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Effect of integrated nutrient management on corm and cormels production of gladiolus cv. PDKV Gold

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Abstract
The present investigation entitled, "Effect of integrated nutrient management on corm and cormels production of gladiolus cv. PDKV Gold" was carried out during the years 2018-19 and 2019-20 at College of Agriculture Garden, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (M.S.).The experiment was laid out in Randomized Block Design with three replications and thirteen treatments. The results of the experiment revealed that, yield parameters *viz*., corms plant^{-1}, corms plot^{-1}, corms hectare^{-1} and cormels plant^{-1}were recorded maximum with the treatment of 75% RDF + 8 t Vermicompost + Azotobacter + PSB. Whereas, quality parameters *viz*., diameter of corm, length of corm, weight of corms plant^{-1} and weight of cormels plant^{-1} were recorded maximum under the treatment 75% RDF + 8 t Vermicompost + Azotobacter + PSB.

Keywords: Azotobacter, gladiolus, quality, PSB, yield

Introduction
Gladiolus is commonly known as sword lily, corn flag, gladioli, etc. It has also known as 'queen of bulbous flowers, has ever increasing demand in the flower markets (Roy *et al.* 2017) [14]. Botanically gladiolus is known as *Gladiolus grandiflorus* L and belongs to Iridaceae family. In India the major gladiolus growing states are West Bengal, Karnataka, Tamil Nadu, Maharashtra, Uttar Pradesh, Madhya Pradesh and Bihar. It is one of the most economic and commercially grown flower crop in Maharashtra. There has been a constant demand for gladiolus spikes particularly from the European markets during winter months and throughout the year in India. Conventional chemical based farming is not sustainable because of many problems such as loss of soil productivity from excessive erosion and associated plant nutrient loss, surface and ground water pollution from fertilizers and sediment, impeding shortages of non-renewable resources and low farm income from high production costs (Pandey *et al.* 2010) [10]. The soils of India are impoverished and hungry of plant nutrients. What is needed is a procured use of optimum input and not of increasing inputs. Considering economic, energy and environment, it is imperative that plant nutrients to use effectively by adopting proper nutrient management system to ensure high yield and to sustain the availability in soil at the optimum level for getting high yield and quality flower production, nutrient management is necessary (Choudhary and Trivedi, 2008) [2]. Therefore, the present study was planned to ascertain the effect of conjoint use of chemical fertilizers, organic manures and biofertilizers on corm and cormels production of gladiolus cv. PDKV Gold.

Materials and methods
The investigation entitled "Effect of integrated nutrient management on corm and cormels production of gladiolus cv. PDKV Gold" was carried out at College of Agriculture Garden, Dr. PDKV., Akola (M.S.) during the *kharif* season of the years 2018-2019 and 2019-2020. The experiment was laid out in Randomized Block Design with thirteen treatments viz., T_1 - 100% RDF (500:200:200 kg NPK ha^{-1}), T_2 - 32 t Vermicompost, T_3 - 32 t Vermicompost + Azotobacter + PSB, T_4 - 100 t FYM, T_5 - 100 t FYM + Azotobacter + PSB, T_6 - 75% RDF + 8 t Vermicompost, T_7 - 75% RDF + 8 t Vermicompost + Azotobacter + PSB, T_8 - 50% RDF + 16 t Vermicompost, T_9 - 50% RDF + 16 t Vermicompost + Azotobacter + PSB, T_{10} - 75% RDF + 25 t FYM, T_{11} - 75% RDF + 25 t FYM + Azotobacter + PSB, T_{12} - 50% RDF + 50 t FYM and T_{13} - 50% RDF + 50 t FYM + Azotobacter + PSB which were replicated thrice.
The gladiolus corms were collected from the Department of Horticulture. Healthy and uniform size corms (4.0-5.0 cm diameter) were selected and used as experimental material.

The spacing between row to row and plant to plant was 45 x 20 cm and plot size was 3.15 m x 1.80 m (5.67 m^2). FYM and vermicompost were added at the time of land preparation whereas, Azotobacter and Phosphate solubilising bacteria (PSB) applied to the soil @5 kg ha^{-1} each by mixing with farm yard manure before planting as per treatments. A recommended dose of N, P and K i.e. 500, 200 and 200 kg ha^{-1}, respectively were applied as per treatment. The full dose of phosphorous and potash as per treatment was given in the form of SSP and MOP at the time of preparation of experimental beds. While, the nitrogen was given in three equal split doses, at two leaves, four leaves and six leaves stages in the form of urea. The observations were recorded in respect of yield parameters *viz*., corms $plant^{-1}$, corms $plot^{-1}$, corms $hectare^{-1}$ and cormels $plant^{-1}$. In respect of quality parameters *viz*., diameter of corm, length of corm, weight of corms $plant^{-1}$ and weight of cormels $plant^{-1}$. The data obtained on various parameters was statistically analyzed as per methods suggested by Panse and Sukhatme (1967) [11].

Results and Discussion

Yield parameters

The data in respect of the corms $plant^{-1}$ was found to be significant in both years of experimentations as influenced by different treatments of integrated nutrient management is presented in Table 1.

The treatment T_7 had produced significantly maximum corms $plant^{-1}$ (2.73 and 2.93), in the years (2018-19 and 2019-20, respectively). However, treatment T_4 had produced minimum corms $plant^{-1}$ (1.33 and 1.47) during the years (2018-19 and 2019-20, respectively) and was found to be at par with the treatments T_2, T_3 and T_5during both the years of experimentation.

Similarly, the pooled result indicated that, the treatment T_7 had produced significantly maximum corms $plant^{-1}$ (2.83). Whereas, significantly minimum corms $plant^{-1}$ were obtained with the plants treated with the treatment T_4 (1.40) and was at par with the treatments T_2, $T_3$and T_5.These results are in accordance with earlier reports of Godse *et al.* (2006) [5], Dalve *et al.* (2009) [3], Singh *et al.* (2014) [19], Pansuriya *et al*. (2016) [13], Tirkey *et al*. (2017) [20], Pansuriya *et al*. (2018) [12], Jha *et al.* (2020) [6] in gladiolus and Kore *et al.* (2020) [7] in tuberose.

The data in respect of gladiolus corms $plot^{-1}$as influenced by different treatments of integrated nutrient management was found to be significant and is presented in Table 1.

The data from the Table 1 revealed that, the treatment T_7 had produced significantly maximum corms $plot^{-1}$ (95.67 and 102.67) during the years (2018-19 and 2019-20, respectively). However, significantly minimum corms $plot^{-1}$ were produced with the treatment T_4 (46.67 and 51.33) in the years (2018-19 and 2019-20, respectively) and was found at par with the treatments T_2, T_3 and T_5.

Similarly, in pooled data, the treatment T_7 had produced significantly maximum corms $plot^{-1}$ (99.17) whereas, significantly minimum corms $plot^{-1}$ were obtained with the plants treated with the treatment T_4 (49.00) and was at par with the treatments T_2, T_3 and T_5.The results are in close conformity with the findings of Sable (2018) [15] and Adhikari *et al.* (2018) [1] in gladiolus.

The data in respect of gladiolus corms $hectare^{-1}$ (lakh) as influenced by different treatments of integrated nutrient management was found to be significant and is presented in Table 1.

The data from the Table 1 revealed that, the treatment T_7 had produced significantly maximum corms $hectare^{-1}$ (3.04 lakh and 3.26 lakh) during the years (2018-19 and 2019-20, respectively). However, significantly minimum corms $hectare^{-1}$ were produced with the treatment T_4 (1.48 lakh and 1.63 lakh) in the years (2018-19 and 2019-20, respectively) and was found at par with the treatments T_2, T_3 and T_5.

In pooled data, the treatment T_7 had produced significantly maximum corms $hectare^{-1}$ (3.15 lakh) which was significantly superior over rest of all the treatments. Whereas, significantly minimum corms $hectare^{-1}$ were obtained with the plants treated with the treatment T_4 (1.56 lakh) and was at par with the treatments T_2,T_3 and T_5.A noticeable rise in corms number might be because of the better availability of phosphorous and other nutrients which is particularly needed for growth of corms. The better production of corms could be a result of the inoculation of corms with biofertilizers that led them to store more carbohydrates through an effective photosynthesis process. This might also be due to more dry matter production by the plants which exhibited superior vegetative growth in treatment combination containing 75% RDF + 8 t Vermicompost + Azotobacter + PSB and thus, higher rates of transport and accumulation of metabolites in storage structures. These results are in accordance with earlier reports of Singh *et al.* (2014) [19], Tirkey *et al.* (2017), Sable (2018) [15] and Kumar *et al.* (2019) [8] in gladiolus.

The data in respect of cormels $plant^{-1}$of gladiolus as influenced by different treatments of integrated nutrient management was found to be significant and is presented in Table 1.

During the years (2018-19 and 2019-20), significantly the maximum cormels $plant^{-1}$ were noted with the treatment T_7 (37.07 and 38.47, respectively). During the year 2018-19, significantly minimum cormels $plant^{-1}$(12.47) were recorded under the treatment T_4 and which was found to at par with the treatments $T_2$and T_3. Similarly, in the year 2019-20, the treatment T_4 produced significantly minimum cormels $plant^{-1}$(13.87) and it was found to be at par with the treatments T_2, T_3 and T_{13}.

The pooled result indicated that, the cormels $plant^{-1}$ were significantly maximum with the treatment T_7 (37.77). However, treatment T_4 recorded significantly minimum cormels $plant^{-1}$ (13.17) and it was found to be at par with the treatments $T_2$and T_3. The results of present study are in close conformity with findings of Sharma *et al*. (2008) [18], Kumari *et al.* (2014) [9], Adhikari *et al*. (2018) [1], Kumar *et al*. (2019) [8] in gladiolus.

Table 1: Effect of integrated nutrient management on yield parameters of gladiolus

Treatments	Corms plant^{-1}			Corms plot^{-1}			Corms hectare^{-1} (lakh)			Cormels plant^{-1}		
	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled
T_1- 100% RDF (500:200:200 kg NPK ha^{-1})	2.20	2.40	2.30	77.00	84.00	80.50	2.44	2.67	2.56	32.40	33.07	32.73
T_2- 32 t Vermicompost	1.47	1.60	1.53	51.33	56.00	53.67	1.63	1.78	1.70	13.60	14.93	14.27
T_3- 32 t Vermicompost + Azotobacter + PSB	1.60	1.67	1.63	56.00	58.33	57.17	1.78	1.85	1.81	15.80	17.27	16.53
T_4- 100 t FYM	1.33	1.47	1.40	46.67	51.33	49.00	1.48	1.63	1.56	12.47	13.87	13.17
T_5- 100 t FYM + Azotobacter + PSB	1.67	1.73	1.70	58.33	60.67	59.50	1.85	1.93	1.89	18.60	18.07	18.33
T_6- 75% RDF + 8 t Vermicompost	1.87	1.93	1.90	65.33	67.67	66.50	2.07	2.15	2.11	21.80	23.13	22.47
T_7- 75% RDF + 8 t Vermicompost + Azotobacter + PSB	2.73	2.93	2.83	95.67	102.67	99.17	3.04	3.26	3.15	37.07	38.47	37.77
T_8- 50% RDF + 16 t Vermicompost	1.80	1.87	1.83	63.00	65.33	64.17	2.00	2.07	2.04	21.00	20.67	20.83
T_9- 50% RDF + 16 t Vermicompost + Azotobacter + PSB	2.27	2.47	2.37	79.33	86.33	82.83	2.52	2.74	2.63	32.60	33.33	32.97
T_{10}- 75% RDF + 25 t FYM	2.00	2.07	2.03	70.00	72.33	71.17	2.22	2.30	2.26	23.60	25.07	24.33
T_{11}- 75% RDF + 25 t FYM + Azotobacter + PSB	2.07	2.13	2.10	72.33	74.67	73.50	2.30	2.37	2.33	26.87	28.33	27.60
T_{12}- 50% RDF + 50 t FYM	1.93	2.00	1.97	67.67	70.00	68.83	2.15	2.22	2.19	22.33	23.73	23.03
T_{13}- 50% RDF + 50 t FYM + Azotobacter + PSB	2.13	2.27	2.20	74.67	79.33	77.00	2.37	2.52	2.44	31.27	32.67	31.97
'F' Test	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
SE (m) $\pm$	0.12	0.13	0.12	4.20	4.55	4.18	0.13	0.14	0.13	1.40	1.62	1.26
CD at 5%	0.35	0.38	0.35	12.33	13.35	12.25	0.39	0.42	0.39	4.11	4.74	3.71

Quality parameters

The data in respect of diameter of gladiolus corm (cm) as influenced by different treatments of integrated nutrient management was found to be significant and is presented in Table 2.

The treatment T_7 recorded maximum diameter of corm (7.74 cm and 7.79 cm)during the years (2018-19 and 2019-20, respectively). However, treatment T_4 recorded minimum diameter of corm (5.66 cm and 5.71 cm) during the years (2018-19 and 2019-20, respectively)and was found at par with the treatments T_2, $T_3$and T_5during both the years.

In pooled data, the treatment T_7 recorded significantly maximum diameter of corm (7.76 cm) which was significantly superior over rest of all the treatments. Whereas, significantly minimum diameter of corm (5.68 cm) was noted under the treatment T_4 and was found at par with the treatments T_2 and T_3.The increase in diameter of corm might be due to storage of nitrogen compounds in the corms. The soluble nitrogen compounds translocate from leaves to corms and resulting in better vegetative growth of plant. This also leads to better floral parameters and finally boost up the corm yielding attributes. Similar trends have also been reported by Pansuriya *et al.* (2016) [13], Adhikari *et al*. (2018) [1] and Kumar *et al.* (2019) [8] in gladiolus.

The data in respect of length of gladiolus corm (cm) as influenced by different treatments of integrated nutrient management was found to be significant and is presented in Table 2.

During the years(2018-19 and 2019-20) the treatment T_7 recorded significantly maximum length of corm (3.70 cm and 3.74 cm, respectively) and was at par with the treatment T_9. Whereas, significantly minimum length of corm (2.67 cm) was noted under the treatment T_4 and was at par with the treatments T_2 and T_3 in the year 2018-19.Similarly, in the year 2019-20 the length of corm was recorded significantly minimum with the treatment T_4 (2.72 cm) and it was at par with the treatment T_2.

The pooled result indicated that, the length of corm recorded significantly maximum with the treatment T_7 (3.72 cm) and which was found to be at par with the treatment T_9. Whereas, treatment T_4 recorded significantly minimum length of corm (2.69 cm) and was found at par with the treatment T_2. Similar trends have also been reported by Kumar *et al.* (2019) in gladiolus.

The data in respect of weight of corms plant^{-1} (g) as influenced by different treatments of integrated nutrient management in gladiolus is presented in Table 2.

The data from Table 2 revealed that, during the year (2018-19 and 2019-20), significantly maximum weight of corms plant^{-1}was noted with the treatment T_7 (114.20 g and 115.27 g, respectively). However, significantly minimum weight of corms plant^{-1}(55.60 g and 56.73 g) was recorded under the treatment T_4during the years (2018-19 and 2019-20, respectively) and was found to be at par with the treatment T_2.

The pooled result indicated that, the weight of corms plant^{-1} was significantly maximum with the treatment T_7 (114.73 g). However, treatment T_4 recorded significantly minimum weight of corms plant^{-1}(56.17 g).Increase in weight of corm due to application of bio fertilizers might be due to the fact that, it increased nutrients availability to the plants, which might have increased photosynthetic activity of the plants, thereby, hastening the movement of photosynthetic sink towards the source (corm). Moreover, it might have also increased auxin concentration in the roots resulting in thicker and well branched roots. The results are in close conformity with the findings of Gangadharan and Gopinath (2000) [4], Sharma *et al*. (2008) [18], Kumari *et al.* (2014) [19], Satapathy *et al*. (2016) [16], Sathyanarayana *et al.* (2017) [17] and Kumar *et al*. (2019) [8] in gladiolus.

The data in respect of weight of cormels plant^{-1}(g)of gladiolus as influenced by different treatments of integrated nutrient management was found to be significant and is presented in Table 2.

The treatment T_7 recorded significantly maximum weight of cormels plant^{-1}(31.00 g and 32.67 g)during the years (2018-19 and 2019-20, respectively). However, treatment T_4 recorded significantly minimum weight of cormels plant^{-1}(9.53 g and 11.07 g)during the years (2018-19 and 2019-20, respectively) and was found at par with the treatment T_2during both the years of experimentation.

The pooled result indicated that, the weight of cormels plant^{-1} was significantly maximum with the treatment T_7 (31.83 g). However, treatment T_4 recorded significantly minimum weight ofcormels plant^{-1}(10.30 g) and it was found to be at par with the treatment T_2.The results of present study are in close conformity with findings of Sharma *et al*. (2008) [18], Kumari *et al.* (2014) [19], Satapathy *et al.* (2016) [16], Sathyanarayana *et al.* (2017) [17] in gladiolus.

Table 2: Effect of integrated nutrient management on quality parameters of gladiolus

Treatments	Diameter of corm (cm)			Length of corm (cm)			Weight of corms plant^{-1} (g)			Weight of cormels plant^{-1} (g)		
	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled
T_1- 100% RDF (500:200:200 kg NPK ha^{-1})	7.23	7.29	7.26	3.34	3.38	3.36	99.33	99.93	99.63	25.13	26.67	25.90
T_2- 32 t Vermicompost	5.71	5.75	5.73	2.78	2.80	2.79	60.00	61.20	60.60	11.47	13.07	12.27
T_3- 32 t Vermicompost + Azotobacter + PSB	5.75	5.79	5.77	2.83	2.86	2.84	66.87	67.93	67.40	13.60	15.20	14.40
T_4- 100 t FYM	5.66	5.71	5.68	2.67	2.72	2.69	55.60	56.73	56.17	9.53	11.07	10.30
T_5- 100 t FYM + Azotobacter + PSB	5.85	5.81	5.83	2.98	2.96	2.97	69.73	69.13	69.43	16.00	15.67	15.83
T_6- 75% RDF + 8 t Vermicompost	6.35	6.39	6.37	3.16	3.24	3.20	75.20	76.33	75.77	17.40	18.93	18.17
T_7- 75% RDF + 8 t Vermicompost + Azotobacter + PSB	7.74	7.79	7.76	3.70	3.74	3.72	114.20	115.27	114.73	31.00	32.67	31.83
T_8- 50% RDF + 16 t Vermicompost	6.14	6.11	6.12	3.15	3.12	3.13	71.87	71.13	71.50	16.60	18.47	17.53
T_9- 50% RDF + 16 t Vermicompost + Azotobacter + PSB	7.33	7.37	7.35	3.60	3.64	3.62	105.60	106.33	105.97	26.53	28.07	27.30
T_{10}- 75% RDF + 25 t FYM	6.70	6.67	6.68	3.19	3.20	3.19	87.33	88.33	87.83	19.33	20.87	20.10
T_{11}- 75% RDF + 25 t FYM + Azotobacter + PSB	6.73	6.75	6.74	3.21	3.24	3.22	96.53	97.07	96.80	19.67	21.27	20.47
T_{12}- 50% RDF + 50 t FYM	6.59	6.57	6.58	3.18	3.18	3.18	77.47	78.53	78.00	17.60	19.27	18.43
T_{13}- 50% RDF + 50 t FYM + Azotobacter + PSB	7.20	7.25	7.22	3.31	3.34	3.32	98.47	99.47	98.97	23.87	25.47	24.67
'F' Test	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
SE (m) ±	0.06	0.03	0.04	0.07	0.04	0.04	1.53	1.54	1.32	1.09	1.14	0.93
CD at 5%	0.19	0.10	0.12	0.19	0.11	0.12	4.50	4.51	3.87	3.21	3.35	2.73

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