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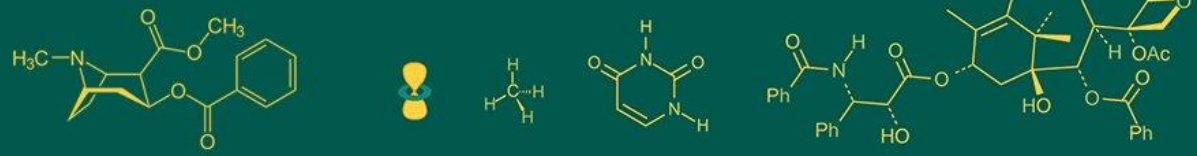

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Effect of intercropping with leafy vegetables on the growth, yield and quality of gladiolus under agroclimatic conditions of Prayagraj

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Abstract
The study was carried out to investigate the effect of leafy vegetables viz. sowa, bathua, fenugreek, palak as intercrops on the growth, yield and quality of gladiolus. The experiment was conducted at the experimental field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.) during 2022-2024. The experiment was laid out in randomized block design, and the study consists of 10 treatments with three replications. From the present investigation, it was concluded that the intercrops significantly affected the performance of gladiolus (growth to yield). The intercropping combinations the treatment T_8- Gladiolus + Fenugreek was found in superior in terms of number of leaves, plant height, number of shoots, days of spike initiation, rachis length, length of spike, number of florets per spike, floret diameter, weight of corms, weight of cormlets per plant corm, yield of corms per hectare, yield of cormlets, vase life. Among the different treatments, the highest gross return, net return and benefit cost ratio is also under the treatment T_8- Gladiolus + Fenugreek.

Keywords: Gladiolus, intercrop, leafy vegetables, growth, yield, quality

1. Introduction
Gladiolus is derived from the Latin word, the diminutive of gladius, a sword is a genus of perennial cormous flowering plants in the iris family (Iridaceae). It is sometimes called the 'sword lily', but is usually called by its generic name (plural gladioli). The genus occurs in Asia, Mediterranean Europe, South Africa, and tropical Africa. The center of diversity is in the Cape Floristic Region. Gladiolus (Gladiolus sp.) is a very popular bulbous ornamental plant. Its magnificent inflorescence with florets of dazzling colors, varying forms and sizes and long keeping quality makes it an attractive cut flower. Gladiolus spikes can be kept in the vases for 8-10 days depending on the variety and the ambient conditions prevailing in the room. It is an essential component of most flower arrangements including bouquets. It is being grown in an area of 11660 ha in the country with an estimated production of 106 crore cut flowers. Amongst the cut flowers, gladiolus occupied third position in terms of both area and production. It is a high revenue generator and occupies 4th place in the international market of floricultural trade and ranks next to rose in India as cut flower (Bose and Yadav, 1989) [1].

Gladiolus cultivation under Northern Indian plains that include whole U.P., coastal areas of Tamil Nadu and Pondicherry has a potential to change the economic scenario of farmers of these areas. It provides both money as well as employment in rural areas. Gladiolus is such a crop which is suitable for establishing floriculture industry by progressive farmers and entrepreneurs and definitely it is one of the best bulbous flowers in India. Considering the importance of popularity of the gladiolus both in domestic market and international market, it is important to study the performance of existing varieties and hybrids and also to test the new lines or hybrids for their superiority of performance and also identify new colors and color combinations along with desirable floral characteristics like spike length, more number and better size of floret, increase vase life, etc. Knowledge of the nature and the extent of association of yield with yield contributing characters are considered to be of great importance for planning an efficient breeding programme.

Intercropping is the growing of two or more crops simultaneously on the same field such that the period of overlap is long enough to include the vegetative stage. Intercropping, double cropping and other mixed cropping practices that allow more efficient uses of on farm resources are among the agricultural practices associated with sustainable crop production. Intercropping provides year-round ground cover, or at least for a longer period than monocultures, in order to protect the soil from desiccation and erosion. By growing more than one crop at a time in the same field, farmers maximize water use efficiency, maintain soil fertility, and minimize soil erosion, which are the serious drawbacks of mono-cropping. It also reduces seasonal work peaks as a result of the different planting and harvesting times of intercropping crops. Moreover, it could serve to increase output per unit area, particularly with low levels of external inputs since a mix of species makes better use of available nutrients and water in the soil. Numerous researchers cover the theory and mechanisms of yield stability in intercropping. Clearly and evidently proposed that intercropping gives higher yields in a given season and greater stability of yields in different seasons compared with sole crops [2-6].

2. Materials and Methods

This chapter contains the details of the materials used and methods adopted for the present thesis entitled ―Effect of intercropping with leafy vegetables on the growth, yield and quality of Gladiolus under Agro-climatic conditions of Prayagraj‖ which was carried out at the experimental plot located at Department of Horticulture, SHUATS, Prayagraj, Allahabad,

Table 1: Treatment details

Sl. No.	Symbol	Treatment
1	T_1	Gladiolus sole
2	T_2	Sowa sole
3	T_3	Bathua sole
4	T_4	Fenugreek sole
5	T_5	Palak sole
6	T_6	Gladiolus + Sowa
7	T_7	Gladiolus + Bathua
8	T_8	Gladiolus + Fenugreek
9	T_9	Gladiolus + Palak
10	T_{10}	Gladiolus + Sowa + Bathua + Fenugreek

3. Results and Discussion

3.1 Vegetative Parameters

3.1.1 Plant height: From the data, it was revealed that plant height at 90 days was recorded maximum in T_8 Gladiolus+ Fenugreek (95.70cm) which is at par with T_6: Gladiolus+ sowa (92.60 cm) whereas minimum plant height was recorded in T_{10}: Gladiolus + sowa+ bathua+ fenugreek+ palak (85.17cm).
These results are supported by the findings of Baker, (1975) and Anitha *et al*., (2001) [7, 8].

3.1.2 Number of leaves: From the data, it was revealed that number of leaves at 90 days was recorded highest in T_8: Gladiolus+ Fenugreek (21.73) whereas minimum number of leaves was recorded in T_9: Gladiolus + palak (20.09).
These results are supported by the findings of Singh *et al*. (2014), Chandana and Dorajeerao (2014) [9, 10].

3.1.3 Number of shoots per corm: From the data, it was revealed that number of shoots at 90 days was recorded highest in T_8, Gladiolus+ Fenugreek (2.80) whereas minimum number of leaves was recorded in T_1: Gladiolus + sowa (2.00).
These results are supported by the findings of Baker, (1975) and Anitha *et al*, (2001) [7, 8]

3.2 Floral Parameters

3.2.1 Days to spike initiation – In the present investigation, the minimum days to spike initiation was recorded in T_8: Gladiolus+ Fenugreek (67.14) followed by T_1: Gladiolus Sole (66.79) while the maximum days to spike initiation was recorded in T_{10}: Gladiolus + sowa+ bathua+ fenugreek +palak (65.75).
These results are supported by the findings of Marschner (1983) [11].

3.2.2 Spike length: In the present investigation, the maximum spike length was recorded highest in T_8: Gladiolus+ Fenugreek (81.62 cm) followed by T_1: Gladiolus sole (79.52 cm) whereas minimum length of spike was recorded in T_{10}: Gladiolus + sowa+ bathua+ fenugreek +palak (74.75).
These results are supported by the findings of Singh *et al*. (2014) [9]

3.2.3 Rachis length: In the present investigation, the maximum rachis length was recorded highest in T_6: Gladiolus+ Fenugreek (54.64 cm) followed by T_9: Gladiolus + palak (51.68 cm) whereas minimum length of spike was recorded in T_7: Gladiolus+ bathua (48.19 cm).
These results are supported by the findings of Kumar *et al*. (2003) and Chandana and Dorajeerao (2014) [12, 10].

3.2.4 Number of florets per spike: From the data, it was revealed that number of florets was recorded in T_8 the highest Gladiolus+ Fenugreek (19.22) followed by T_9: Gladiolus+ palak (17.95) whereas minimum number of florets per spike was recorded in T_{10}: Gladiolus + sowa+ bathua+ fenugreek +palak (14.72).
These results are supported by the findings of Singh *et al*. (2014) [9].

3.2.5 Floret Diameter – From the data, it was revealed that size of florets was recorded the treatment T_8, highest Gladiolus+ Fenugreek (11.50 cm) followed by T_1: Gladiolus sole (10.88 cm) whereas minimum floret size was recorded in T_{10}: Gladiolus + sowa+ bathua+ fenugreek +palak (8.61).
These results are supported by the findings of Singh *et al*. (2006) [13].

3.2.6 Vase life: The maximum vase life (days) in normal tap water was recorded in T_8: Gladiolus + Fenugreek (11.87 days) followed by T_9: Gladiolus + palak (10.73 days) whereas the minimum vase life was found in T_{10}: Gladiolus + sowa+ bathua+ fenugreek +palak (9.30).

3.3 Yield Parameters

3.3.1 Weight of corms: From the data, it was revealed that the weight of corms was recorded highest in the treatment T_8, Gladiolus+ Fenugreek (48.41 g) followed by T_9: Gladiolus+ Palak (47.77 g) whereas minimum weight of corms was recorded in T_7: Gladiolus + bathua (44.61g).

These results are supported by the findings of Shankar *et al*., (2016) [14].

3.3.2 Yield of corms: In the present investigation, the yield of corms (kg/ha) was recorded the highest in T_8: Gladiolus+ Fenugreek (2060 kg/ha) followed by T_9: Gladiolus + palak (1910 kg/ha)) whereas minimum yield of corms was recorded in T_7: Gladiolus + bathua (1480 kg/ha).

3.3.3 Yield of cormlets: In the present investigation, the yield of cormlets (kg/ha) was recorded the highest in T_8: Gladiolus+ Fenugreek (172.66 kg/ha) followed by T_9: Gladiolus + palak (168.47 kg/ha) whereas minimum yield of corms was recorded in T_{10}: Gladiolus + sowa+ bathua+ fenugreek +palak (160.02).
These results are supported by the findings of Mukhopadhyay and Yadav, (1984) [15].

3.3.4 Herbage yield per plot: In the present investigation, significant variation was observed among sowa, bathua, fenugreek, palak under different intercropping treatments. In sowa, the highest herbage yield was recorded in T_2: sowa sole (677.33 g) while it is recorded lowest in T_6: Gladiolus+ sowa (573.67). In fenugreek, T_8: Fenugreek + palak (728.67 g) recorded the highest herbage yield per plot while the lowest was recorded in T_4: fenugreek sole (682.33g). In bathua, the maximum herbage yield per plot was recorded in T_4: bathua sole (446.67 g), whereas the lowest herbage yield per plot was recorded in T_7: Gladiolus+ Bathua (332.33). In palak, the maximum herbage yield per plot was recorded in T_9: bathua sole (681.67 g), whereas the lowest herbage yield per plot was recorded in T_9: Gladiolus+ palak (557.67 g). Hence the best treatment in herbage yield is T_8: Gladiolus+ fenugreek.

3.5 Economic Parameters

The Cost of cultivation for this experiment was 196944 Rs /hectare, the maximum Gross return was observed with T_8- Gladiolus + fenugreek (364510 Rs /hectare) , the maximum Net return was observed with T_3- Gladiolus+ fenugreek (241087.84 Rs /hectare) and the maximum Benefit cost ratio was observed with T_8- Gladiolus + fenugreek 2.95 [16-19]

Table 2: Effect of Intercropping on Vegetative parameters of Gladiolus

Treatments	Plant height (cm)	No. of Leaves	No. of shoots per corm
T_1: Gladiolus sole	90.40	18.83	1.72
T_2: Sowa sole	-	-	-
T_3: Bathua sole	-	-	-
T_4: Fenugreek sole	-	-	-
T_5: palak sole	-	-	-
T_6: Gladiolus+ sowa	92.60	19.63	2.00
T_7: Gladiolus+ bathua	91.70	16.86	1.60
T_8: Gladiolus+ Fenugreek	95.70	21.73	2.80
T_9: Gladiolus+ Palak	86.97	20.09	1.73
T_{10}: Gladiolus+Sowa+ Bathua+ Fenugreek + Palak	85.17	18.30	1.70
F test	S	S	S
SE (d)	0.43	0.20	0.14
CD (5%)	0.96	0.45	0.22
CV	0.59	1.28	

Table 3: Effect of Intercropping on Floral parameters of Gladiolus

Treatments	Days to spike initiation	Spike length	Rachis length	No. of florets per spike	Floral Diameter	Vase life
T_1: Gladiolus sole	66.79	79.52	49.65	16.38	10.88	9.67
T_2: Sowa sole	-	-	-	-	-	-
T_3: Bathua sole	-	-	-	-	-	-
T_4: Fenugreek sole	-	-	-	-	-	-
T_5: palak sole	-	-	-	-	-	-
T_6: Gladiolus+ sowa	66.27	78.92	51.16	17.12	10.25	10.47
T_7: Gladiolus+ bathua	65.90	77.09	48.19	15.89	9.34	9.40
T_8: Gladiolus+ Fenugreek	67.14	81.62	54.64	19.22	11.50	11.87
T_9: Gladiolus+ Palak	66.78	79.30	51.68	17.95	10.60	10.73
T_{10}: Gladiolus+Sowa+ Bathua+ Fenugreek + Palak	65.75	74.75	48.51	14.72	8.61	9.30
F test	S	S	S	S	S	S
SE (d)	1.27	0.53	0.56	0.31	0.21	0.46
CD (5%)	2.82	1.18	1.26	0.70	0.47	1.02
CV	2.33	0.83	1.36	2.29	2.52	5.46

Table 4: Effect of Intercropping on Yield parameters of Gladiolus

Treatments	Weight of corm of gladiolus	Yield of corms	Yield of cormlets
T_1: Gladiolus sole	46.37	1620	162.44
T_2: Sowa sole	-	-	-
T_3: Bathua sole	-	-	-
T_4: Fenugreek sole	-	-	-
T_5: palak sole	-	-	-
T_6: Gladiolus+ sowa	46.82	1730	163.81
T_7: Gladiolus+ bathua	44.61	1480	160.78
T_8: Gladiolus+ Fenugreek	48.41	2060	172.66
T_9: Gladiolus+ Palak	47.77	1910	168.47
T_{10}: Gladiolus+Sowa+ Bathua+ Fenugreek + Palak	46.82	1526	160.02
F test	S	S	S
SE (d)	0.55	23.37	1.13
CD (5%)	1.22	52.06	0.48
CV	1.43	1.66	3.58

Table 5: Effect of Intercropping on herbage yield of Gladiolus

Treatment	Herbage yield/ plot (g)				Herbage yield (t/ha)			
	Sowa	Bathua	Fenugreek	Palak	Sowa	Bathua	Fenugreek	Palak
T_1: Gladiolus sole	-	-	-	-	-	-	-	-
T_2: Sowa sole	677.33	-	-	-	6.77	-	-	-
T_3: Bathua sole	-	446.67	-	-	-	4.47	-	-
T_4: Fenugreek sole	-	-	682.33	-	-	-	6.82	-
T_5: Palak sole	-	-	-	681.67	-	-	-	6.82
T_6: Gladiolus + sowa	573.67	-	-	-	5.74	-	-	-
T_7: Gladiolus+ Bathua	-	332.33	-	-	-	3.32	-	-
T_8: Gladiolus+ fenugreek	-	-	728.67	-	-	-	-	-
T_9: Gladiolus+ Palak	-	-	-	557.67	-	-	7.29	5.58
T_{10}: Gladiolus+ Sowa+Bathua+ Fenugreek + Palak	409.67	286.33	508.67	458.67	4.10	2.86	5.09	4.95
F TEST	S	S	S	S	S	S	S	S
SE (D)	16.60	19.65	76.97	12.489	0.17	0.20	0.77	0.12
CD (5%)	46.09	54.55	213.71	34.64	0.46	0.55	0.14	0.35
CV	3.67	6.78	14.73	2.70	3.67	6.78	14.33	2.70

4. Conclusion

From the present investigation, it is concluded that among the different inter cropping's, the treatment T_8- Gladiolus + Fenugreek was found in superior in terms of number of leaves, plant height, number of shoots, days of spike initiation, rachis length, length of spike, number of florets per spike, floret diameter, weight of corms, weight of cormlets per plant corm, yield of corms per hectare, yield of cormlets, vase life. Among the different treatments, the highest gross return, net return and benefit cost ratio is also under the treatment T_8- Gladiolus + Fenugreek.

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