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Assessment of morphological characters of faba bean (*Vicia faba* L.) genotypes grown in Manipur

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Abstract

The present experiment was conducted at Vegetable Research Farm, College of Horticulture and Forestry, Central Agricultural University, Pasighat, East Siang, Arunachal Pradesh, India during Rabi season 2021-2022 to investigate "Assessment of Morphological Characters of Faba bean (*Vicia faba* L.) genotypes grown in Manipur". These morphological characters revealed the wide variation among the twenty-one locally available genotypes. Qualitative characters such as growth habit, anthocyanin colouration in stem, leaf shape, and melanin spot in wing, colour of melanin spot in wing, seed shape and black pigmentation in hilum of dry seed were recorded. Quantitative characters such as days to germination, days to first flowering, days to 50% flowering, days to first pod, first podding height (cm), leaf length (cm), leaf width (cm), leaf area (cm²), number of stem per plant, number of leaflet per leaf, number of pods per node, number of pods per plant, number of seeds per pod, pod length (cm), pod width (cm), plant height (cm), 100 seed weight (g) and yield per plant (g) were studied. The mean performance revealed that CHF FaB-13 gave highest yield per plant (126.98), highest 100 seed weight in CHF FaB-13 (97.70), longest pod length in CHF FaB-13 (12.40), longest pod width in CHF FaB-13 (2.27), maximum number pods bear per node in CHF FaB-13 (4.00), maximum number of pods per plant in CHF FaB-13 (19.67). The minimum days to first flowering were recorded in genotypes CHF FaB-5 (42.00) and lowest number of days taken for 50% flowering was found in genotypes CHF FaB-5 (48.67).

Keywords: Faba bean, genetic diversity, variation, genotype

Introduction

Faba bean (*Vicia faba* L.) is one of the most important minor legume crops, and it is extensively cultivated in India and North-east region of India. Commonly referred to as horse bean or broad bean, it is mostly harvested as dry seeds for food or fresh seeds and tender pods are being used as vegetables. Faba bean is a rich source of protein, carbohydrates, starch, total sugar, vitamins and minerals (Duranti *et al.*, 2008) [8]. L-dopa contents in different parts of faba bean have been the natural source for treating Parkinson's disease (Duranti, 2006) [7]. Its wide consumption has been hindered with the presence of some antinutritional components like phytic acid, tannin, phenols, trypsin inhibitor, vicine and covaxin which causes hemolytic anemia called favism. Faba bean provides valuable ecological and environmental services in modern sustainable agriculture, providing diversity in cropping systems and establishing symbiosis with specific rhizobia bacteria results in biological nitrogen fixation which reduces the input of synthetic fertilizers in cultivable lands. The area under faba bean cultivation in India is very minimal but among the legumes crop in the world, it ranked at seventh position behind a top group including soya bean, groundnut and common bean.

There are two main faba bean groups: the small-seeded group and the large-seeded group. The small-seeded group has the greatest number of endemic forms and the greatest diversity of specific characteristics lacking in other groups, such as pairs of leaflets, and grey-green colour, shattering or non-shattering pods, seed size, colour and shape, leaflet size, stem height and branching of stem. The large-seed group is regarded as a more recent secondary centre of the faba bean diversity. There is little evidence of wild faba bean since faba bean does not cross with other *Vicia* species (Muratova, 1931) [14]. Faba bean are diploid in nature with 14 chromosomes while some exhibits 12 chromosomes (Singh *et al.*, 2013) [18].

Genetic diversity available is of ex situ collections since wild faba bean are rare and they are of local populations maintained by farmers in traditional agricultures. As a results of outcrossing floral biology of the species and its low multiplication rate there is limited ex situ

conservation of faba bean collections (Suso *et al.* 2011) [19]. Discovery of genetic variability for breeding programme for traits of agronomic interest mostly for yield related parameters and high nutritional aspects are of utmost goal. Explorations of locally available for twenty-one faba bean genotypes with respect to morphological characters were investigated within the framework of this experimental study.

Materials and Methods

The planting material comprises of twenty-one genotypes out of which 20 genotypes are of indigenous genotypes grown in Manipur and one varietal check namely, HFB 2. The experiment was conducted at Vegetable Research Farm, College of Horticulture and Forestry, Central Agricultural University, Pasighat, East Siang, Arunachal Pradesh, India during Rabi reason 2021-2022. The geographical location of the research farm is having an altitude of 154 m above mean sea level, latitude of N 28° 04' 37.19"; longitude E 95° 19' 29.16". The climate of this area is humid, sub-tropical and maximum rainfall occurs between June-September. The soil is sandy loam with pH 6.7 and organic carbon 2.1%. Each genotype was sown in three replications with spacing of 45 cm X 20 cm in randomized block design. Qualitative characters such as growth habit, anthocyanin colouration in stem, leaf shape, and melanin spot in wing, colour of melanin spot in wing, seed shape and black pigmentation in hilum of dry seed were recorded. Quantitative characters such as days to germination, days to first flowering, days to 50% flowering, days to first pod, first podding height (cm), leaf length (cm), leaf width (cm), leaf area (cm²), number of stem per plant, number of leaflet per leaf, number of pods per node, number of pods per plant, number of seeds per pod, pod length (cm), pod width (cm), plant height (cm), 100 seed weight (g) and yield per plant (g) were recorded following random sampling.

The experimental data thus recorded on these characters were subjected to statistical and biometrical analysis for analysis of variance given by Gomez and Gomez (1984) [10] and on the basis of individual plant observation; the mean of each character in all population was calculated as follows:

$$\bar{Y} = \frac{1}{n} (\sum_{i=1}^n Y_i)$$

Where,

\bar{Y} = Population mean.

Y_i = Individual value.

n = Number of observations.

Results and Discussion

The qualitative morphological characters observed for the twenty-one genotype is presented in Table 1. The characterization of genotypes for the following qualitative morphological traits were done using faba bean descriptors given by International Board for Plant Genetic Resources (IBPGR), 1985 [1] and DUS guidelines given by PPV AND FRA, 2001 [2].

CHF FaB-1, CHF FaB-2, CHF FaB-3, CHF FaB-5, CHF FaB-6, CHF FaB-7, CHF FaB-8, CHF FaB-9, CHF FaB-10, CHF FaB-11, CHF FaB-12, CHF FaB-13, CHF FaB-14, CHF FaB-15, CHF FaB-16, CHF FaB-17, CHF FaB-18, CHF FaB-19, CHF FaB-20 were found to be indeterminate except for CHF FaB-4 and HFB 2 which was found to be semi-determinate.

Anthocyanin colouration in stem were found in CHF FaB-1, CHF FaB-2, CHF FaB-3, CHF FaB-5, CHF FaB-6, CHF FaB-8, CHF FaB-9, CHF FaB-13 and were absent in CHF FaB-4, CHF FaB-7, CHF FaB-10, CHF FaB-11, CHF FaB-12, CHF FaB-14, CHF FaB-15, CHF FaB-16, CHF FaB-17, CHF FaB-18, CHF FaB-19, CHF FaB-20 and HFB 2. Leaf shape of the following genotypes were grouped as narrow, intermediate and rounded. CHF FaB-3, CHF FaB-14, CHF FaB-16, CHF FaB-19 and HFB 2 were recorded as narrow. CHF FaB-1, CHF FaB-2, CHF FaB-6, CHF FaB-9, CHF FaB-10, CHF FaB-11, CHF FaB-12, CHF FaB-15 and CHF FaB-20 were recorded as intermediate. CHF FaB-4, CHF FaB-7, CHF FaB-8, CHF FaB-13, CHF FaB-17 and CHF FaB-18 were recorded as rounded. Melanin spot in wing of flowers were recorded as present and absent. CHF FaB-1, CHF FaB-2, CHF FaB-3, CHF FaB-4, CHF FaB-5, CHF FaB-6, CHF FaB-7, CHF FaB-8, CHF FaB-9, CHF FaB-10, CHF FaB-11, CHF FaB-12, CHF FaB-13, CHF FaB-14, CHF FaB-15, CHF FaB-16, CHF FaB-17, CHF FaB-18, CHF FaB-19, CHF FaB-20 and HFB 2 present melanin spot in wing. Melanin spot colour in wing were grouped into greenish yellow, brown and black. CHF FaB-1, CHF FaB-2, CHF FaB-3, CHF FaB-4, CHF FaB-5, CHF FaB-6, CHF FaB-7, CHF FaB-8, CHF FaB-9, CHF FaB-16, CHF FaB-17, CHF FaB-18, CHF FaB-19, CHF FaB-20 and HFB 2 were recorded as having black melanin spot whereas CHF FaB-10, CHF FaB-11, CHF FaB-12, CHF FaB-13, CHF FaB-14 and CHF FaB-15 were recorded as having brown melanin spot. There were no genotypes having greenish yellow melanin spot colour. Seed shape of faba bean genotypes were grouped as flattened, round, mixed and angular. CHF FaB-1, CHF FaB-3, CHF FaB-6, CHF FaB-7, CHF FaB-8, CHF FaB-9, CHF FaB-10, CHF FaB-12, CHF FaB-13, CHF FaB-14, CHF FaB-17, CHF FaB-18, CHF FaB-19, CHF FaB-20 were recorded as flattened. CHF FaB-2, CHF FaB-5, CHF FaB-11, CHF FaB-15, CHF FaB-16 were recorded as mixed. CHF FaB-4 and HFB 2 were recorded as having round type of seed. Black pigmentation of hilum in dry seed was recorded as present or absent. CHF FaB-4, CHF FaB-5, CHF FaB-11, CHF FaB-16 and HFB 2 were found present of black pigmentation of hilum in dry seed. CHF FaB-1, CHF FaB-2, CHF FaB-3, CHF FaB-6, CHF FaB-7, CHF FaB-8, CHF FaB-9, CHF FaB-10, CHF FaB-12, CHF FaB-13, CHF FaB-14, CHF FaB-15, CHF FaB-17, CHF FaB-18, CHF FaB-19 and CHF FaB-20 were found absent of black pigmentation of hilum in dry seed.

Analysis of variance

The analysis of variance (ANOVA) for eighteen characters is presented in Table 2. There were highly significant differences among the treatments for all the characters under study, showing wide range of variation in twenty-one genotypes of faba bean.

Mean performance of the genotypes for eighteen quantitative morphological characters is presented in table 3.

Days to germination

In the present investigation, the lowest number of days to germination was found in genotypes CHF FaB-10, CHF FaB-11, CHF FaB-14 which is 6.67 and highest number of days to germination was taken by genotypes HFB 2 (10.33) with a mean of 7.73 which have similar findings with previous work conducted by Singh *et al.* (2017) [17].

Days to first and 50% flowering

The minimum days taken to first flowering was recorded in genotypes CHF FaB-5 (42.00) followed by CHF FaB-1 (48.33), CHF FaB-14 (49.67) where maximum was recorded in CHF FaB-4 (61.67) followed by CHF FaB-6 (60.00) and CHF FaB-15 (59.67) with a mean of 54.60. The lowest number of days taken for 50% flowering was recorded in genotypes CHF FaB-5 (48.67) followed by CHF FaB-1

(56.00) and CHF FaB-14 (56.67). The highest number of days taken for 50% flowering was recorded in CHF FaB-6 (69.33) followed by CHF FaB-4 (68.33) and CHF FaB-3 (67.67) with a mean performance of 61.41. These finding had also agreed with which was reported earlier by McDonald *et al.* (1994)^[12], Mulualem *et al.* (2013)^[13], Verma *et al.* (2015)^[21] and Singh *et al.* (2017)^[17].

Table 1: Qualitative Morphological characters of twenty-one genotypes

Genotype	Growth habit	Anthocyanin colouration in stem	Leaf shape	Melanin spot in wing	Colour of melanin spot in wing	Seed shape	Black pigmentation of hilum in dry seed
CHF FaB-1	Indeterminate	Present	Intermediate	Present	Black	Flattened	Absent
CHF FaB-2	Indeterminate	Present	Intermediate	Present	Black	Mixed	Absent
CHF FaB-3	Indeterminate	Present	Narrow	Present	Black	Flattened	Absent
CHF FaB-4	Semi-determinate	Absent	Rounded	Present	Black	Round	Present
CHF FaB-5	Indeterminate	Present	Rounded	Present	Black	Mixed	Present
CHF FaB-6	Indeterminate	Present	Intermediate	Present	Black	Flattened	Absent
CHF FaB-7	Indeterminate	Absent	Rounded	Present	Black	Flattened	Absent
CHF FaB-8	Indeterminate	Present	Rounded	Present	Black	Flattened	Absent
CHF FaB-9	Indeterminate	Present	Intermediate	Present	Black	Flattened	Absent
CHF FaB-10	Indeterminate	Absent	Intermediate	Present	Brown	Flattened	Absent
CHF FaB-11	Indeterminate	Absent	Intermediate	Present	Brown	Mixed	Present
CHF FaB-12	Indeterminate	Absent	Intermediate	Present	Brown	Flattened	Absent
CHF FaB-13	Indeterminate	Present	Rounded	Present	Brown	Flattened	Absent
CHF FaB-14	Indeterminate	Absent	Narrow	Present	Brown	Flattened	Absent
CHF FaB-15	Indeterminate	Absent	Intermediate	Present	Brown	Mixed	Absent
CHF FaB-16	Indeterminate	Absent	Narrow	Present	Black	Mixed	Present
CHF FaB-17	Indeterminate	Absent	Rounded	Present	Black	Flattened	Absent
CHF FaB-18	Indeterminate	Absent	Rounded	Present	Black	Flattened	Absent
CHF FaB-19	Indeterminate	Absent	Narrow	Present	Black	Flattened	Absent
CHF FaB-20	Indeterminate	Absent	Intermediate	Present	Black	Flattened	Absent
HFB 2	Semi-determinate	Absent	Narrow	Present	Black	Round	Present

Table 2: Analysis of variance for eighteen morphological characters

S. N.	Source of variation	Mean square		
		Replication	Genotype	Error
	Degree of freedom	2	20	40
1.	Days to germination	0.78	2.29**	0.28
2.	Days to first flowering	3.44	62.46**	1.21
3.	Days to 50% flowering	1.73	67.43**	1.18
4.	Days to first pod	2.20	70.24**	1.24
5.	First podding height (cm)	0.46	119.38**	2.66
6.	Leaf length (cm)	0.19	11.38**	0.12
7.	Leaf width (cm)	0.03	2.47**	0.016
8.	Leaf area (cm ²)	1.19	476.32**	1.16
9.	Number of stems per plant	0.11	8.38**	0.56
10.	Number of leaflets per leaf	0.49	1.42**	0.29
11.	Number of pods per node	0.20	0.96**	0.07
12.	Number of pods per plant	0.83	31.98**	1.79
13.	Number of seeds per pod	0.05	0.61**	0.13
14.	Pod length (cm)	0.47	9.90**	0.12
15.	Pod width (cm)	0.002	0.32**	0.05
16.	Plant height (cm)	9.70	642.90**	4.75
17.	100 seed weight (g)	8.15	1309.37**	3.98
18.	Yield per plant (g)	2.34	1868.15**	15.66

**Significant at 1% level of probability.

*Significant at 5% level of probability.

Table 3: Mean performance of genotypes for quantitative morphological character

Genotype	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
CHFFaB-1	8.00	48.33	56.00	63.33	20.00	12.89	2.3	44.43	4.00	4.67	2.00	10.33	3.33	7.13	1.57	68.3	89.45	79.87
CHFFaB-2	7.00	53.67	59.67	65.67	25.00	10.36	2.67	50.58	2.67	4.00	2.00	8.67	2.67	4.93	1.00	56.33	81.03	44.33
CHFFaB-3	8.00	58.67	67.67	70.00	24.77	12.15	2.5	35.62	4.33	3.00	3.00	10.00	3.00	7.23	1.63	56.26	88.74	57.20
CHFFaB-4	8.00	61.67	68.33	73.67	21.23	11.71	3.37	48.71	2.00	4.00	2.00	4.67	2.67	8.63	1.63	54.4	37.73	33.13

CHFFaB-5	8.00	42.00	48.67	55.33	31.63	9.74	4.13	31.00	3.00	4.00	3.00	8.67	3.33	5.70	1.50	101.03	66.98	54.34
CHFFaB-6	9.00	60.00	69.33	70.67	27.50	14.66	3.5	47.93	6.00	4.33	2.33	14.00	2.33	7.87	1.63	53.5	83.58	97.89
CHFFaB-7	7.67	53.33	60.33	66.00	31.10	10.86	3.36	44.79	7.00	4.00	3.00	17.00	3.00	10.83	1.83	69.5	83.75	88.75
CHFFaB-8	7.67	57.00	64.33	66.00	27.30	13.66	3.6	45.81	3.00	5.00	2.00	8.67	3.00	6.83	1.80	57.23	77.15	84.78
CHFFaB-9	8.00	58.00	62.67	70.67	31.30	14.92	3.4	68.30	4.67	5.00	3.00	11.67	3.00	7.60	1.60	57.26	57.09	52.13
CHFFaB-10	6.67	59.00	60.00	68.00	19.90	12.23	2	40.38	3.67	4.00	2.00	10.67	3.00	8.30	1.63	51.36	43.86	84.98
CHFFaB-11	6.67	54.33	58.67	63.00	23.33	14.59	3	58.35	4.67	5.33	2.33	12.00	2.00	8.33	1.53	61.53	84.53	93.33
CHFFaB-12	7.00	52.33	59.67	66.00	19.13	9.21	3.4	34.86	3.00	4.67	2.67	9.00	3.00	7.67	1.47	64.2	77.34	90.00
CHFFaB-13	8.33	54.33	60.00	68.67	11.83	13.10	4.23	54.58	8.67	6.00	4.00	19.67	4.00	12.40	2.27	87.83	97.67	126.98
CHFFaB-14	6.67	49.67	56.67	62.67	22.63	10.65	4.26	32.08	5.00	4.33	2.67	13.33	3.00	8.40	1.63	59.1	39.06	91.62
CHFFaB-15	8.33	59.67	67.67	73.33	23.80	11.22	3.63	41.81	5.00	4.67	3.00	9.67	2.67	6.57	1.73	63.76	33.98	58.00
CHFFaB-16	7.67	51.00	59.67	75.00	35.07	11.19	4.66	21.15	3.00	4.67	3.00	9.00	2.33	6.37	1.30	73.63	46.30	57.33
CHFFaB-17	8.00	52.33	62.33	68.00	29.10	14.73	4.53	65.32	5.67	4.67	2.00	13.33	3.00	7.70	1.33	81.86	82.10	78.66
CHFFaB-18	7.33	52.00	60.67	62.00	34.20	14.41	5	55.50	6.00	5.00	3.00	14.67	2.67	6.33	1.97	90.96	58.38	86.55
CHFFaB-19	7.00	56.00	60.00	72.33	30.61	10.71	4.72	36.68	4.00	3.67	3.00	12.33	3.00	6.77	1.97	82.03	63.10	74.00
CHFFaB-20	7.00	56.00	63.00	68.67	24.70	10.91	4.86	51.51	4.00	4.00	3.33	10.00	3.00	8.97	1.63	57.13	68.15	50.00
HFB 2	10.33	57.33	64.33	74.00	12.90	8.46	2.33	22.01	2.00	3.33	2.00	5.67	2.00	4.23	0.70	46.6	28.93	21.33
Mean	7.73	54.60	61.41	67.76	25.10	12.02	3.59	44.35	4.35	4.40	2.63	11.10	2.86	7.56	1.59	66.37	66.14	71.68
Min	6.67	42.00	48.67	53.33	11.83	8.46	2.00	21.15	2.00	3.00	2.00	4.67	2.00	4.23	0.70	46.60	28.90	21.33
Max	10.33	61.67	69.33	75.00	35.07	14.92	5.00	68.30	8.67	6.00	4.00	19.67	4.00	12.40	2.27	101.03	97.70	126.98
S.Em. ±	0.30	0.64	0.63	0.64	0.94	0.20	0.07	0.62	0.43	0.31	0.16	0.77	0.26	0.38	0.13	1.26	1.2	2.29
CV (%)	6.82	2.01	1.77	1.64	6.50	2.92	3.55	2.42	17.22	12.29	10.26	12.15	12.67	8.61	14.13	3.28	3.0	5.52
CD at 5%	1	2.09	2.06	2.12	3.1	0.67	0.24	2.04	1.42	1.02	0.51	2.54	0.689	1.23	0.43	4.14	3.8	7.52

1. Days to germination 2. Days to first flowering 3. Days to 50% flowering 4. Days to first pod 5. First podding height (cm) 6. Leaf length (cm) 7. Leaf width (cm) 8. Leaf area (cm²) 9. Number of stems per plant 10. Number of leaflets per leaf 11. Number of pods per node 12. Number of pods per plant 13. Number of seeds per pod 14. Pod length (cm) 15. Pod width (cm) 16 Plant height (cm) 17. 100 seed weight (g) 18. Yield per plant (g).

Days to first pod and first podding height (cm)

The minimum number of days taken for first pod to appear was recorded in CHF FaB-5 (55.33) followed by CHF FaB-18 (62.00) and CHF FaB-14 (67.67). The maximum number of days taken for first pod to appear was recorded in CHF FaB-16(75.00) followed by CHF FaB-4 (73.67) and CHF FaB-15 (73.33) with a mean observation of 67.67. The minimum height which bears first pod was recorded in CHF B-13 (11.83) followed by CHF FaB-2 (12.90). The maximum height which bears first pod was recorded in CHF FaB-16 (35.07) followed by CHF FaB-18 (34.20) which have mean performance of 25.10. These finding of days to first pod and first podding height (cm) have conformity finding with Talal al barri (2012) [3] and Terzopoulos *et al.* (2004) [20].

Leaf length (cm), leaf width (cm) and leaf area (cm²)

The shortest length of leaf was observed in HFB 2 (8.46) followed by CHF FaB-12 (9.21) and the longest length of leaf was observed in CHF FaB-9 (14.92) followed by CHF FaB-17 (14.73) with a mean performance of 12.02. The shortest width of leaf was observed in CHF FaB-10 (2) followed by CHF FaB-1 and HFB 2 (2.33) with longest width of leaf was observed in CHF FaB-18(5) followed by CHF FaB-20 (4.86) with a mean performance of 3.59. The minimum of leaf area was recorded in CHF FaB-16 (21.15) followed by HFB 2 (22.01) with maximum leaf area was recorded in CHF FaB-9 (68.30) followed by CHF FaB-17 (65.32) with a mean performance of 44.35. These leaf length, leaf width and leaf area have similar findings with De Cillis *et al.* (2019) [6], Osman *et al.* (2013) [15] and Peksen, (2007) [16].

Number of stems per plant and number of leaflet per leaf

The lowest number of stems per plant was recorded in CHF FaB-4 and HFB 2 (2.00) followed by CHF FaB-2 (2.67) with highest number of stems per plant was recorded in CHF FaB-13 (8.67) followed by CHF FaB-7 (7.00) with a mean observation of 4.35. The least number of leaflets per leaf was

observed in CHF FaB-3 (3.00) followed by HFB 2 (3.30) while the highest number of leaflets per leaf was observed in CHF FaB-13 (6.00) followed by CHF FaB-11 (5.33) with a mean performance of 4.40. These have similar finding with Terzopoulos *et al.* (2004) [20].

Number of pods per node, number of pods per plant and number of seeds per pod

The minimum number of pods bear per node was recorded in CHF FaB-1, CHF FaB-2, CHF FaB-4, CHF FaB-8, CHF FaB-10, CHF FaB-17 and HFB 2 (2.00) and the maximum number pods bear per node was recorded in CHF FaB-13 (4.00) followed by CHF FaB-20 (3.33) with a mean observation of 2.63. The minimum number of pods per plant was recorded in CHF FaB-4 (4.67) followed by HFB 2 (5.67). The maximum number of pods per plant was recorded in CHF FaB-13 (19.67) followed by CHF FaB-18 (14.67) with a mean performance of 11.09. The minimum number of seeds per pod was recorded in CHF FaB-11 and HFB 2 (2.00) followed by CHF FaB-6 and CHF FaB-16 (2.33). The maximum number of seeds per pod was recorded in CHF FaB-13 (4.00) followed by CHF FaB-1 (3.00) with a mean performance of 2.86. These finding of number of pods per node, number of pod per plant and number of seed per pod had similar findings with the work conducted by López-Bellido *et al.* (2005) [11].

Pod length and pod width (cm)

The shortest pod length was recorded in HFB 2 (4.23) followed by CHF FaB-2 (4.93). The longest pod length was observed in CHF FaB-13 (12.40) followed by CHF FaB-7 (10.83) with a mean performance of 7.56. The shortest pod width was recorded in HFB 2 (0.70) followed by CHF FaB-2 (1.00). The longest pod width was observed in CHF FaB-13 (2.27) followed by CHF FaB-18 (1.97). The mean performance recorded was 1.59. The finding of these experiments had similar results with Suso *et al.* (1996) [20] and Al-Refae *et al.* (2004) [4].

Plant height (cm) and 100 seed weight (g)

The shortest plant height was recorded in HFB 2 (46.6) followed by CHF FaB-10 (51.36). The tallest plant height was recorded in CHF FaB-5 (101.03) followed by CHF FaB-18 (90.96). The mean height recorded was 66.37. Significant results were also found for plant height by Elshafei *et al.* (2019) ^[9] and Singh *et al.* (2017) ^[17]. The lowest 100 seed weight was recorded in HFB 2 (28.90) followed by CHF FaB-15 (33.98). The highest 100 seed weight was recorded in CHF FaB-13 (97.70) followed by CHF FaB-1 (89.45). The mean weight recorded was 66.14. Similar findings were recorded by Singh *et al.* (2017) ^[17] and Ammar *et al.* (2015) ^[5] for 100 seed weight.

Yield per plant (g)

The lowest yield per plant was recorded in HFB 2 (21.33) followed by CHF FaB-4 (33.13). The highest yield per plant was recorded in CHF FaB-13 (126.98) followed by CHF FaB-6 (97.09). The mean yield per plant recorded was 71.68. The result found was in conformity with the finding of De Cillis *et al.* (2019) ^[6].

Conclusion

Wide variations among the study genotypes can be seen both for qualitative and quantitative morphology characters. Thus, these studied characters can be used for breeding programme in order to improve yield. The mean performance of quantitative morphological characters revealed that the more the number of stems per plants, number of pods per node and plants contribute maximum amount in yield. Highest number of stems per plant, number of pods per node, number of pods per plant, pod length, 100 seed weight and yield per plant was recorded in CHF FaB-13. Thus, these genotypes can be used for producing high amount of yield in future breeding programme. The present investigation revealed that the lowest days taken for plant to appear first flower, days to 50% flowering, days to first pod can be observed in genotypes CHF-FaB-5, which further revealed that these genotypes can be used for earliness in near future breeding programme.

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