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Impact of foliar application of Multiplex General Liquid on yield and yield attributing traits of Gerbera (*Gerbera jamesonii* L.) growing under protection

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Abstract

Gerbera for being occupier of a prominent position among the top traded cut flowers, it has become a quite profit earning crop that has boosted its cultivation so far. As the quality plays utmost importance for a cut flower as because it must be eye appealing to the consumers; micronutrients are found to play a very crucial role. Multiplex General Liquid is a commercial micronutrient formulation that contains various micronutrients in adequate combination that satisfies the need of micronutrient requirement of plant internally thus enhances the various quality parameters. The current investigation was executed under polyhouse condition at Horticultural Research Station, College of Agriculture, Orissa University of Agriculture and Technology, Bhubaneswar during the period starting from October, 2018 up to April, 2019. This experiment was executed following Randomised Block Design with three replications & twelve treatments including a control. Promising results like increased plant height (31.87 cm), leaf area (204.53 cm²), flower stalk length (46.50 cm), diameter of flowering head (10.84 cm), number of flowers per plant (3.63), vase life of cut flowers (6.70 days) and chlorophyll content of leaves (73.02) were obtained when the plants were subjected to foliar application of micronutrient commercial formulation i.e. Multiplex General Liquid @0.2%.

Keywords: Gerbera, profit earning crop, multiplex general liquid, yield, protection

Introduction

Flowers are found to be associated with human culture and civilization since time immemorial. They are considered to be the symbolic representation of beauty, prosperity, passion, peace, purity and love. Apart from being used in the beautification of surrounding, they are also known to possess various aesthetic, social, economical as well as religious values.

Gerbera (*Gerbera jamesonii* L.) a proud member of family Asteraceae is native to South Africa more particularly Transvaal province & Asiatic regions. Genus "Gerbera" was named in the honour of German naturalist Traugott Gerber, who travelled Russia during 1743. The species "jamesonii" was named after Dr. L. S. Jameson, a British Colonial statesman in South Africa who was one of the discoverers of the species.

The genus comprises of around 45 species. In India, about 7 species are recorded. Out of all the recorded species viz. *Gerbera asplenifolia*, *Gerbera aurantiaca*, *Gerbera Jamesonii*, *Gerbera kunzeana*, *Gerbera viridifolia* etc. Only *Gerbera Jamesonii* is under cultivation with chromosome number $n=x=25$.

Gerbera is mostly preferred among commercial growers because of its wide range of colour variation, long lasting behaviour and wider adaptability for culture which have made Gerbera a flower of choice for cultivation in India. It is popularly known as Transvaal Daisy, African Daisy, Barberton Daisy, Veldt Daisy or Hilton Daisy. In the International cut flower trade it ranks fourth position next to rose, carnation & chrysanthemum.

With the change in life style of people, they have become more conscious about nutritional security, a portion of which has also started to be aesthetically conscious which has paved a way for the raised demand for commercial cut flowers like gerbera.

This increased demand can be successfully met by growing adequate amount of good quality gerbera cut flowers. It can be made possible through growing gerbera plants under protection which ensures year round production by protecting the plants from external vagaries and providing the plants with major nutrients along with micronutrients which not only increase the cumulative yield but also enhance the quality of cut flowers in gerbera by meeting the crop demand that fetches higher price in market in return.

Multiplex General Liquid is a commercial micronutrient formulation having the chemical composition of Zn (3.0%), Mg (0.2%), Fe (0.2%), Mn (0.2%), Cu (0.1%) and Mo (0.005%). The investigation envisaged the impact of Multiplex General Liquid on various plant parameters that attributes to the yield as well as quality of flowers.

The aim of the experiment conducted was concentrated on following objectives-

1. Impact on vegetative growth of plant.
2. Impact on flowering parameters.
3. Impact on chlorophyll content on gerbera leaves.

Materials and Methods

The present study on Impact of foliar application of Multiplex General Liquid on yield and yield attributing traits of Gerbera (*Gerbera jamesonii* L.) growing under protection was executed during 2018-19 at the Horticultural Research Station, College of Agriculture, OUAT, Bhubaneswar, Odisha on already existing plantations. The investigation was conducted to study the effect of foliar application of Multiplex General Liquid- a commercial formulation of micronutrient on various vegetative and flowering parameters of Gerbera (*Gerbera jamesonii* L.) cv. Stanza.

The tissue culture gerbera plantlets to be used in the experiment were procured from KF Bio-Plants, Pune through air which were supplied by the firm in pro-trays having coco peat media. Immediately after being received, the plantlets were subjected to direct planting on well prepared beds under polyhouse condition.

The entire experimental area was divided into 36 plots each of 2.1m × 0.7m size. The design followed for this experiment was Randomised Block Design that comprised of 3 replications consisting of 12 treatments in each replication. The treatment details are as follows:-

- T₁:** NPK 20:20:20 @15g/10 L (Control)
T₂: NPK 20:20:20 @15g/10 L+ ZnSO₄ (0.2%)
T₃: NPK 20:20:20 @15g/10 L + Borax (0.2%)
T₄: NPK 20:20:20 @15g/10 L + MnSO₄ (0.2%)
T₅: NPK 20:20:20 @15g/10 L+ZnSO₄ (0.2%) + Borax (0.2%)
T₆: NPK 20:20:20 @15g/10 L+ ZnSO₄ (0.2%) + MnSO₄ (0.2%)
T₇: NPK 20:20:20 @15g/10 L+ Borax (0.2%) + MnSO₄ (0.2%)
T₈: NPK 20:20:20 @15g/10 L+ ZnSO₄ (0.1%) + Borax (0.1%) + MnSO₄ (0.1%)
T₉: NPK 20:20:20 @15g/10 L + ZnSO₄ (0.2%) + Borax (0.2%) + MnSO₄ (0.2%)
T₁₀: NPK 20:20:20 @15g/10 L+ Toto Care (0.2%)
T₁₁: NPK 20:20:20 @15g/10 L+ Power Bio-20 (0.2%)
T₁₂: NPK 20:20:20 @15g/10 L + Multiplex General Liquid (0.2%)

Chemical composition of commercial formulations used in this experiment

Toto Care: Zn (3.6%), Fe (6.6%), Mn (4.3%), Cu (0.8%) and B (0.7%)

Power Bio-20: NPK+ Mg (1%), Fe EDTA (960 mg), Mn (480 mg), Cu (480 mg), Zn (480 mg), B (190 mg), Co (8 mg), Mo (8 mg)

Multiplex General Liquid: Zn (3.0%), Mg (0.2%), Fe (0.2%), Mn (0.2%), Cu (0.1%), Mo (0.005%)

The recommended dose of fertilizer (RDF) i.e. NPK 20:20:20 @15g/10 ltr was applied through foliar spray at weekly interval whereas foliar application of Multiplex General Liquid and other micronutrients and commercial formulations was done at fortnight interval. Besides regular weeding and plant protection measures were taken as & when required. Plants were irrigated twice a day through drip irrigation.

Observations regarding various vegetative parameters viz. Plant height (cm), leaf area (cm²); floral parameters such as flower stalk length (cm), diameter of flowering head (cm), number of flowers per plant, vase life (days); for biochemical parameter observation was taken on chlorophyll content of leaves by using the measuring instrument called spadmeter.

Statistical Analysis

The observations recorded on various growth and flowering parameters were subjected to statistical analysis. The analysis of variance table was prepared. The treatment effects were tested by using "F" test at 5% level of significance. The critical difference at 5% level was calculated to compare the treatment means.

Result and Discussion

Result of the experiment envisaged that out of all treatment combination, foliar application of Multiplex General Liquid commercial formulation performed best as it resulted in increased plant height (cm), leaf area (cm²), flower stalk length (cm), diameter of flowering head (cm), number of flowers per plant, vase life of cut flowers (days) and chlorophyll content of leaves.

Plant height (cm)

Observations on plant height of gerbera influenced by the foliar application of Multiplex General Liquid were recorded periodically. From the recorded data, it was observed that maximum plant height (31.87 cm) was recorded in plants receiving the treatment combination consisting up RDF @15g/10 L and Multiplex General Liquid @0.2% which was significantly different from other treatments, followed by 29.67 cm in T₁₁ (NPK 20:20:20 @15g/10L + Power Bio-20 @0.2%), 29.27 cm in T₆ (NPK 20:20:20 @15g/10L + ZnSO₄ @0.2% + MnSO₄ @0.2%) & 29.13 cm in T₈ (NPK 20:20:20 @15g/10L + ZnSO₄ @0.1% + Borax @0.1% + MnSO₄ @0.1%). However, minimum plant height (28.06 cm) was recorded in the control.

The increased plant height was attributed because of foliar application of Multiplex General Liquid which is having micronutrient elements those are responsible for nitrogen metabolism that stimulates the vegetative growth thus resulting in increased plant height. They also activate the enzyme IAA oxidase which oxidizes IAA in plants which is responsible for apical dominance leading to increased plant height. By serving as a catalyst, the micronutrient elements alter the enzymatic reactions and helps in larger biosynthesis of photosynthetic assimilates which is another for enhanced plant height. In 2014, Bhagyalakashmamma^[1] obtained similar result in Gerbera as maximum plant height was obtained with foliar application of Multiplex General Liquid.

Leaf area (cm²)

The observations concerning the leaf area were found to be influenced by the foliar application of micronutrient combinations. However, the gerbera plants under treatment combination T₁₂ (NPK 20:20:20 @15g/10 L + Multiplex

General Liquid 0.2%) showed highest leaf area i.e. 204.53 cm² which was subsequently followed by T₆ (NPK 20:20:20 @15g/10 L + ZnSO₄ @0.2% + MnSO₄ @0.2%) & T₁₀ (NPK 20:20:20 @15g/10 L + Toto Care @0.2%) which were at par with each other showing 197.13 cm² & 196.27 cm² leaf area respectively. Minimum leaf area (160.33 cm²) was registered in control plot.

Foliar application of micronutrient formulation i.e. Multiplex General Liquid plays stimulative effect on loosening cell wall, thereby increasing cell elongation along with cell differentiation & enlargement which accounts increase in leaf area. Similarly, micronutrients are also known to play vital role in increasing photosynthesis & translocation of the manufactured food materials that may result in enhanced leaf area. The result comes in line with the experimental findings reported by Chaturvedi *et al.* (1986) [2], where increased numbers of leaves were obtained with application of Agromin (2% N + chelated form of Mn, Mg, B, Zn, Fe, Cu and Mo).

Flower stalk length (cm)

The recorded observations for flower stalk diameter depicted that maximum flower stalk length (46.50 cm) was noted under the treatment combination NPK 20:20:20 @15g/10 L + Multiplex General Liquid @0.2% i.e. 46.50 cm which was subsequently followed by the treatment combination NPK 20:20:20 @15g/10 L + Toto Care @0.2% (T₁₀), NPK 20:20:20 @15g/10 L + Power Bio-20 @0.2% (T₁₁) and NPK 20:20:20 @15g/10 L + Borax @0.2% + MnSO₄ @0.2% (T₇) pertaining flower stalk length of 45.90 cm, 45.73 cm & 45.44 cm which were found to be at par with each other. However, the lowest stalk length (42.11 cm) was recorded in the control plot receiving only major nutrients.

Micronutrient play pivotal role in enhancing cell division and enlargement, improve protein synthesis and dry matter accumulation thus promoting the apical dominance which may be a prominent reason of increased stalk length. The result collaborates with the research findings given by El-Naggar (2009) [3], who recorded maximum floral stem length in Carnation when plants were fertilized through foliar spray with "Sangral" containing Fe, Zn, Cu, B and Mo. In 2003 [9], Nagaraju *et al.* also reported increased flower stem length in Rose.

Diameter of flowering head (cm)

According to the observed data, highest flower head diameter (10.84 cm) was recorded when the plants were treated with NPK 20:20:20 @15g/10 L + Multiplex General Liquid @0.2% (T₁₂) which was followed by NPK 20:20:20 @15g/10 L + ZnSO₄ @0.1% + Borax @0.1% + MnSO₄ @0.1% (T₈) & NPK 20:20:20 @15g/10 L + Power Bio-20 @0.2% (T₁₁) resulting in 10.74 cm & 10.53 cm diameter of flowering head respectively. The control plot showed lowest flower head diameter i.e. 9.49 cm.

The increased flower head diameter may be due to foliar application of micronutrient elements as Multiplex General Liquid as those are responsible for production more photosynthates because of enhanced photosynthesis that serves to increased diameter of flowering head. El-Naggar in 2009 [3] registered maximum flower diameter in Carnation with foliar fertilization of micronutrient formulation "Sangral". The result was also supported by Nagaraju *et al.*

(2003) [9], where highest flower bud diameter was obtained with foliar spray of Multiplex.

Number of flowers per plant

The persual of collected data revealed that the gerbera plants receiving the treatment combination T₁₂ (NPK 20:20:20 @15g/10 L + Multiplex General Liquid @0.2%) noted to produce maximum number of flowers per plant that was closely followed by T₆ (3.50), T₁₁ (3.36), T₁₀ (3.13) which are found to be at par with each other. Number of flowers per plant was recorded to be minimum (2.20) under control (T₁) where plants are subjected to foliar application of major nutrients only NPK 20:20:20 @15g/10 L.

The various micronutrient elements present in Multiplex General Liquid plays vital role in the carbohydrate metabolism and helps in higher assimilate synthesis which may serve as a reason for increased flower production. They are also essential for chlorophyll formation thus promotes the photosynthetic process resulting in production of more photosynthates thus ultimately boosting up the total flower yield. This result corroborates with the findings of [5] Kirilov *et al.* (1988) in carnation where he used Lactofol and [9] Nagaraju *et al.* (2003) in rose where multiplex general liquid gave max flowers.

Vase life of cut flowers (days)

The observed data on vase life of cut flowers revealed that the vase life of cut gerbera was found to be maximum in T₁₂ (NPK 20:20:20 @15g/10 L + Multiplex General Liquid @0.2%) i.e. 6.70 days which was subsequently followed by T₂ (6.53 days), T₁₁ (6.07 days) & T₆ (5.83 days). On the other hand minimum vase life (4.63 days) of cut gerbera was inferred in control (T₁) receiving the treatment combination NPK 20:20:20 @15g/10 L.

The commercial micronutrient formulation application in foliar form is known to play crucial role in the photosynthesis process, thereby enhancing the stored carbohydrate reserve which may serve as a prominent reason for prolonged vase life. The result comes in conformity with the experimental findings of Kewate and Sable (1997) [4] in rose cv. Paradise & Muthumanicham *et al.* (1999) [8] in gerbera.

Chlorophyll content of leaves

Perusal of the data revealed that that the plants receiving the treatment combination NPK 20:20:20 @15g/10 L + Multiplex General Liquid @0.2% showed highest chlorophyll content 73.02 which was followed by T₉ (70.09). It was found to be subsequently followed by T₈ (NPK 20:20:20 @15g/10 L + ZnSO₄ @0.1% + Borax @0.1% + MnSO₄ @0.1%) & T₁₀ (NPK 20:20:20 @15g/10 L + Toto Care @0.2%) pertaining 67.92 and 66.79 respectively which were statistically similar with each other. The leaf chlorophyll content of gerbera plants were found to be minimum i.e. 56.07 in control plot applied with T₁ (NPK 20:20:20 @15g/10 L).

Multiplex General Liquid contains various micronutrient elements like Zn, Mn, Cu, Fe, Mo etc those act as catalyst and play crucial role in enhancing the synthesis of chlorophyll molecule thereby increasing the total chlorophyll content of gerbera leaves. The result was supported by Kumar *et al.* (2004) [6] in tuberose cv. Double and Mostafa *et al.* (1997) [7] in chrysanthemum.

Table 1: Impact of Multiplex General Liquid on various plant parameters

Sl. No.	Treatments	Plant height (cm)	Leaf area (cm ²)	Flower stalk length (cm)	Diameter of flowering head (cm)	Number of flowers per plant	vase life of cut flowers (days)	Chlorophyll content of leaves
1	T ₁	28.07	160.33	42.11	9.49	2.20	4.63	56.07
2	T ₂	28.93	189.87	44.88	10.33	2.40	6.53	63.61
3	T ₃	27.60	179.67	43.78	10.23	2.43	5.40	60.99
4	T ₄	27.87	181.93	42.46	10.37	2.27	5.03	64.65
5	T ₅	27.87	186.07	42.92	10.27	2.54	5.20	64.02
6	T ₆	29.27	197.13	44.91	10.23	3.50	5.83	63.26
7	T ₇	27.33	183.67	45.44	10.51	2.38	5.17	61.17
8	T ₈	29.13	194.67	45.25	10.74	2.99	5.50	67.92
9	T ₉	27.53	187.27	44.76	10.20	2.77	5.57	70.79
10	T ₁₀	28.27	196.27	45.89	10.37	3.13	5.68	66.79
11	T ₁₁	29.67	195.07	45.73	10.53	3.36	6.07	60.11
12	T ₁₂	31.87	204.53	46.50	10.84	3.63	6.70	73.02
SE(m)±		0.692	4.405	0.383	0.247	0.269	0.311	2.694
C.D. at 5%		2.043	13.002	1.130	0.728	0.794	0.919	7.951

**Fig 1:** Gerbera cv. Stanza used in the experiment

Conclusion

Based on the results derived from the current investigation, foliar application of the treatment combination T₁₂ (NPK 20:20:20 @15g/10 L + Multiplex General Liquid @0.2%) gave the most promising results regarding various plant parameters. As compared to others, best performance on parameters like plant height, leaf area, flower stalk length, diameter of flowering head, vase life of cut flowers & chlorophyll content of leaves was attributed through the foliar spray of Multiplex General Liquid. Thus this micronutrient formulation can be commercialized as well as popularized among commercial flower growers so that they can produce adequate quality flowers which will in turn fetch premium price in the market.

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