by foliar application of $ZnSO_4$ at 0.4 % + $FeSO_4$ at 0.4 % which was found to be statistically at par with application of $ZnSO_4$ at

0.4 % + $FeSO_4$ at 0.2 %, $FeSO_4$ at 0.2 % and $ZnSO_4$ at 0.4 %. The increased number of cormels may be related to the impact of zinc and iron in the translocation of constituents from one mother corm to daughter corm and thus higher cormel output was obtained. Similar results were reported by Maurya and Kumar (2014), Subbareddy *et al*. (2014) and Naik *et al*. (2015) in gladiolus.

The data presented in Table 1 revealed that maximum corms weight per plant was obtained by 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 synthesis of nitrogen and also because of the catalytic role in enzyme activation (Chaturvedi *et al*, 1986). The micronutrients play vital role in synthesis of carbohydrates, protiens and starch components which finally translocated to the corms and may enhance the weight of corms. Similar results were reported by Naik *et al*. (2015) in gladiolus.

The effect of micronutrient application reported that significantly higher weight of cormels per 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 %. The variation could be due to application of essential micronutrients boosts the metabolic activity of the plant which results in enhanced growth and yield of cormels. Halder *et al*. (2007).

The various micronutrients foliar spray has affected significantly in diameter of corms. The diameter of corm was found maximum with $ZnSO_4$ with 0.2 % and $FeSO_4$ with 0.2 % which is followed by $ZnSO_4$ at 0.4 % + $FeSO_4$ at 0.4 % and $ZnSO_4$ at 0.4 %. The development of larger corms with more weight may be due to micronutrients that have helped in nitrogen assimilation and synthesis of protein and also because of their catalytic role in enzyme activation. Similar results were reported by Subbareddy *et al*. (2014), Fahad *et al*. (2014) in gladiolus.

Yield of corms and cormels is economically beneficial as again used for next generation. Among the foliar spray of various micronutrients maximum yield of corms per plot was recorded in $ZnSO_4$ with 0.2 % and $FeSO_4$ with 0.2 % . Variation with respect to corm and cormel yield may be due to application of micronutrients which play important role with respect to synthesis and translocation of storage components that may develop the final yield of corms and cormels. (Maurya and Kumar (2014).

Relative Economics

Various micronutrient application upon cultivar nova lux was studied effectively and the results revealed that, the foliar spray of $ZnSO_4$ with 0.2 % and $FeSO_4$ with 0.2 % recorded highest net income per hectare (Rs 7,18,463.9/ha) and cost benefit ratio (1:2.34) which is closely followed by $ZnSO_4$ at 0.4 % and $ZnSO_4$ at 0.4 % + $FeSO_4$ at 0.4 %. This difference may be due to higher yield of spikes, corms and cormels by the cultivar nova lux as compared to other treatments. Similar results were reported by Alam *et al*. (2010) and Nandeshwar *et al*. (2014) and Jadhav *et al*. (2014)

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.

References

Alam, M. N., Abedin, M. J. and Azad, M. 2010. Effect of micronutrients on growth and yield of onion under calcareous soil environment. *International Journal of Plant Sciences*, **1**(3): 56-61.

Arora, A. S., Watanabe, B. M., Takada, K. and Ezura, H. 2006. A novel ethylene receptor homolog gene isolated fromethylene-insensitive flowers of gladiolus (*Gladiolus grandiflora* Hort.). *Biochemical and biophysical research communications*, **351**: 739-744.

Chaturvedi, O. P., Shukla, I. N. and Singh, A. R. 1986. Effect of agromin on growth and flowering in gladiolus. *Progressive horticulture*, **18**(3-4): 196-199.

Edward, R. M. 2009. Importance of micronutrients in changing horticultural scenario in India. *Journal of Horticultural Science*, **4**(1): 1-27.

Fahad, S., Ahmad, K. M., Anjum, M. A. and Hussain, S. 2014. The effect of micronutrient (B, Zn and Fe) foliar application on the growth, flowering and cormproduction of gladiolus

(*Gladiolus grandiflorus* L.) in calcareous soils. *Journal of Agriculture Science and Technology*, **16**: 1671-1682.

Halder, N. K., Ahmed, R., Sharifuzzamin, S. M., Begam, R. A. and Siddiky, M. A. 2007. Effect of boron and zinc fertilization on corm and cormel production of gladiolus in grey terrace soils of Bangladesh. *International Journal of Sustainable Crop Production*, **2**(5): 85-89.

Jadhav, P. B., Alka, S., Mangave, B. D., Patil, N. B., Patel, D. J., Dekhane, S. S. and Kireeti, A. 2014. Effect of organic and inorganic fertilizers on growth and yield of African Marigold (*Tagetes erecta* L.) cv. Pusa Basanti Gainda. *Annals of Biological Research*, **5**(9): 10-14.

Khosa, S., A., Younis, A., Rayit, S., Yasmeen. and Riaz, A. 2011. Effect of Foliar Application of Macro and Micro Nutrients on Growth and Flowering of *Gerbera jamesonii* L. cv. Amer Euras. *Journal of Agriculture and Environmental Sciences*, **11**: 736-757.

Lahijie, M. F. 2012. Application of micronutrients $FeSO_4$ and $ZnSO_4$ on the growth and development of Gladiolus variety "Oscar". *International Journal of Agriculture and Crop Sciences*, **4**(11)**:** 718-720.

Maurya, R. and Kumar**,** A. 2014. Effect of micronutrients on growth and corm yield of gladiolus. *Plant Archives*, **14**(1): 529-531.

Mortvedt, J. J. 1991. Correcting iron deficiencies in annual and perennial plants: Present technologies and future prospects. *Plant and Soil*, **130**(1-2): 273-279.

Naik, D. V., Dhaduk, B. K., Jambhale, S. S. and Kapadia, D. B. 2009. Effect of different micronutrients in gladiolus cv. American Beauty, *Journal of Ornamental Horticulture*, **12**(4): 274-277

Nandeshwar, V. N., Mastiholi, A. B., and Kerutagi, M. G. 2014. Economics of onion (*Allium cepa* L.) production under organic condition. *International Research Journal of Agricultural Economics and Statistics*, **5**(1): 35-38.

Subbareddy, G. V., Rao, M. B. N. and Chandhrasekhar, R. 2014. Studies on the effect of foliar application of zinc on vegetative growth, flowering, corm and cormel production in gladiolus cv. White Prosperity. *Journal of Environmental Sciences*, **4**:35-39.

Tagliavini, M., and Rombolà, A. D. 2001. Iron deficiency and chlorosis in orchard and vineyard ecosystems. *European Journal of Agronomy*, **15**(2): 71-92.

Table 1. Effect of micronutrient treatments on corm attributes and corm yield in gladiolus

Treat ments	Concentration of Micronutrients (mg/l)	Number of corms per plant	Corms weight perplant (g)	Cormels weight perplant (g)	Number of cormels per plant	Diameter of corms (cm)	Yield of corms per plot (g)	Yield of cormels perplot (g)
T_1	Control (Water spray)	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. Effect of micronutrient treatments on relative economics of gladiolus

Treatments	Concentration of micronutrients (mg/l)	Total cost of cultivation (Rs per ha)	Gross income (Rs per ha)	Net income (Rs per ha)	B : C ratio
T_1	Control (Water spray)	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

Table 3. Concentration of micronutrient treatments on flowering characteristics in gladiolus

Treatments	**Concentration of Micronutrients (mg/l)**	**Days taken for spike emergence (days)**	**Days taken for 1st floret opening (days)**
T_1	Control (Water spray)	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 4. Effect of micronutrient treatments on flowering characteristics in gladiolus

Treatments	Concentration of Micronutrients (mg/l)	Spike length (cm)	Rachis length (cm)	Number of florets per spike	Diameter of the florets (cm)	Weight of the spike(g)	Vase life (days)
T_1	Control (Water spray)	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
T10	$ZnSO_4$ @ 0.4% + $FeSO_4$ @ 0.2%	78.17	44.20	15.40	9.64	68.37	12.09
T11	$ZnSO_4$ @ 0.4% + $FeSO_4$ @ 0.4%	80.78	54.73	16.53	10.31	70.99	12.27
T12	$FeSO_4$ @ 0.2% + MnSO4 @ 0.2%	66.11	44.20	15.15	10.25	68.15	11.02
T13	$FeSO_4$ @ 0.2% + MnSO4 @ 0.4%	73.67	43.80	15.25	10.32	67.80	10.56
T14	$FeSO_4$ @ 0.4% + MnSO4 @ 0.2%	74.22	48.70	15.19	10.16	70.56	10.03
T15	$FeSO_4$ @ 0.4% + MnSO4 @ 0.4%	77.11	47.37	15.69	10.06	70.67	10.97
T16	$ZnSO_4$ @ 0.2% + MnSO4 @ 0.2%	69.56	42.50	15.65	10.17	67.35	10.91
T17	$ZnSO_4$ @ 0.2% + MnSO4 @ 0.4%	71.44	45.43	15.62	10.16	67.12	10.01
T18	$ZnSO_4$ @ 0.4% + MnSO4 @ 0.2%	71.89	43.43	15.62	10.19	66.27	9.28
T19	$ZnSO_4$ @ 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**