Developing optimal primary, secondary and micro nutrients levels for cut Gladiolus production

An Academia (UAF) – Industry (Greenworks) Joint Project

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Gladiolus (*Gladiolus* L. hybrids), also known as 'Sword Lily' belongs to family Iridaceae and sub-family ixidaceae. It is a perennial bulbous plant cultivated as cut flower throughout the world and occupies a prime value among profitable flower crops, which have great demand and value in national and international markets. Its attractiveness, beauty, numerous cultivars with catching colors, corms of various sizes and narrow to broad sword shape leaves are major reasons of its high demand and popularity. It grows from round and symmetrical corm, which is enveloped in several layers of brownish and fibrous tunics. Stems are usually un-branched, producing one to nine narrow, sword-shaped leaves, so that it is also called 'Sword Lily' .It has different varieties which varies from small to massive giant flower spikes (Safiullah and Ahmed, 2001).

Fertilization play a pivatol role in quality flower production. Currently, growers apply mainly primary nutrients but no secondary or mincronutrients are used for glaiolus production. Being calcareous soils in most parts of Punjab and Sindh, nutrients available in soil do not become available to the plants. Therefore, best option is to either use soilless substrated to grow or apply majority of nutrients in the form of foliar application. Foliar applications of micronutrients should be completely available to the plant, because they are not either retained or diluted in soil (Baloch et al., 2008). Iron and zinc deficiencies have been observed in Gladiolus plants grown under Punjab conditions (Kumar and Arora, 2000). To maximize corm and cormel production, micronutrients play essential role in plant structure and in physiological process (Halder et al., 2007). Mukesh et al. (2001) observed the effect of foliar application of Zn, Cu, and Fe on the yield and quality of gladiolus and reported that plants treated with micronutrients exhibited better results as compared with the control.

Nitrogen increases the yield and quality of cut flowers (Pandey et al., 2000). Foliar application of nitrogen along with phosphorus can also increase number of florets, corms, cormels and spike length (Lehri et al., 2011). Increase in potassium levels increased the last floret persistency. It may be due to more number of carbohydrates present in the uppermost (last) florets of gladiolus spikes due to the continuous flow of carbohydrates from the senescing lower florets of gladiolus spikes to those developing acropetally (Waithaka et al. 2001). The deficiencies of secondary or micronutrients cause different abnormalities like chlorosis, resetting and scorching as they have vital importance in various metabolism and synthesis processes (Singh et al., 2012). It was observed that application of zinc increased the green pigments of necrotic leaves (Srivastava, 2003). Foliar spray of Ca, B and Zn increased the production of florets per spike. Application of Ca, Zn and B has remarkably influenced the number of florets per spike. Sharma et al. (2004), Jauhari et al. (2005) and Halder et al. (2007) have also reported similar results in gladiolus.

Gladiolus is major bulbous cut flower crop of Pakistan and has high demand in local markets. However, there is no recommendation for optimal use of primary, secondary, and micronutrients for gladiolus production. Therefore, this study was conducted to find out response of four cultivars of gladiolus to various primary, secondary and/or micronutrients.

Objective

To optimize the doses of primary, secondary and micronutrients for better yield and quality production of cut gladiolus.

Materials and Methods

A study was conducted at University of Agriculture, Faisalabad, Pakistan in collaboration with Greenworks, Lahore, to evaluate the effect of primary, secondary and micronutrients on production performance of gladiolus cultivars. Corms were received from Greenworks, Lahore, in 2nd week of February, 2016, acclimatized in laboratory at 25C for a week and sown in 3rd week of February, 2016 on ridges spaced 60 cm (24 inches). Before sowing, corms were treated with fungicide (Reedomil Gold; 1%) for 10 min. and sown after treatment.

Cultivars tested were:

- Amsterdam
- Bangladesh
- Essential
- Grand Prix

Basal dose of fertilizer (Primary macronutrients; N,P and K) were applied at sowing. Corms were sown at 15 cm (6 inches) spacing between corms and 3-4 inches deep. After sowing, all treatment plots were irrigated individually to avoid flow of nutrients between plots. 2nd dose of fertilizer (micronutrients; B, Fe and Zn) was applied at 3 leaf stage, after 6 weeks of sowing, while 3rd dose of fertilizer (secondary nutrients; Ca, Mg and S) were applied at 4 leaf stage; after 8 weeks of sowing. Moreover, 4th dose of fertilizer (2nd application of micronutrients) was applied at 6 leaf stage; after 10 weeks of sowing.

All other cultural practices, viz., irrigation, hoeing, mounding up, staking, IPM etc. were same for all treatments during entire period of study.

Treatments

Treatments included:

- Control (No Additional Fertilizer)
- Nitrogen (N) @ 50 Kg per acre (Urea)
- Phosphorus (P) @ 60 Kg per acre (SSP)
- Potassium (K) @ 60 kg per acre (SOP)
- N+P (50:60)
- N+K (50:60)
- P+K (60:60)
- N+P+K (50:60:60)
- NPK + Secondary Elements ($Ca(NO_3)$, $MgSO_4$, $CaSO4.MgSO_4$)

- NPK + Micronutrients (Boric acid, $FeSO_4$, $ZnSO_4$)
- NPK + Secondary Elements + Micro

Primary Nutrients (NPK) were applied as under:

- N 50 Kg per acre
- P 60 Kg per acre
- K 60 Kg per acre

Secondary nutrients were applied at following rate:

- Mg 0.5 Kg per acre
- S 1 Kg per acre
- Ca 25 Kg per acre

Micronutrients were sprayed twice at following concentrations:

- B 2%
- Fe 2%
- Zn 5 Kg per acre

Measurements

Data were collected on following parameters using standard methods:

- Stem length (cm)
- Time to harvest (days)
- Spike length (cm)
- Spike diameter (mm)
- Number of florets per spike
- Floret diameter (mm)
- Fresh weight of a spike (g)
- Vase life (days)
- Number of cormels per clump

Salient Results

Fertilizer application

- Application of N alone, NPK or NPK along with Sec. and micronutrients increased stem length, spike length, floret diameter and number of cormels per clump of all tested cultivars.
- Fertilizer treatments had no effect on number of florets per spike and only minor effect on vase life.
- Compound fertilizer application delayed flowering by 1-3 days as compared with unfed or single nutrient.
- Fertilizer application increased cormel production in ‘Amsterdam’ and ‘Bangladesh’.

Cultivars

- Among cultivars, 'Amsterdam' had higher stem length (88 cm) followed by 'Bangladesh', (87 cm) whereas 'Essential' and 'Grand Prix' had comparatively shorter stems (72-73 cm).
- 'Essential' started flowering earlier with being 3 days earlier (81 days) than 'Amsterdam' (84 days), while Grand Prix' and 'Bangladesh' took same time to harvest (88 days).
- 'Amsterdam' and 'Bangladesh' had bigger spikes with more number of florets than 'Essential' and 'Grand Prix'.
- All cultivars had similar vase life (4-5 days) with minor differences among fertilizer treatments.
- 'Essential' and 'Grand Prix' had no cormel production, while Amsterdam' and 'Bangladesh' produced 5-7 cormels.

Conclusion

- Use of macronutrients (Primary and Secondary) enhanced growth and improved quality of tested cultivars.
- Micronutrients were not effective might be due to higher temperatures at application time.
- All tested cultivars performed well for spring/summer production in Faisalabad
- Vase life was shorter (due to anticipated higher metabolic rate) but acceptable for local use.

References

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Table 1: Effect of primary, secondary, and micronutrients application on stem length and time to harvest of gladiolus cultivars 'Amsterdam', Bangladesh', 'Essential' and 'Grand Prix'. Data represent means of 30 plants/samples.

Treatments	Stem length (cm)				Time to harvest (days)			
	Amsterdam	Bangladesh	Essential	Grand Prix	Amsterdam	Bangladesh	Essential	Grand Prix
control	83.5	82.2	71.5	70.0	81.3	80.7	78.4	84.9
N	86.0	111.4	72.6	75.3	81.2	81.6	84.7	83.1
P	83.3	81.6	70.8	73.6	82.9	82.6	85.2	85.7
K	87.5	83.9	71.1	70.6	80.2	80.5	81.2	87.6
NP	86.5	83.6	75.6	75.6	81.6	82.8	83.2	85.7
NK	86.8	82.9	74.3	73.5	82.3	83.6	84.5	85.7
PK	86.9	82.6	71.3	69.4	80.5	82.4	82.8	87.7
NPK	85.8	80.9	77.5	76.5	83.5	83.4	83.7	86.9
NPK+S.E	88.8	86.1	78.7	76.7	84.7	83.1	83.3	88.4
NPK+M.N	83.8	84.1	78.6	74.9	82.4	82.1	84.7	88.2
NPK+S.E+M.N	83.7	84.8	79.7	77.2	82.9	83.3	83.3	86.9

Table 2: Effect of primary, secondary, and micronutrients application on spike length and number of florets per spike of gladiolus cultivars 'Amsterdam', Bangladesh', 'Essential' and 'Grand Prix'. Data represent means of 30 plants/samples.

Treatments	Spike Length (cm)				Number of florets per spike			
	Amsterdam	Bangladesh	Essential	Grand Prix	Amsterdam	Bangladesh	Essential	Grand Prix
control	34.5	40.4	30.1	28.2	11.5	12.3	10.2	11.1
N	37.6	42.3	32.8	32.4	12.1	12.7	10.7	11.5
P	38.3	39.8	30.7	29.4	12.2	12.7	10.0	10.4
K	38.0	39.7	33.1	31.1	12.8	13.7	10.7	10.1
NP	38.2	38.9	35.3	33.2	12.9	12.4	10.7	10.8
NK	37.8	37.5	34.1	34.3	13.0	12.8	10.1	11.2
PK	38.1	39.7	30.9	28.8	11.8	13.2	10.2	9.8
NPK	39.4	40.5	33.8	34.1	13.0	13.1	11.5	10.4
NPK+S.E	41.9	41.9	33.4	32.5	13.5	13.6	11.8	10.4
NPK+M.N	39.7	40.5	32.4	32.2	13.0	13.1	11.5	10.6
NPK+S.E+M.N	40.6	40.4	34.8	36.1	12.9	12.7	11.4	11.5

Table 3: Effect of primary, secondary, and micronutrients application on fresh weight of a stem and spike diameter of gladiolus cultivars 'Amsterdam', Bangladesh', 'Essential' and 'Grand Prix'. Data represent means of 30 plants/samples.

Treatments	Fresh weight of stem (g)				Spike diameter (cm)			
	Amsterdam	Bangladesh	Essential	Grand Prix	Amsterdam	Bangladesh	Essential	Grand Prix
control	36.6	36.8	33.2	29.0	7.6	8.0	7.1	7.5
N	39.6	37.7	36.3	36.4	7.8	8.3	7.5	7.9
P	37.5	37.5	34.6	33.2	7.8	8.3	7.8	7.6
K	37.8	38.4	32.6	33.2	7.8	7.9	7.4	8.0
NP	38.8	37.6	38.0	39.1	7.9	8.1	7.8	8.2
NK	38.6	37.8	39.5	34.4	7.9	8.7	7.7	8.0
PK	37.2	38.1	34.0	36.2	7.9	8.2	7.1	7.6
NPK	39.7	38.7	39.0	38.8	8.2	8.6	7.8	7.8
NPK+S.E	39.9	37.6	39.9	41.6	8.7	8.8	7.8	8.0
NPK+M.N	38.8	38.9	37.9	42.1	7.9	7.9	7.7	8.0
NPK+S.E+M.N	40.6	39.1	39.5	41.3	8.2	8.8	8.0	8.2

Table 4: Effect of primary, secondary, and micronutrients application on vase life and number of cormels per clump of gladiolus cultivars 'Amsterdam', Bangladesh', 'Essential' and 'Grand Prix'. Data represent means of 30 plants/samples.

Treatments	Vase life (days)				Number of cormels per clump			
	Amsterdam	Bangladesh	Essential	Grand Prix	Amsterdam	Bangladesh	Essential	Grand Prix
control	6.7	6.5	5.4	5.5	5.1	4.3	0.4	0.1
N	7.1	7.0	5.3	5.5	3.7	4.0	0.2	0.7
P	7.0	6.7	5.5	5.4	5.5	4.3	0.1	0.5
K	7.6	6.8	5.4	5.3	7.0	4.7	0.4	0.2
NP	7.0	6.6	5.3	5.1	6.5	3.7	0.1	0.9
NK	7.3	6.6	5.3	5.3	6.8	5.7	1.0	0.2
PK	6.8	6.6	5.2	4.7	6.9	5.5	0.1	0.1
NPK	7.0	6.9	5.5	5.8	7.0	4.7	0.2	1.5
NPK+S.E	7.0	6.9	5.7	5.8	7.3	4.8	0.1	0.3
NPK+M.N	6.9	6.5	5.6	4.9	6.9	5.3	0.9	0.2
NPK+S.E+M.N	7.1	6.9	6.1	5.7	7.5	6.2	2.1	2.5

Glimpses of the Trial