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Effect of organic and inorganic fertilizer in gladiolus with special reference to growth, yield and flower quality: A review

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Abstract
The word gladiolus is derived from the Latin word "Gladius" meaning sword. It is also named as "Sword Lily" or "Corn Flag". Corn flag is another name in Europe because Gladiolus illyricus is found as wild weed in corn field. In India, the improvement in gladiolus had not still reached to the expected level. Flower crops are very much responsive to fertilizer. It is highly capable of exhausting huge nutrients from native soil. So, it require higher amount of chemical fertilizer in balance proporation for ensuring maximum flower production. Fertilizer requirements of gladiolus like other crops, has vital role in growth, quality, corn and cormel production. There are some reports on the requirement of Nitrogen (N), phosphorus (P), potassium (K) and other fertilization in many countries. Major nutrients like nitrogen, phosphorus, potassium along with zinc noticeably increase the number of flowers, florets/spike, length of spike and flowering stem of gladiolus (Afify, 1989). The microorganisms in biofertilizers restore the soils natural nutrient cycle and build soil organic matter. Through the use of biofertilizers, healthy plants can be grown while enhancing the sustainability and the health of soil.

Keywords: FYM, nitrogen, phosphorus, potassium, flower quality, gladiolus

Introduction
Gladiolus also known as „Queen" of the bulbous flowers is one of the important ornamental flowering crops of the world. It is a popular cut flower owing to its versatile colours and varieties having larger keeping quality of flower. It has great economic value for cut flower trade and much valued by the aesthetic world for beauty and loving people because its prettiness and unparallel elegance 15 (Sadhu and Bose, 1973). They are widely used as artistic garlands, floral ornaments, bouquets etc. The long flower spikes are excellent as cut flower for table decoration when arranged in vases. Gladioli contribute the most important item for aesthetic, economic and social appeal.

Gladiolus is widely grown as specimen for exhibitions. It is mainly cultivated for cut flower, which fetches good price in the cities of India, besides having an export market as well. Gladiolus is one of the important flowers which occupies 5th position in terms of global floriculture trade (Sharma and Sharga, 1994). Besides aesthetic significance as bulbous flower many other uses of Gladiolus species has also been documented. Guillarmod (1977) mentioned that *Gladiolus crassifolius* is used for headache and lumbago, whole plant is crushed heated and applied to the affected part. Cooked corms of *Gladiolus saundersii* when mixed with food are effective against diarrhea.

Gladiolus is a flowering plant with an un- branched stem that grows from a bulbous and rounded corm. Generally 1 to 9 longitudinal leaves can be found on the stem. The flowers are usually found in the same side on the stem, and they are long and funnel shaped. The inflorescence, a spike, bears up to 25 florets arranged alternately on the axis. The numbers of various floral parts are in threes. The outermost 3 segments are called calyx (sepal) and the next 3 corolla (true petals). Collectively, sepal and petals form the perianth (tepals). There are three carpel in the flower, and the tri carpellated pistil has a three forked stigma. The ovary has 75-150 ovules. Anther dehisces in about 2-4 hr after opening of the perianth, when most of the pollen falls on the ground or lip of the lower tepals.

Gladiolus being a highly nutrient responsive crop requires large doze of nutrients *viz*. nitrogen, phosphorus and potassium, which are the major nutrients effecting growth, development and yield. The FYM contains 0.4%-0.6% N, 0.2% P, and 0.4%K and many other micro nutrients, whereas vermicompost is contains 3%, N, 1%P, and 1.5%K. It has been found that, when nutrients are added through mixed source of organic manures and inorganic fertilizers, the yield and quality of corm improves greatly. Looking to poor and marginal farmer it will be beneficial to minimize inorganic nutrient sources through organic manures.

Review of Literature

1. Effect of FYM and Vermicompost on gladiolus

Wisniewska (1982) studied the effect of pine bark as an organic fertilizer in gladiolus culture. In 3-year trials plants were grown on plots receiving pine bark compost, fresh shredded bark (85% pine and 15% birch bark) or non-shredded 5-year-old bark, each at 20 or 40 liters/m.2 NPK basal dressing was also applied. The treatments increased plant height, inflorescence length and corm and cormels yields compared with the control (no organic fertilizers). Asrery *et al.* (2002) [5] the soil application of cotton cake followed by treatment of spikes with 150 ppm 8-hydroxyquinoline resulted in the longest vase life (13.41 days) over the control (8.56 days). Ruppenthal *et al.* (2005) [32] the use of UWC maintained appropriate levels of P and K in the soil. Its application combined with mineral P and K fertilizer increased soil P and K content. The UWC dose of 10.0 tones ha-1 created adequate conditions for plant nutrition, development, and yield of the gladiolus crop.

Godse *et al.* (2006) [16] evaluated the effect of organic manure and biofertilizers with reduced doze of inorganic fertilizer on gladiolus The results revealed that plants receiving vermicompost 8 t/ ha+Azotobacter and PSB @ 25 kg/ ha each+80% RDF significantly increased growth, yield and quality attributes . Ramachandrudu *et al.* (2007) [30] There was a significantly reduction in duration of flowering in cow urine (20%) + Kinetin (50ppm), cow urine at 20%, 50% and 100% greatly improved the number of cormels/plant. Bigger size and heavier corm were produced with cow urine (20%) + Kinetin (50ppm) compared to control and other treatment. Tripathi *et al.* (2007) [40] Application of 1:2 mixtures to soil as a manure enhanced the growth and productivity of gladiolus. Flowering characters like spike length, number of florets/ spike and plant height showed best performance when 1:2 mixture was added @ 20 tones /ha. Nitrogen, phosphorus and potassium contents of soil significantly increased over the control after addition of both mixtures. Overall performance of 1:2 mixture was better in all studied characters over 1:1 mixture and distillery effluent. Gupta et al. (2008) [17] studied the effect of different level of Vermicompost, NPK and FYM on performance of gladiolus. Among the three treatment i.e. T1 Vermicompost (125gm/sqm.), T2 NPK (75gm/sqm.) and T3 FYM (2.5kg/sqm), T3 treatment was recorded best result of plant growth, flowering and corm yield parameters and the same was considered to be the treatment for growing a successful crop.

2. Effect of FYM and Vermicompost on other crops

Yanova and Pyshnyuk (1982) studied the effect of different forms of manure on potato yield. In trials during 1976-77 with potatoes grown on a chernozem soil containing low humus content in the Ukraine, application of 150 kg N/ha as FYM, pig slurry or its solid fraction gave average tuber yields of 28.8, 28.9 and 31.4 t/ha, respectively, compared with 25 t without manures. Patel and Mehta (1984) [26] studied the effect of farm manure, spacing and nitrogen on yield of yam. The corm yields of A. campanulatus increased by 15.5% with 30 t FYM/ha and by 6.5% with 150 kg N/ha. With a spacing of 90 cm between plants the yield in rows 60 cm apart was 19.1 and 38.5% higher than in rows 90 and 120 cm apart, respectively. Sharma (1990) [36] tuber yield increased with up to 120 kg N without FYM and up to 180 kg N with FYM. Total N uptake averaged across N rates was 87.6 kg/ha with FYM and 99.2 kg without FYM. Adhikari *et al.* (1992) [1] Tuber yield, percentage of tubers of more than 45 mm and net profit were highest with application of 150 kg N as ammonium sulphate + 20 t poultry litter/ha. Tejasarwana (1998) [39] Whereas, maximum number of opened flowers was 13.2 flowers/rachis and the highest flower production was 2.9 stalks/hill/year which was obtained by applying 200 g manure polybag twice a year. Mondal *et al.* (2001) [24] reported that addition of various organic sources (T12, 75% RDF + 10 tonnes FYM + 10 tonnes Mushroom spent + 2 tonnes Poultry manure + 4 tonnes Vermi compost + Azotobacter and Phosphorus Solving Bacteria) enhanced the fertility status of soil and improved the soil physio - chemical properties that created the favourable condition in rhizosphore, increase the uptake of nutrients, also the secretion of certain enzymes and auxins and other growth promoting substances which ultimately improved the quality of potato.

Kumar *et al.* (2006) These yield parameters were maximum in FYM+ PSB followed by FYM + Azotobacter and minimum in FYM alone(control), while FYM+ Azospirillum was at par with FYM alone. Bhalla *et al.* (2007) [7] at New Delhi studied that the effect of organic manures and biofertilizers on growth and flowering of Standard carnation (*Dianthus caryophyllus* L.) When cultivar Raggio- de-Sole grown in sand + soil + vermicompost (1:1:1) (v/v) + inorganic fertilizer + biofertilizer@ 2g/plant (Azospirillum and phosphate solubilizing microorganisms) produced maximum plant height (73.20 cm). Sonawane *et al.* (2009) the maximum plant height (66.89 cm), plant spread (25.03 cm) and number of branches (12.73) was observed with the application of 10 tonnes of FYM. The application of FYM @10t/ha had significant effect on uptake of N, P and K in comparison with no application (F0). Significantly highest uptake of N (117.26 Kg/ha), P (32.81 Kg/ha) and K (56.09 Kg/ha) was recorded with FYM application @ 10 t/ha. Yassen and Khalid (2009) [44] studied the influence of organic manures on yield and mineral content of onion. All organic fertilizer treatment i.e. mixture of FYM and chicken manure, overcame the control treatment (recommended NPK) and improved the vegetative growth characters, essential oils, and NPK content.

3. Best combination organic and inorganic nitrogen sources on gladiolus.

Gangadharan and Gopinath (2000) [13]. Results indicated that the recommended NPK dosage + 15 t FYM/ha recorded minimum height of plant at 30, 45 and 60 days after planting (30.34, 58.16 and 80.54 cm respectively). While at 15 days after planting the combination of 15 tonnes of sewage sludge/ha + 60% recommended NPK dosage recorded minimum height of plant, Recommended NPK dosage + 15 t of FYM/ha recorded the minimum leaf area and leaf area index at 60 days after planting, minimum dry weight of whole plant. Bhattacharjee *et al.* (2001) [8] has also recommended for Gladiolus cv. Mayur an NPK dose of 40:20:20g/m2 along with 10 kg FYM for Pune Region. Shankar (2001) [35] studied the response of NPK and FYM alone and in combination on gladiolus. The leaf breadth, weight of cormels per plots, dry weight of plant and yields of cormels was found maximum in the treatment NPK@ 40:20:20g/msq. + FYM @ 5kg/msq; N in two splits (at planting and 60 DAP). Zaghloul and Moghazy (2001) [45] studied the response of some gladiolus cultivars to organic manure and NPK fertilizers on gladiolus. The best results were obtained with the combined application of chicken manure at 60 m3/feddan + NPK at 300:300:150 kg/feddan [1 feddan=0.42 ha]. Castro et al. (2002) [10] All organic fertilizers provided satisfactory results and can, therefore, be used as substitutes to chemical fertilizers, with

the urban waste compost providing the highest economic efficiency. Alla *et al.* (2003) [36] studied the effect of different organic manure (cattle manure, chicken manure, sewage sludge and compost) and NPK fertilizer on the vegetative growth, flowering and chemical composition of some gladiolus. Treatment with chicken manure resulted in the highest leaf number and fresh and dry weight of leaves and spikes.

4. Best combination organic and inorganic nitrogen sources on other crops

Singh and Singh (1971) [34] The highest yields of A grade tubers were obtained by the application of 100 t FYM, + 100 kg N/ha Singh (1977) [34] studied the influence of farmyard manure and fertilizer nitrogen on the tuber yield, dry matter and protein production in potato tuber. The results reported that Dry matter and protein yields of potatoes increased with increases in FYM rates from 0 to 100 t/ha and/or N rates from 0 to 100 kg/ha; they were decreased with 200 kg N/ha applied alone and with FYM. Winter (1979) [43] studied the manurial requirements of Dahlia plants. In a dahlia trial on land that had not been manured with FYM for several years application of the granular organic NPK fertilizer Gekro at 2 kg/RR2 (14.20 m2.) reduced the loss of cuttings after planting and doubled the yield of tubers produced, compared with plants receiving no fertilizer. Sharma *et al.* (1980) [36] studied the effect of farmyard manure on distribution of photosynthates and efficiency of nitrogen utilization by potato. In pot trials, potatoes grown in sandy clay loam acid soil were given 50-200 mg N/kg soil as FYM, calcium ammonium nitrate (CAN) and FYM + CAN in 1:1 ratio on N basis. FYM was less effective than CAN in increasing tuber yields. Widjajanto and Widodo (1982) [42] Maximum marketable tuber yields (20.58 kg/plot) were achieved with application of 20 t FYM + 180 kg N/ha. Sud *et al.* (1990) Yields increased from 13.7 to 27.4 t/ha with 180 kg N/ha and decreased to 25.7 t with 240 kg N/ha. The optimum N rate was 181 kg/ha without FYM and 163 kg with FYM. FYM increased the use efficiency of applied N by 22.4%. Karadogan (1995) [21] studied the effects of manure and fertilizer application on yields, yield components and quality of potatoes. In a field trials, potatoes was given 0, 2.5 or 5.0 t FYM/ha, 0, 8, 16 or 25 kg P2O5/ha, or 0, 8, 16 or 24 kg N/ha. Plant height, percentage of medium-sized and small tubers, and yield of medium-sized tubers increased with increasing FYM rate, while the percentage and yield of large tubers decreased.

Hassandokht and Kashi (2000) [18] Tuber yield increased with increasing FYM rate (17.76, 22.66 and 25.66 t/ha, respectively), while yield from the N rates was 17.79, 24.99 and 23.00 tonnes/ha respectively. Ahmed *et al.* (2004) [2] studied the effect of urea, DAP and FYM on growth and flowering of Dahlia (Dahlia variabilis). The treatments comprised of control (T0), 20 g urea/m2 (T1), 40 g (DAP)/m2 (T2), 4 kg FYM/m2 (T3), T1+T2 (T4), and T1+T2+T3 (T5). The greatest plant height, highest number of branches per plant, highest number of flowers and largest flower size was recorded in T5. Chettri and Thapa (2004) [11] Application of 75% of the recommended dose of N, P and K in conjunction with 10 t FYM/ha significantly increased the dry matter production, tuber bulking rate and tuber yield compared to N, P and K applied singly, even at higher dose. John *et al.* (2007) [25] The result revealed that the maximum value in terms of plant height, stem thickness, wrapper leave area bulb number/m.2 and their weight were recorded with highest level of 60t/ha organic manure tested in the study. Waheeduzzama *et al.* (2007) [41] studied the effect of integrated nutrient management practices to improve flower yield in anthurium (Anthurtum andreanum Lind.). The treatment combination of 4% Panchagavya + 50% RDF favorably influenced plant height (32.40 cm), number of leaves per plant (6.20), days to first flowering (206.50), number of suckers per plant (4.20) and flower yield per plant (5.90).

Gharat *et al.* (2008) [15] result indicated that the significantly less number of days for first flower bud emergence from transplanting was required in treatment T2 -RDF + Vermicompost (66.27 days) and was at par with treatments T3 (68.04 days), T6 (69.12 days). and T1 (70.84 days). Less days for 50 percent flowering (90.12days) were observed in T2, which was at par with treatment T10 (92.14 days) Treatment FYM + Vermicompost produced flower of large size (6.92 cm) which was at par with rest of the treatments except control. Gauhar and Raghav (2008) [14] tuber yield (339.5 q/ha) was obtained with T1275% RDF at 160:100:120 kg/ha + 10 t farmyard manure/ha + 10 t mushroom spent/ha + 2 t poultry manure/ha + 4 t vermicompost/ha + Azotobacter and phosphate solubilizing bacteria (T12). Patil and Dhaduk (2009) [27] The treatment 100% inorganic was significantly superior to the control. Comparatively less growth was reported with produced at 100% Castor Cake and 100% Neem Cake than that observed with 100% FYM. The commencement of flowering was delayed with application of organic fertilizers and control in comparison with inorganic fertilizers. Surindra (2009) maximum range of some plant parameters i.e. root length, shoot length, leaf length, fruit weight, number of cloves in garlic fruit and number of leaves per plant was in the T4 (15t/ha vermicompost + 50% NPK), treatment plot. Also, the average fruit weight was approximately 26.4% greater in T4 than recommended NPK treatment plot (T1). The vermicompost manure showed a comparatively better result of plant production than composted manure.

5. Economics of gladiolus cultivation

Gangadharan and Gopinath (2000) [13] Highest numbers of spikes per plot and per hectare were obtained with treatment combinations of 5 t sewage sludge/ha + 80% NPK and 10 t vermicompost/ha+60% NPK. The latter combination also resulted in the highest number of corms per plant (24.67) and per hectare (246 666). Sasani *et al.* (2003) [33] studied the effect of levels of inorganic fertilizers with and without organic manures on yield of potato in North Gujarat. The treatment where the potato crop received 25% more dose of NPK than the recommended dose (i.e. 220:110:220kg NPK/ha) along with FYM at 25 tonnes/ha recorded the maximum tuber yield of 533.3 q/ha and 388.5 q/ha during 2001-02 and 2002-03, respectively. This treatment also recorded the highest net returns of Rs 69,990/ha over the same level of inorganic fertilizers without FYM (Rs 55,570/ha). Application of FYM increased the potato yield at all levels of applied fertilizers. Rajhansa (2010) [29] studied the effect of organic and inorganic fertilizers on gladiolus. He reported that treatment combination T3: 50%N (urea) + 50% N (FYM) + P and K @20gm/m2 gave highest benefit cost ratio (1:2.66), with gross return Rs 1139518.50 and net return Rs 828206.89.

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