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Effect of Sulphur and Copper Deficiency on Yield and Dry Matter of Gerbera Grown on Cocopeat under Polyhouse Conditions

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Abstract

The results of the experiment revealed that without sulphur and copper treatment showed significant reduction in yield, fresh and drymatter production of gerbera per plant.

Minimum number of flowers were recorded in without copper and without sulphur treatment (2.60 and 2.80 flowers respectively). The significant decrease in fresh weight of roots were recorded under without copper and without sulphur treatment (35.23g and 35.97g respectively). The lowest fresh weight of crown + leaves was recorded in without sulphur treatment (91.84 g) followed by without copper treatment (93.99 g). The lowest fresh weight of flower was observed in without copper treatment (62.03 g) followed by without sulphur treatment (68.89 g) as compared to all nutrient treatment (136.18 g). Significantly lowest dry weight of roots was recorded in without copper treatment (5.97 g) followed by without sulphur treatment (6.20 g). Significantly lowest dry weight of crown + leaves was observed in without sulphur treatment (15.99 g) followed by without copper treatment (16.33 g). The lowest dry weight of flower was observed in without copper treatment (10.51 g) followed by without sulphur treatment (11.88 g) as compared to all nutrient treatment (24.41 g).

Keywords: Gerbera; Sulphur; Copper; Cocopeat; Deficiency; Dry Matter.

Introduction

Gerbera is an important commercial flower crop grown throughout the world in a wide range of climatic conditions. Gerbera rank 4th among the cut flowers demand (Sujatha, et. al., 2002).[6] Maharashtra is one of the pioneer state for protected flower cultivation. In Maharashtra, the area under polyhouse for production was 600 hectares in the year 2010.

Out of that more than 100 hectares area is being adopted for gerbera cultivation with 1476 lakh flowers per year with a productivity of 250

flowers/m^2 (Anonymous 2010).[2] The area under protected gerbera cultivation is mostly confined in Pune, Satara, Kolhapur and Nashik etc. This crop is having lot of scope for export. The success of gerbera cultivation under polyhouse depends largely on nutrient management apart from other factors. There is very little information available about correct diagnosis of particular nutrient deficiency in crop plants. The criteria of essentiality given by Arnon and Stout (1939), states that 17 essential nutrient elements required for plant to complete their life cycle. Out of 17 essential elements sulphur and copper are important for plant to complete their life cycle.It is also essential to study the effect of deficient nutrient on movement or accumulation of other nutrients. Gerbera growing farmers facing problems to rectify the deficiency symptoms of various nutrients under polyhouse condition. The success of gerbera cultivation under polyhouse depends largely on nutrient management apart from other factors. Therefore it is necessary to know the effect of sulphur and copper deficiency on yield and dry matter of Gerbera.

Material and Methods

The present investigation on "Diagnosis of sulphur and copper deficiency on gerbera grown on cocopeat under polyhouse conditions" was undertaken during 2013-2014 at the Hi-Tech Floriculture and Vegetable Project, College of Agriculture, Pune on gerbera cv. Goliath in a factorial completely randomized block design with three replications. There were sixteen (15 + 1) treatment combinations with 3 main treatment (Nutrient combination) and 5 subtreatments (harvesting days). Main teratments consist of T_1 treatment combinations were supplied with all nutrients solution, T_2 treatment combinations were supplied with all nutrients without sulphur solution and T_3 treatment combinations were supplied with all nutrients without copper solution. Subtreatments includes harvesting at 115, 130, 145, 160, 175 days after planting. Fertigation through drippers was started after 21 days after planting and this was continued up to 100 days after planting to all plants. All nutrients fertigation was given upto 100 days. There after the treatments were started and fertigation was given through saline bottles @ 500ml per each plant per alternate day as per the treatments. It was carried out by following tank A and tank B stock solutions. Tank "A" for all nutrients, without sulphur, without copper were prepared in 25 litres stock solution and stored in cans, whole tank "B" for all nutrients, without sulphur, without copper were also prepared 25 litres stock solution, it was also stored in cans. Twenty five litres of tank "A" and tank "B" solutions were prepared. The solution was diluted from both the tanks (10 ml from tank A + 10 ml from tank B prepared volume 1 litre adjusted pH 5.0-6.1, EC 1.2-1.4 dSm-1) and 500 ml given per plant /alternate day. The dose of nitrogen 200, phosphorous 60 and potassium 260 mg/plant/alternate day before flowering was applied. After flowering, to meet the demand of the crop the dose was incresed for nitrogen 350, phosphorous 60 and potassium 300 mg/plant/ alternate day. All nutrients were given to plants upto 100 days and treatments were started after 100 days. These fertigations through saline bottles were continued up to 175 days after planting i.e., till the final harvest on every alternate day. Cocopeat used for experimental purpose is acidic in nature (pH 5.70) and having very high water holding capacity (81.0%). It contains all the nutrients in limited quantities but rich in iron. The cocopeat contains 0.61% sulphur and 22.0 mg kg^{-1} copper initially. The cocopeat also have high CEC and is responsible for holding the nutrients added in growth media. Amongst the micro nutrients, comparatively higher values of iron than that of zinc, manganese and copper were found in cocopeat. The data recorded was statistically analysed using factorial completely randomized design for each treatment by the methods described by Panse and Sukhatme[4] (1985).

Results and Discussion

Number of flowers per plant

Minimum number of flowers were recorded in without copper and without sulphur treatment (2.60 and 2.80 flowers respectively) due to without copper and without sulphur nutrition. It might be due to sulphur has its role in production of starch, sugars, vitamins and other vital compounds through photosynthesis. In without copper it might be due to copper acts as electron carrier in enzymes which bring about oxidation reduction. Maximum number of flowers (4.53 flowers) were recorded under all nutrients treatment due to all nutrients supply. Also maximum no. of flowers (5.44) were recorded at 175 DAP which was significantly superior over 115 (0.33), 130 (2.11), 145 (3.89) and 160 (4.78) days after planting. The interaction was found statistically significant. Minimum number of flowers were recorded under without copper treatment because copper has its role in flowering. The results obtained are in confirmation with earlier

Table 1: Effect of nutrients on number of flowers per plant at different days after planting

Treatments	Days after planting					
	115	130	145	160	175	Mean
Number of flowers per plant						
T_1 All nutrients	1.00	2.33	5.33	6.67	7.33	4.53
T_2 Without S	0.00	2.00	3.33	4.00	4.67	2.80
T_3 Without Cu	0.00	2.00	3.00	3.67	4.33	2.60
Mean	**0.33**	**2.11**	**3.89**	**4.78**	**5.44**	**-**
	Treatment (T)		**DAP (D)**		**Interaction (T x D)**	
SE ±	0.12		0.16		0.28	
CD at 5%	0.36		0.47		0.81	

Observation at 100 days after planting: 0 (Flowers were not allowed upto 100 days)

results as stated by Ranshur[5] (2009).

Fresh weight of roots, crown + leaves and flowers as influenced by with and without sulphur and copper treatments at different days after planting are presented in Table 2.

Fresh weight of roots

The significant decrease in fresh weight of roots were recorded under without copper and without sulphur treatment (35.23 g and 35.97 g respectively) due to decreased root length and decreased number of roots. Significantly lowest fresh weight of roots were recorded under without copper treatment due to small and inhibited root growth. It might be due to copper has important function in root metabolism as well as in utilization of ammonical nitrogen by plants as well as sulphur having its role in production of starch, sugars, vitamins and other vital compounds through photosynthesis with protein production. The highest fresh weight of roots was recorded at 115 DAP (38.88 g) which was significantly superior over 145 (38.40 g), 160 (38.49 g) and 175 (38.08 g) days after planting and at par on 130 DAP (38.86 g). The interaction effect between treatment and days after planting was found significant. Similar results for sulphur and copper were reported by Juszczuk and Ostaszewaska[3] (2011) and Alexandre[1] *et al.* (2013).

Fresh weight of crown + leaves

The lowest fresh weight of crown + leaves was recorded in without sulphur treatment (91.84 g) followed by without copper treatment (93.99 g). The highest fresh weight of crown + leaves was recorded at 115 DAP (105.06 g) which was significantly superior over 130 (38.86 g), 145 (38.40 g), 160 (38.49 g) and 175 (38.08 g) days after planting. Interaction was found significant with significantly lowest fresh weight (86.77 g) under without sulphur treatment at 175 days after planting. Reduction in fresh weight of leaves observed due to decrease in number of leaves under without sulphur and copper treatment. It might be due to the reduced photosynthetic activity of plant, decreased chlorophyll formation, protein synthesis, starch, sugars, vitamins and other vital compounds through photosynthesis. Similar results for sulphur and copper were reported by Juszczuk and Ostaszewaska[3] (2011) and Ranshur[5] (2009).

Fresh weight of flowers

The lowest fresh weight of flower was observed in without copper treatment (62.03 g) followed by without sulphur treatment (68.89 g) as compared to all nutrient treatment (136.18 g). The highest fresh weight of flowers were recorded at 175 DAP (146.22 g) which was significantly superior over 115 (9.03 g), 130 (56.41 g), 145 (104.83 g) and 160 (86.33 g) days after planting. Interaction was found significant with significantly lowest fresh weight (100.03 g) under without copper treatment at 175 days after planting. Fresh weight of flowers was significantly reduced in without sulphur and copper treatment, due to reduction in number of flowers and decreased flower quality. It might be due to reduced vitamins, enzymes and proteins.

The effect of nutrient addition, days after planting and their interactions on dry weight of roots, crown + leaves and flowers are presented in Table 3.

Dry weight of roots

Dry weight of roots was significantly reduced in without sulphur and copper treatment, as compared

Table 2: Effect of nutrients on fresh weight of roots, crown +leaves and flowers at different days after planting (g)

Treatments	Days after planting					
	115	**130**	**145**	**160**	**175**	**Mean**
A) Fresh weight of roots						
T_1 All nutrients	40.4	42.67	44.23	46.37	48.43	**44.42**
T_2 Without S	38.43	37.5	35.9	34.53	33.47	**35.97**
T_3 Without Cu	37.8	36.4	35.07	34.57	32.33	**35.23**
Mean	**38.88**	**38.86**	**38.4**	**38.49**	**38.08**	**–**
	Treatment (T)		**DAP (D)**		**Interaction (T × D)**	
SE ±	0.078		0.1		0.17	
CD at 5%	0.22		0.28		0.49	
Observation at 100 days after planting: 38.4						
B) Fresh weight of crown + leaves						
T_1 All nutrients	118.7	120.83	122.7	124.5	126.6	**122.67**
T_2 Without S	97.23	94.47	91.77	88.97	86.77	**91.84**
T_3 Without Cu	99.23	96.17	93.53	90.57	90.47	**93.99**
Mean	**105.06**	**103.82**	**102.67**	**101.34**	**101.28**	**–**
	Treatment (T)		**DAP (D)**		**Interaction (T x D)**	
SE ±	0.25		0.32		0.56	
CD at 5 %	0.72		0.93		1.62	
Observation at 100 days after planting: 116.8						
C) Fresh weight of flowers						
T_1 All nutrients	27.1	66.17	156.27	202.43	228.93	**136.18**
T_2 Without S	0	52.6	84.93	97.2	109.7	**68.89**
T_3 Without Cu	0	50.47	73.3	86.33	100.03	**62.03**
Mean	**9.03**	**56.41**	**104.83**	**128.66**	**146.22**	**–**
	Treatment (T)		**DAP (D)**		**Interaction (T x D)**	
SE ±	3.58		4.63		8.02	
CD at 5%	10.25		13.23		22.92	
Observation at 100 days after planting: 0 (Flowers were not allowed upto 100 days)						

Table 3 : Effect of nutrients on dry weight of roots, crown +leaves and flowers at different days after planting

Treatments 115	Days after planting					
	115	**130**	**145**	**160**	**175**	**Mean**
(A) Dry weight of roots (g)						
T_1 All nutrients	7.24	7.65	7.93	8.31	8.68	7.96
T_2 Without S	6.63	6.47	6.19	5.95	5.77	6.20
T_3 Without Cu	6.41	6.17	5.94	5.86	5.48	5.97
Mean	**6.76**	**6.76**	**6.69**	**6.71**	**6.64**	**–**
	Treatment (T)		**DAP (D)**		**Interaction (T × D)**	
SE ±	0.013		0.017		0.030	
CD at 5%	0.039		0.050		0.087	
Observation at 100 days after planting : 6.1						
(B) Dry weight of crown + leaves (g)						
T_1 All nutrients	21.27	21.38	21.31	21.63	21.99	21.52
T_2 Without S	16.98	16.50	15.94	15.45	15.07	15.99
T_3 Without Cu	17.24	16.70	16.25	15.74	15.71	16.33
Mean	**18.50**	**18.20**	**17.83**	**17.61**	**17.59**	**–**
	Treatment (T)		**DAP (D)**		**Interaction (T x D)**	
SE ±	0.13		0.17		0.30	
CD at 5 %	0.39		0.50		0.87	
Observation at 100 days after planting: 20.4						
(C) Dry weight of flowers (g)						
T_1 All nutrients	4.86	11.86	28.00	36.28	41.03	24.41
T_2 Without S	0.00	9.07	14.64	16.76	18.91	11.88
T_3 Without Cu	0.00	8.55	12.42	14.63	16.95	10.51
Mean	**1.62**	**9.83**	**18.36**	**22.56**	**25.63**	**–**
	Treatment (T)		**DAP (D)**		**Interaction (T x D)**	
SE ±	0.63		0.81		1.41	
CD at 5%	1.81		2.34		4.05	
Observation at 100 days after planting : 0 (Flowers were not allowed upto 100 days)						

to all nutrient treatment. Significantly lowest dry weight of roots was recorded in without copper treatment (5.97 g) followed by without sulphur treatment (6.20 g) as compared to all nutrient treatment (7.96 g). It might be due to copper has important function in root metabolismas well as in utilization of ammonical nitrogen by plants. The highest dry weight of roots was recorded at 115 DAP and 130 DAP (6.76 g) which was significantly superior over 145 DAP (6.69 g) and 175 DAP (6.64 g) however at par with 160 DAP (6.71 g). The interaction effect between treatment and days after planting was found significant with significantly lowest dry weight (5.48 g) under without copper treatment at 175 days after planting. Dry weight of roots was reduced due to decrease in number of roots, root length and fresh weight of roots and reduction in activation of enzymes, proteins. Similar results for dry matter production in without sulphur and copper treatment were reported by Juszczuk and Ostaszewska[3] (2011), Ranshur[5] (2009) and Alexandre[1] *et al.* (2013).

Dry weight of crown + leaves

Dry weight of crown + leaves was significantly reduced in without sulphur and copper treatment, as compared to all nutrient treatment. Significantly lowest dry weight of crown + leaves was observed in without sulphur treatment (15.99 g) followed by without copper treatment (16.33 g). The highest dry weight of leaves were recorded at 115 DAP (18.50 g) which was significantly superior over 145 DAP (17.83 g), 160 DAP (17.61 g) and 175 DAP (17.59 g) however at par with 130 DAP (18.20 g). Interaction was found significant with significantly lowest dry weight (15.07 g) under without sulphur treatment at 175 days after planting. Dry weight of crown + leaves was significantly reduced due to decreased number of leaves and chlorosis of leaves. Similar results for dry matter production in without sulphur and copper treatment were reported by Juszczuk and Ostaszewska[3] (2011), Ranshur[5] (2009) and Alexandre *et al.* (2013).

Dry weight of flowers

The lowest dry weight of flower was observed in without copper treatment (10.51 g) followed by without sulphur treatment (11.88 g) as compared to all nutrient treatment (24.41 g). The highest dry weight of flower was recorded at 175 DAP (25.63 g) which was significantly superior over other days after planting. Interaction between treatment and days after planting was found significant with significantly lowest fresh weight (8.55 g) under without copper treatment at 130 DAP. Dry weight of flower was significantly reduced in without sulphur and copper treatment due to reduced fresh weight of flowers and reduced number of flowers. Similar results for dry matter production in without sulphur and copper treatment were reported by Juszczuk and Ostaszewska[3] (2011) and Alexandre[1] *et al.* (2013).

Conclusion

The results of the experiment revealed that without sulphur and copper treatment showed significant reduction in yield, fresh and dry matter production of gerbera per plant.

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