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PERFORMANCE STUDIES OF SOME GLADIOLUS GENOTYPES UNDER TERAI REGION OF WEST BENGAL

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Abstract- This study was carried out involving twenty genotypes of gladiolus at the Horticultural Farm of Uttar Banga Krishi Viswavidyalaya, India during 2011-2013 to investigate the genotypes performance in a particular region regarding their growth, flowering and yield attributes ability. Among 20 genotypes studied, five genotypes were found to be promising and they are ACC-11, ACC-14, ACC-04 'ACC-15' and ACC-13, thus can be recommended for commercial cut flower production as well as for breeding purposes under terai region of West Bengal. However, ACC-14, ACC-01 and ACC-09 could be taken up for maximum corms and cormels production.

Keywords- Genotypes, Gladiolus, Performance, Flowering.

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Introduction

The name gladiolus has been derived from the Latin word 'gladius', meaning a sword as it has sword shaped leaves [1]. So, gladiolus popularly known as Sword lily or Corn Lily originated from South Africa [2]. *Gladiolus grandiflora* Hort., belong to family Iridaceae, sub-family Ixioideae, tribe Ixieae, sub-tribe Gladiolines is a prominent bulbous cut flower plant [3]. Various kind of Gladiolus flowers are produced in different parts of the country like India. Gladiolus "Queen of bulbous flower crops" grown in many parts of the world [4] and has been rated as the second most important popular flower in the world. It is commercially cultivated in all parts of the world and it was introduced into cultivation towards the end of the 16 century [5]. The major gladiolus producing countries are the United States, Holland, France, Poland, Italy, Bulgaria, Brazil, Australia, Israel and India. It occupies 8th position in the world cut flower trade and first in the domestic bulbous flower trade [6].

Gladiolus is the next most important cut flower crop after rose in India. It is being grown over an area of 1200 ha with a production of 1905.88 lakh spikes from states *viz,* West Bengal, Himachal Pradesh, Sikkim, Karnataka, Uttar Pradesh, Tamil Nadu, Punjab and Delhi. In the eastern states like Tripura, Assam, Manipur, Meghalaya and Nagaland, this flower has established itself as a commercial proposition. There is a sizeable area under glad in Jammu-Kashmir, Andhra Pradesh and Gujarat too [7]. West Bengal possesses six different agro-climatic zones namely Hill Zone, Terai Zone, Old Alluvial zone, New Alluvial Zone, Red and Lateritic Zone and Coastal Saline zone and among them Hill zone (Kalimpong and adjoining areas in the Darjeeling Hills of West Bengal) is famous for gladiolus cultivation.

In gladiolus, new varieties are evolved through hybridization, which is recognized as the most important sources of evolution and crop improvement. A plant breeding program can be divided into three stages, *viz*. building up a gene pool of variable germplasm, selection of individual from the gene pool and utilization of selected individual to evolved superior variety [8]. In ornamental plant breeding, these phenomena go hand in hand and can be observed in the breeding history of many ornamental crops. Expert breeders have devoted more than a century of hybridization and selection to modify gladiolus plant to the colourful, blossom laden varieties in demand today but evaluation is the first important step in any crop improvement programme. It is the basic tool for assessing the genetic variability present in any crop species, which could be exploited for its utilization. Selection of better plant type from the collected germplasm can be of immense value to the breeder for improvement of crop.

Gladiolus has 260 species, out of which 250 are native to sub-Saharan Africa and 10 belong to Eurasia [9] with more than 30,000 varieties evolved in gladiolus so far through conventional breeding [10] of which about 20 are grown for commercial purposes. Being a flowering plant, it exhibit great variability in respect of growth and their development, which is the essence of any planned crop improvement, program. It is well established that the greater the genetic diversity higher the chance of getting better hybrid or recombinant. The study of existing varieties and genotypes performance in a particular region regarding their growth and flower producing ability is the prerequisite for undertaking conventional breeding program so that suitable genotypes can be selected for further hybridization under given agro-climatic conditions.

MaterialsandMethods

This study was carried out involving twenty genotypes of gladiolus [Table-1] including American Beauty (ACC-20) as check variety at the Horticultural Farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal during 2011-2013 to investigate performance of gladiolus germplasm. The area lies under the terai agro climatic zone of West Bengal. Geographically the farm is situated at 26°19'86" N latitude and 89°23'53" E longitude, at an elevation of 43 m above mean sea level. The climatic condition of terai zone is characterized by high rainfall (above 3000 mm annually), high humidity, moderate temperature, prolonged winter with high residual soil moisture and metrological data pertaining to the study period from 2011 to 2013 is given in [Table 2]. The soil of the experimental field was sandy loam in nature, coarse in texture having poor water holding capacity with low pH (5.23) and organic carbon 0.93 %. The available nitrogen, phosphorus and potassium is 217.21, 18.24 and 111.89 kg/ ha respectively. Five representative plants were selected at random and tagged in each

Table-1 *Gladiolus germplasm used in present investigation*

Genotype's Accession No.	Flower colour grouping and RHS (5th Edition) Number	Spike and floret characters
ACC-01	Red-purple group (N57-C)	Arranged in zig-zag fashion but faced one side having violet coloured throat
ACC-02	Red group (45-B)	Florets are loosely arranged side by side and all florets faced at one side of the spike
ACC-03	Red group (45-B)	All florets faced one side of the spike
ACC-04	Violet group (83-B)	All florets faced one side of the spike and sparsely arranged without any throat
ACC-05	Red-purple group (N57-A)	Each floret on the spike face alternatively and loosely having creamy yellow coloured at mid portion
ACC-06	White group (NN155B)	Florets compactly arranged one above the other facing one side of the spike along with red coloured throat
ACC-07	Red group (45-B)	All florets arranged loosely in zig-zag fashion
ACC-08	Red-purple group (N57-A)	Florets arranged compactly one above the other and faced one side of the spike and throat colour is creamy colour
ACC-09	White group (NN155-B)	Each floret on the spike face alternatively one above the other having light greenish throat
ACC-10	Red-purple group (N57-B)	Florets faced in appositive manner one above other and loosely arranged having dark red coloured throat and outside creamy yellow at lower tip portion
ACC-11	Red group (40-C)	Florets faced one side and compactly arranged one above the other without any throat
ACC-12	Violet group (N88-C)	Each floret on the spike face alternatively in loose manner along with white shade at centre
ACC-13	Yellow group (8-C)	Florets are compactly arranged and faced at one side of the spike and fringed
ACC-14	Yellow group (12-C)	Florets are arranged in zig-zag fashion and sparsely having outside orange shade at tip portion
ACC-15	Orange red group (13-B)	Florets are faced side by side and arranged compactly with white shade at centre
ACC-16	Purple group (N20-C)	Arranged in zig-zag fashion and compact manner along with creamy coloured throat at lower two petals
ACC-17	Red-purple group (N57-C)	Florets arranged compactly and faced one above the other and petals become smaller at lower portion
ACC-18	White group (NN155-A)	Florets faced one side and loosely arranged one above the other even petals are big as well as loosely attached
ACC-19	White group (NN155-D)	Florets faced one side and arranged compactly one above the other without ant throat
ACC-20 (American Beauty)	Red group (43-B)	All florets faced one side of the spike having light white coloured throat

(RHS: Royal Horticulture Society)

Table-2 *Metrological data pertaining to the study period from 2011 to 2013*

Months	Temperature (°C)				Relative Humidity (%)				Rainfall (mm)		Wind Speed (Km hr^{-1})		Sunshine (hr:mm)	
	2011-12		2012-13		2011-12		2012-13		2011-12	2012-13	2011-12	2012-13	2011-12	2012-13
	Max	Min	Max	Min	Max	Min	Max	Min						
September	32.68	25.24	30.89	24.68	98.87	66.90	99.00	76.17	11.75	23.62	4.49	4.55	8.63	7.84
October	31.30	21.77	30.38	20.22	99.00	60.52	99.00	60.48	0.47	0.71	2.77	2.90	8.69	8.10
November	27.25	15.17	27.74	13.96	98.93	51.90	99.00	45.70	0.03	0.00	3.00	2.47	7.66	7.83
December	23.80	11.82	23.13	11.68	98.84	56.19	99.00	60.58	0.13	0.00	3.26	2.55	7.14	6.10
January	21.15	9.60	22.11	7.96	98.87	57.45	99.00	51.55	0.08	0.00	2.94	3.11	6.31	7.01
February	25.02	10.86	26.69	12.34	99.00	46.48	99.00	45.29	0.31	0.64	3.05	3.15	7.86	7.63
March	29.14	15.20	30.27	16.72	93.61	37.10	98.87	41.87	0.23	0.00	4.84	4.96	8.53	8.73
April	29.63	20.30	30.33	20.15	97.57	60.07	96.03	53.57	5.48	4.08	6.24	6.23	8.67	8.90

Source: Department of Agronomy, AAS (Agro-met Advisory Services), UBKV, Pundibari

Table-3 *Mean performance of twenty genotypes of gladiolus for growth characters*

Accession No.	Plant height (cm)			Leaf number plant^{-1}			Leaf length (cm)			Days to spike initiation		
	Year-1	Year-2	Pooled	Year-1	Year-2	Pooled	Year-1	Year-2	Pooled	Year-1	Year-2	Pooled
ACC-01	66.46	68.78	67.62	5.88	6.78	6.33	35.93	40.09	38.01	65.39	67.29	66.34
ACC-02	46.25	50.25	48.25	5.34	5.99	5.67	32.66	35.16	33.91	72.66	74.89	73.78
ACC-03	74.89	70.13	72.51	5.96	6.69	6.33	31.98	35.03	33.51	73.26	69.39	71.33
ACC-04	66.44	72.86	69.65	5.78	6.87	6.33	32.15	34.91	33.53	71.55	73.12	72.34
ACC-05	41.55	46.41	43.98	3.95	4.71	4.33	30.96	33.25	32.11	78.91	80.43	79.67
ACC-06	55.76	62.28	59.02	5.69	6.98	6.34	34.91	36.76	35.84	63.44	65.22	64.33
ACC-07	43.32	50.31	46.82	5.71	6.95	6.33	31.22	33.21	32.22	67.58	69.32	68.45
ACC-08	78.54	82.15	80.35	6.88	7.77	7.33	40.65	42.05	41.35	64.01	63.33	63.67
ACC-09	77.46	81.44	79.45	6.43	6.91	6.67	39.76	41.25	40.51	61.74	63.16	62.45
ACC-10	64.68	66.81	65.75	5.85	6.15	6.00	36.45	38.55	37.50	63.78	61.56	62.67
ACC-11	78.79	83.36	81.08	6.88	7.77	7.33	40.94	43.07	42.01	56.43	58.23	57.33
ACC-12	61.36	65.34	63.35	5.37	5.96	5.67	35.98	38.15	37.07	67.28	69.59	68.44
ACC-13	89.65	93.51	91.58	8.39	8.95	8.67	51.98	54.15	53.07	66.54	64.79	65.67
ACC-14	77.87	83.68	80.78	7.44	7.88	7.66	40.74	42.14	41.44	60.39	62.27	61.33
ACC-15	82.17	88.98	85.58	8.51	8.83	8.67	50.22	51.88	51.05	73.81	71.95	72.88
ACC-16	66.76	70.87	68.82	5.98	6.67	6.33	37.89	39.88	38.89	63.77	65.79	64.78
ACC-17	60.77	64.62	62.70	6.44	6.88	6.66	36.88	39.10	37.99	64.88	66.45	65.67
ACC-18	80.32	84.63	82.48	7.11	7.55	7.33	42.68	44.91	43.80	58.66	60.67	59.67
ACC-19	82.48	87.62	85.05	7.99	8.66	8.33	47.57	50.24	48.91	67.72	69.62	68.67
ACC-20	80.41	85.88	83.15	7.79	8.21	8.00	45.15	47.11	46.13	61.89	62.77	62.33
CD at 5%	7.311	6.375	6.843	0.969	0.930	0.950	7.000	8.943	7.972	6.375	6.979	6.677
SE(d)	3.119	3.024	3.072	0.552	0.615	0.584	3.316	3.295	3.306	3.715	3.088	3.402
SE(m) ±	2.445	2.132	2.289	0.324	0.311	0.318	2.341	2.991	2.666	2.132	2.334	2.233
CV	6.781	5.998	6.390	10.328	11.143	10.736	10.112	10.316	10.214	5.324	4.998	5.161

(Year-1: 2011-12; Year-2: 2012-13)

Table-4 *Mean performance of twenty genotypes of gladiolus for flowering characters*

Accession No.	Days to spike emergence			Days to bud separation			Days to show colour			Days to open floret			Days to flowering		
	Year-1	Year-2	Pooled	Year-1	Year-2	Pooled	Year-1	Year-2	Pooled	Year-1	Year-2	Pooled	Year-1	Year-2	Pooled
ACC-01	68.14	70.32	69.23	73.33	76.77	73.33	73.48	75.17	74.33	74.41	76.25	75.33	78.77	76.55	77.67
ACC-02	75.37	77.34	76.36	79.28	77.24	79.28	82.81	83.85	83.33	86.12	87.31	86.72	87.22	89.22	88.22
ACC-03	73.27	75.39	74.33	76.68	77.97	77.33	81.46	79.87	80.67	81.68	83.66	82.67	84.79	86.54	85.67
ACC-04	73.69	75.36	74.53	79.14	77.41	78.27	79.65	80.79	80.22	83.14	81.47	82.31	83.88	85.54	84.71
ACC-05	81.68	83.65	82.67	87.64	89.70	88.67	91.59	92.40	92.00	92.76	93.89	93.33	96.73	97.93	97.33
ACC-06	68.43	66.23	67.33	69.51	70.49	70.00	71.75	72.25	72.00	72.41	74.24	73.33	75.13	76.21	75.67
ACC-07	70.28	72.18	71.23	75.87	76.81	76.34	80.32	78.97	79.65	80.57	81.66	81.12	82.16	84.28	83.22
ACC-08	66.69	67.97	67.33	68.62	70.21	69.33	73.58	71.76	72.67	73.75	74.25	74.00	76.21	77.79	77.00
ACC-09	67.57	65.93	66.75	67.87	69.61	68.74	73.05	71.44	72.25	73.21	74.63	73.92	74.26	76.83	75.55
ACC-10	64.89	66.45	65.67	69.51	67.82	68.67	71.21	70.13	70.67	72.33	77.35	72.33	74.45	76.21	75.33
ACC-11	59.38	61.27	60.33	62.48	64.18	63.33	67.87	66.78	67.33	70.00	73.15	70.00	72.55	73.45	73.00
ACC-12	71.70	72.98	72.34	76.81	78.52	77.67	80.94	79.54	80.24	84.54	83.11	83.83	85.21	87.45	86.33
ACC-13	68.41	70.49	69.45	71.77	70.78	71.28	74.48	72.47	73.48	74.67	76.28	75.48	76.45	77.78	77.12
ACC-14	63.85	62.87	63.36	64.31	67.02	65.67	67.87	68.79	67.33	68.32	70.33	69.33	72.15	71.19	71.67
ACC-15	76.92	78.41	77.67	80.37	78.11	79.24	80.76	82.58	81.67	81.89	83.70	82.80	84.82	86.96	85.89
ACC-16	66.41	67.59	67.00	68.98	70.35	69.67	71.31	72.68	72.00	72.65	74.69	73.67	75.47	77.87	76.67
ACC-17	69.64	68.81	69.23	70.43	71.57	71.00	72.68	74.66	73.67	73.66	74.83	74.25	78.43	79.57	79.00
ACC-18	59.21	60.79	60.00	66.21	65.32	65.77	66.81	68.52	67.67	70.13	69.50	69.85	70.54	72.11	71.33
ACC-19	70.21	71.79	71.00	76.39	74.27	75.33	79.29	77.36	78.33	79.67	81.66	80.67	82.55	84.79	83.67
ACC-20	64.77	65.88	65.33	68.05	66.61	67.33	71.45	73.21	72.33	74.25	72.41	73.33	76.33	74.32	75.33
CD at 5%	6.372	6.222	6.297	9.024	6.697	7.861	8.323	7.281	7.802	5.520	4.638	5.079	6.685	7.064	6.875
SE(d)	3.250	3.712	3.481	3.005	3.128	3.067	3.451	3.653	3.552	2.557	2.634	2.596	3.211	3.121	3.166
SE(m) ±	2.117	2.067	2.092	2.998	2.225	2.612	2.765	2.419	2.592	1.834	1.541	1.688	2.221	2.347	2.284
CV	6.000	5.870	5.935	5.241	5.221	5.231	5.498	5.576	5.537	4.110	4.000	4.055	2.321	2.256	2.289

Table-5 *Mean performance of twenty genotypes of gladiolus for floret characters*

Accession No.	Floret length (cm)			Floret diameter (cm)			Florets spike^{-1}			Rachis girth (mm)		
	Year-1	Year-2	Pooled	Year-1	Year-2	Pooled	Year-1	Year-2	Pooled	Year-1	Year-2	Pooled
ACC-01	9.94	9.86	9.90	9.21	9.90	9.56	15.00	15.80	15.40	21.78	22.34	22.06
ACC-02	7.20	7.88	7.54	5.78	4.78	5.28	9.20	11.20	10.20	20.55	18.59	19.57
ACC-03	9.50	9.50	9.50	9.15	9.59	9.37	14.05	14.82	14.44	23.11	21.91	22.51
ACC-04	9.21	8.81	9.10	7.98	8.52	8.25	13.98	12.90	13.40	27.98	28.87	28.43
ACC-05	7.76	8.90	8.33	4.88	5.32	5.10	10.74	11.25	11.00	18.11	18.56	18.34
ACC-06	10.87	11.53	11.20	11.57	10.86	11.22	13.95	12.81	14.38	37.21	38.27	37.74
ACC-07	10.76	11.44	11.10	10.52	9.73	10.13	12.05	13.17	12.61	21.96	22.99	22.48
ACC-08	9.98	10.21	10.10	9.94	10.27	10.11	14.85	14.27	14.56	21.15	22.12	21.64
ACC-09	9.93	10.27	10.10	9.90	10.59	10.25	14.03	13.39	13.70	31.35	30.89	31.12
ACC-10	9.54	9.72	9.63	11.12	11.49	11.31	11.80	12.68	12.24	24.65	26.17	25.41
ACC-11	8.04	8.36	8.20	6.84	7.59	7.22	15.02	16.32	15.67	25.98	27.13	26.56
ACC-12	8.57	9.24	8.91	7.05	7.37	7.21	10.54	11.34	10.94	17.88	18.96	18.42
ACC-13	7.25	7.89	7.57	6.80	7.47	7.14	16.87	17.41	17.14	26.56	27.44	27.00
ACC-14	8.12	8.30	8.21	7.32	7.98	7.65	14.95	15.85	15.40	20.11	20.34	20.23
ACC-15	9.15	9.29	9.22	9.09	9.63	9.36	14.21	14.84	14.53	32.13	33.01	32.57
ACC-16	8.39	8.93	8.66	9.81	10.49	10.15	9.65	10.43	10.04	22.82	23.61	23.22
ACC-17	7.54	7.66	7.60	7.13	7.75	7.44	11.95	12.64	12.30	18.89	19.87	19.38
ACC-18	10.76	11.61	11.19	14.62	15.38	15.00	8.67	9.63	9.15	25.11	25.95	25.53
ACC-19	7.88	8.12	8.00	10.52	11.77	11.15	12.75	13.25	13.00	26.89	27.98	27.44
ACC-20	9.65	10.34	10.00	8.50	9.15	8.83	10.22	10.88	10.55	43.79	44.89	44.34
CD at 5%	1.044	1.329	1.187	4.074	4.014	4.044	3.345	3.399	3.372	4.974	5.676	5.325
SE(d)	0.512	0.235	0.374	1.871	1.889	1.880	1.591	1.781	1.686	2.600	2.581	2.591
SE(m) ±	0.348	0.443	0.396	1.358	1.338	1.348	1.115	1.133	1.124	1.658	1.892	1.775
CV	8.345	9.324	8.835	11.553	12.622	11.088	15.283	14.761	15.022	11.769	12.771	12.270

Table-6 *Mean performance of twenty genotypes of gladiolus for cormel characters*

Accession No.	Rachis length (cm)			Spike length (cm)			Spike weight (g)			Field life (days)		
	Year-1	Year-2	Pooled	Year-1	Year-2	Pooled	Year-1	Year-2	Pooled	Year-1	Year-2	Pooled
ACC-01	48.84	48.80	48.82	69.46	71.26	70.36	102.00	100.93	101.47	6.30	6.70	6.50
ACC-02	41.12	41.27	41.20	58.20	61.25	59.72	82.55	83.17	82.86	6.05	7.20	6.63
ACC-03	39.43	41.06	40.25	73.85	75.05	74.45	99.05	106.27	102.66	5.95	6.34	6.15
ACC-04	39.54	41.36	40.45	65.75	66.80	66.28	120.21	128.97	124.59	7.00	7.65	7.33
ACC-05	33.87	34.56	34.22	57.02	58.18	57.60	69.85	71.41	70.63	5.43	5.66	5.55
ACC-06	47.05	48.55	47.80	73.46	75.29	74.38	131.45	133.81	132.63	7.10	7.78	7.44
ACC-07	40.86	41.77	41.32	82.25	80.91	81.58	84.05	85.23	84.64	5.55	6.05	5.80
ACC-08	35.88	37.43	36.66	69.83	68.45	69.14	127.85	131.63	129.74	6.00	5.51	5.76
ACC-09	34.20	35.02	34.61	64.25	65.40	64.83	121.55	123.21	122.38	6.45	7.10	6.78
ACC-10	44.87	46.21	45.54	77.27	79.90	78.59	129.54	128.14	128.84	6.11	6.51	6.31
ACC-11	43.77	44.97	44.37	77.90	79.10	78.50	131.66	133.69	132.68	7.00	7.30	7.15
ACC-12	50.26	51.84	51.05	63.07	64.19	63.63	87.28	85.75	86.52	7.66	7.00	7.33
ACC-13	50.90	51.70	51.30	85.90	87.98	86.94	137.25	139.65	138.45	7.33	7.92	7.63
ACC-14	42.55	44.56	43.56	64.95	66.47	65.71	88.55	90.46	89.51	6.35	6.95	6.65
ACC-15	49.10	49.90	49.50	83.55	84.70	84.13	131.45	133.81	132.63	7.58	8.25	7.91
ACC-16	37.85	39.14	38.50	83.31	84.95	84.13	121.55	123.33	122.44	6.24	6.93	6.59
ACC-17	47.11	48.43	47.77	73.85	74.79	74.32	99.25	97.87	98.56	6.25	6.48	6.37
ACC-18	47.88	48.68	48.28	84.25	86.00	85.13	126.75	126.90	126.83	6.55	7.21	6.88
ACC-19	36.75	37.65	37.20	88.50	89.63	89.07	128.54	130.31	129.43	7.60	7.99	7.80
ACC-20	37.05	38.07	37.56	70.05	68.57	69.31	97.45	99.45	98.45	6.00	6.66	6.33
CD at 5%	5.714	4.071	4.893	4.705	3.730	4.218	5.726	5.989	5.858	1.335	1.290	1.313
SE(d)	2.236	2.115	2.176	2.458	2.882	2.670	2.762	2.548	2.655	0.231	0.549	0.390
SE(m) ±	1.892	1.348	1.620	1.558	1.235	1.397	1.896	1.983	1.940	0.442	0.427	0.435
CV	6.781	7.883	7.332	4.345	4.562	4.454	3.112	3.052	3.082	10.212	11.113	10.663

Table-7 *Mean performance of twenty genotypes of gladiolus for cormel characters*

Accession No.	Corms plant^{-1}			Corm diameter (cm)			Corm weight plant^{-1} (g)		
	Year-1	Year-2	Pooled	Year-1	Year-2	Pooled	Year-1	Year-2	Pooled
ACC-01	3.50	3.95	3.73	5.11	6.06	5.59	89.45	91.89	90.67
ACC-02	2.02	2.20	2.11	3.35	3.83	3.59	34.98	36.03	35.51
ACC-03	2.52	2.96	2.74	5.05	5.25	5.15	79.54	81.75	80.65
ACC-04	5.11	5.75	5.43	4.85	5.39	5.12	102.85	107.81	105.33
ACC-05	2.15	3.29	2.72	4.55	4.99	4.77	35.00	35.73	35.37
ACC-06	1.37	1.51	1.44	3.85	4.15	4.00	22.01	23.08	22.55
ACC-07	0.97	1.03	1.00	4.75	4.86	4.81	82.55	83.82	83.19
ACC-08	3.15	3.42	3.29	4.36	4.57	4.47	25.75	26.42	26.09
ACC-09	2.55	3.00	2.78	4.58	4.66	4.62	85.75	87.71	86.73
ACC-10	5.26	5.47	5.37	3.43	3.55	3.49	18.24	18.64	18.44
ACC-11	3.13	3.31	3.22	4.00	4.26	4.13	24.89	25.85	25.37
ACC-12	3.21	3.52	3.37	5.01	5.33	5.17	16.79	17.88	17.34
ACC-13	3.12	3.53	3.33	4.35	4.65	4.50	22.95	24.00	23.48
ACC-14	4.25	4.80	4.53	4.18	4.35	4.27	17.25	17.75	17.50
ACC-15	4.10	4.99	4.55	4.35	4.65	4.50	21.95	22.36	22.16
ACC-16	2.35	2.49	2.42	2.62	2.82	2.72	16.24	17.16	16.70
ACC-17	1.61	1.75	1.68	4.44	4.59	4.52	26.05	27.00	26.53
ACC-18	2.75	2.85	2.80	5.45	5.55	5.50	26.55	28.12	27.34
ACC-19	1.10	1.24	1.17	3.95	4.07	4.01	45.25	46.25	45.75
ACC-20	1.59	1.75	1.67	6.45	6.73	6.59	34.95	36.28	35.62
CD at 5%	1.344	1.314	1.329	1.660	1.362	1.511	5.996	6.350	6.173
SE(d)	0.445	0.328	0.387	0.325	0.812	0.569	2.118	2.895	2.507
SE(m) ±	0.451	0.441	0.446	0.557	0.457	0.507	2.012	2.131	2.072
CV	12.161	13.145	12.653	10.151	11.011	10.581	8.239	8.412	8.326

Table-8 *Mean performance of twenty genotypes of gladiolus for cormel characters*

Accession No.	Cormels plant^{-1}			Cormels diameter (cm)			Cormels weight plant^{-1} (g)		
	Year-1	Year-2	Pooled	Year-1	Year-2	Pooled	Year-1	Year-2	Pooled
ACC-01	69.19	72.15	70.67	5.47	5.95	5.71	25.95	26.82	26.39
ACC-02	17.23	17.86	17.55	3.91	3.97	3.94	49.01	50.06	49.54
ACC-03	18.22	19.15	18.69	4.95	5.07	5.01	25.11	25.84	25.48
ACC-04	18.90	19.10	19.00	5.15	5.82	5.48	27.55	28.29	27.92
ACC-05	11.00	11.66	11.33	4.15	4.00	4.08	33.98	35.08	34.53
ACC-06	28.20	28.64	28.42	4.38	4.56	4.47	25.22	25.59	25.41
ACC-07	50.45	50.79	50.62	4.56	4.67	4.62	22.96	24.25	23.61
ACC-08	74.11	74.55	74.33	4.00	4.22	4.11	98.34	99.94	99.14
ACC-09	25.06	26.46	25.76	4.30	4.11	4.21	27.15	28.35	27.75
ACC-10	35.21	36.13	35.67	3.95	4.10	4.03	80.85	82.39	81.62
ACC-11	35.13	36.21	35.67	4.45	4.57	4.51	80.95	82.15	81.55
ACC-12	58.25	59.75	59.00	5.31	5.51	5.41	65.95	66.70	66.33
ACC-13	27.95	28.66	28.31	4.02	4.21	4.12	67.45	66.49	66.97
ACC-14	21.35	20.16	20.75	4.66	4.86	4.76	55.13	56.35	55.74
ACC-15	24.65	25.11	24.88	4.05	4.20	4.13	40.27	41.47	40.87
ACC-16	77.64	79.02	78.33	2.68	2.75	2.72	43.89	45.15	44.52
ACC-17	55.98	57.39	56.69	5.00	4.83	4.92	63.55	61.95	62.75
ACC-18	22.96	22.05	22.51	4.56	4.92	4.74	58.75	60.36	59.56
ACC-19	36.07	34.75	35.41	4.56	5.43	5.00	16.80	18.00	17.40
ACC-20	15.21	15.70	15.46	4.86	4.19	4.53	44.25	45.48	44.87
CD at 5%	7.632	6.941	7.287	0.828	1.023	0.926	7.701	7.469	7.585
SE(d)	3.532	3.167	3.350	0.532	0.448	0.490	3.537	3.689	3.613
SE(m) ±	2.543	2.313	2.428	0.276	0.341	0.309	2.566	2.489	2.528
CV	11.872	12.325	12.099	13.881	12.268	11.575	9.231	8.994	9.113

treatment and replication for the convenience of observing the characters include in the study of germplasm performance. The pooled value of the two years data observed was taken to represent a particular germplasm with respect to a character. The observations on growth and productions parameters were considered those ultimately decide the yield and quality of flower spikes and recorded from 60 days of planting to post harvest stages. The field experiments laid out in RBD (Randomized Complete Block Design) and replicated thrice.

Results and Discussion

Various factors such as adequate and suitable pollination, hormonal level, enough vegetative growth, and orchard management may affect the final yield, but genotype has great influence on plant performance [11 &12]. The genotypes have shown significant differences for most of the growth parameters at the stage of 60 days growth (60 DAP) [Table-3]. They exhibited significant differences with respect to plant height. The genotype ACC-13 recorded the highest plant height where as ACC-05 was found to be the shortest.

As far as number of leaves per plant was concerned ACC-13 recorded the maximum and ACC-05 the least. Height of plant also influenced the leaves length and maximum leaves length was recorded in case of ACC-13 while minimum in ACC-05. These trends may be attributed to the inherent growth character of the genotypes. These results confirmed the finding of Javvad et al. [13] who reported great effect of and cultivars (genetics) on performance of gerbera.

The genotypes have shown significant differences for the time taken to initiate spike [Table-3]. Genotype ACC-18 was the earliest to initiate the spikes and the ACC-02 was last compared to the other genotypes. On an average they took 59 to 78 days to initiate their spikes. These variations may be attributed to the different inherent characters of genotypes and some even to the agro-climatic conditions of the particular area. Genotypes have maintained the differences noticed in the number of days taken for spike initiation for the other characters such as number of days taken for complete emergence of spike, first floret to show colour and first floret to open [Table-4]. The results indicated that there is a particular set of period for each genotype for the flowering. The average number of days taken for first floret to open was 67 to 92 days and ACC-14 was the earliest to open the first flower and the ACC-05 was the last. These traits depend on environmental conditions (temperature, altitude etc.) and may change and Cosmulescu et al. [14] stated that "flowering time or duration" is a feature which is influenced by climatic factor as well as genetic factor too.

Spike characters are important ones with regard to cut flower production in gladiolus. The genotypes under study have shown significant differences with respect to spike length which is one of the important characters for quality assessment [Table-6]. The range was from 57.60 cm to 86.94 cm. The genotype ACC-13 possessed the longest spikes which is a desirable character for a cut flower, as it will have more number of florets per spike and will last longer in the fields. The lowest spike length was recorded in the ACC-05. Spike girth is a crucial character since it determines the sturdiness of the cut flower. Mahanta and Paswan [15] recognized sturdiness of the cut flower as one of the important characters. The maximum diameter of the floret was recorded in ACC-18 (15.00 cm), which was followed by ACC-06 (11.22 cm), ACC-16 (11.10 cm) and so on and least was recorded in the ACC-05 (5.10 cm). These differences in genotypes may be attributed to their inherent characters.

Spike weight is another important crucial character for a cut flower variety. The importance of weight comes into picture during cut flower handling, packing and transportation, especially in air cargo charges for export purposes which are quiet high under Indian conditions. In fact, this heavy spike weight is one of the major problems in boosting gladiolus exports from India though it can be successfully grown out door. So, it should be less comparatively to reduce the transportation costs. In this study, the range of average spike weight obtained was from 70.63 to 138.45 g. The lowest spike weight was recorded in ACC-05 and the maximum was in the ACC-13. These variations in spike weights might be due to their genetic makeup as suitable growth and vigor was necessary for optimum photosynthesis to supply enough carbohydrates for higher yield [12]. Along with these spike characters, number of florets per spike is also important for a cut flower variety as it will decide the attractiveness of the spike and vase life of the spike [Table-5]. If more number of florets is there the spike will last for longer period. ACC-11 produced maximum number of florets per spike followed by ACC-13, ACC-15 and so on. The lowest floret number was recorded in ACC-18.

For a successful breeding programme, field life is an important factor as it provides the opportunities for maximum number of crossing and may coincide the time of pollen and stigma maturity. The preference of breeders depends on the field life of the spikes along with other good qualities of spikes as colour of floret, spike length and the number of florets per spike. In the present investigation, genotypes have shown significant differences for the field life period [Table-6]. The range observed was from 5.43 days to 8.40 days. ACC-15 remained attractive for longer period and obtained spike life of 7.63 days followed by ACC-13, while shorter spike life (5.55) was recorded for ACC-05. Similar variations in spike quality parameters of gladiolus varieties were quoted by the workers *viz*., [17,18] in gladiolus.

The genotype ACC-15 showed the maximum field life period which may be attributed to its longer spike length and more number of florets per spike which help the spike to retain attractiveness for a longer period. For the good appearance of a spike the florets in a spike should also be attractive. Florets should be big and arranged in a compact manner on only one side of the rachis. Length and diameter should be high to have attractive big floret. With respect to length of the floret the genotypes significant differences were observed among the genotypes. As far as floral diameter is concerned, maximum floral diameter was obtained in ACC-18 and least was in ACC-05. Along with all these growth and flower characters a good cut flower genotypes should also produce of big sized daughter corms and good number of cormels for the future planting. In the present investigation, the genotypes have shown varied response with respect to the weight and number of cormels produced [Table-7, Table-8]. The range for number of corms plant-1 among genotypes was from 1.00 cm to 5.43 cm. The maximum corm number was recorded in ACC-04 (5.43), which was followed by genotypes ACC-10 (5.37), ACC-15 (4.55) and so on. The lowest corm number (1.00) was recorded in the genotypes ACC-07. Average weight of the individual daughter corm was highest in ACC-04, which is good for having a good planting in the next season. The production of daughter corms of more weight may be attributed to the good vegetative growth of the plants in the initial stages, which supplies good amount of photosynthates for storage in the corms, which are also the storage organs. There should be good production of cormels to have the good amount of planting material for the next generations. The range obtained was from 11.33 to 70.67 cormels per plant. Highest number of cormels per plant was recorded in ACC-01 and the least was in ACC-05.

Conclusion

Among 20 genotypes studied, five genotypes were found to be promising and they are ACC-11, ACC-14, ACC-04 'ACC-15' and ACC-13, thus can be recommended for commercial cut flower production as well as for breeding purposes under terai region of West Bengal. However, ACC-14, ACC-01 and ACC-09 could be taken up for maximum corms and cormels production.

Conflict of Interest: None declared

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