Original Research Article

Morphological evaluation of the local genotypes of broad bean (*Viciafaba*L.) for yield attributes under the Nilgiris condition

Abstract

The broad bean (*Viciafaba* L.) is the predominant and oldest domesticated cool-season food legume in the world next to chickpea and pea. The present study was carried out to evaluate the performance of 20 broad bean accessions(named from Vf1 to Vf20)in Nilgiris, Tamil Nadu, India conditions.It was developedin randomized blockdesign with three replications during the year 2022. Observations on quantitative traits *viz*., plant height (cm), number of branches per plant, days to 50% flowering, days to maturity, pod length (cm), pod width (cm), number of pods per cluster, number of pods per plant, number of seeds per pod, 100 seed weight (g), seed yield per plant (g) and pod yield per plant (g) were recorded fo-r each genotype. Substantial genotypic variations were observed for all attributes under investigation. Based on the mean performance, the genotypesVf2 (273.67), Vf8 (245.83) and Vf1 (234.67) have recorded the highest green pod yield per plant, outperforming all other genotypes. Their outstanding performance in terms of number of branches per plant, pod length, number of pods per cluster, number of pods per plant, and 100-seed weight was the major factor contributing to their superiority in terms of yield. Since the genotypes show wide range of variation for all the traits taken under study, they can be effectively utilized in breeding programmes for varietal development in broad bean.

Keywords: Broad bean; evaluation;genotypes; pod yield; quantitative traits; variability.

1. Introduction

Broad bean (*Viciafaba* L.; Family : Fabaceae) also known as faba bean, bakla bean, winter bean and windsor bean is a minor leguminous vegetable grown in hilly regions of India. Broad beans are said to have originally originated in the Middle East and have been in from about 4,500 BC.The impact of the broad bean as a grain legume for global protein security is risingfor the production of animal feed and food for human consumption(Bishnoi *et al.*, 2012).It is a multipurpose crop and can be used as vegetable, pulse, forage, cover crop and as green manure. Mostly fresh seeds and tender pods are used as vegetables or dried seeds in foodacross the Nilgiris district.Broad bean contains high levels of proteins (25–40%), carbohydrates, antioxidants, dietary fibre, vitamins as well as minerals(Nosworthy *et al.*, 2018).It is an excellent depot of levodopa (L-Dopa), a substance that is used to treat Parkinson's disease and is a precursor to dopamine(Singh *et al.*, 2013).

Although it is ranked seventh among legumes globally, its production is considerably low in India and restricted to a small area in Bihar, Madhya Pradesh, and a relatively small part of Uttar Pradesh (Singh *et al.*,2012). Out of more than 50 nations that produce broad beans, production is mostly centred in Asia, the European Union (EU), and Africa with China being the leading producer followed by Ethiopia (FAO, 2020).

Despite being a crop that is underutilised, broad beans command good prices in the Nilgiris district of Tamil Nadu. Due to the fact that it is not cultivated commercially in the state, no standard variety is available for growers in this area. Lack of high yielding cultivars with good-

quality podsis a primary constraint in broad bean cultivation.The Horticultural Research Station, Tamil Nadu Agricultural University (TNAU), Udhagamandalam begun diligently gathering native strains for germplasm conservation, evaluation and utilise them for yield improvement of this vegetable crop. In light of this, twenty broad bean genotypes collected from several villages in the Nilgiris district were evaluated for pod yield and certain yield-contributing factors in the current experiment.

2. Materials and methods

The experimental material comprised of 20 genotypes of *Viciafaba*gathered from various locations around the Nilgiris district of Tamil Nadu. The crops were raised at the experimental farm of Horticultural Research Station, TNAU, Udhagamandalam, Nilgiris, Tamil Nadu, India during the year 2022. The farm is situated between 11.4° and 11.5°N latitude, at a height of 2535 m above mean sea level. The average temperature ranged from 9°C to 18°C at night and from 21°C to 32.2°C during day time with relative humidity of 57 to 75%.The initial characteristics of the experimental soil were evaluated in the lab, and it was found to be a clay loam with pH of 4.97. Each genotype was raised in three rows, each measuring 3 metres long and spaced 45 X 15cm apart in randomized block design (RBD)with three replications. All package of practises were carried out to raise a healthy crop. Data on 12 quantitative traits were collected from randomly chosen plants in all the three replications of 20 genotypes to assess the morphological genetic diversity among the genotypes. These traits included plant height (cm), number of branches per plant, days to 50% flowering, days to maturity, pod length (cm), pod width (cm), number of pods per cluster, number of pods per plant, number of seeds per pod, 100 seed weight (g), seed yield per plant (g) and pod yield per plant (g). The experimental data were subjected to statistical analysis and analysis of variance was done as described by Gomez and Gomez (1984). At a 5% level of significance, the calculated and tabulated "F" values were compared. It was deemed significant if the calculated 'F' value surpassed the tabulated value. Taking advantage of OPSTAT Software, the analysis was done.

3. Results and Discussion

3.1. Analysis of Variance

The potential for choosing improved genotypes with desirable features depends on the presence of significant genetic variation for various traits. The analysis of variance (ANOVA) for 12 characters is provided in the Table 1. The outcome of the analysis of variance showed that there were substantial variations between all of the treatments for each attribute under investigation, demonstrating the great range of variation existing in the twenty broad bean accessions. (Kumar *et al.,* 2017; Singh *et al.,* 2017; Tadele*et al.,* 2019; Kumar and Kaushik, 2020; Sharifi*et al.,* 2020; Lourembam*et al*., 2022) have also reported similar observations in broad beans.

Table 1: Analysis of variance for various morphological characters in broad bean (*Viciafaba*)

Characters	Mean sum of squares		
	Treatment	Replication	Error
Plant height	226.973**	134.444	11.544
No. of branches per plant	0.537**	0.196	0.080

Days to 50% flowering	17.415**	3.255	0.483
Days to maturity	33.763**	0.900	1.216
Pod Length (cm)	1.596**	0.028	0.002
Pod Width (cm)	0.010**	0.001	0.001
No. of Pods per cluster	0.534**	0.004	0.061
No. of Pods per plant	53.342**	0.278	0.816
No. of seeds per pod	0.255**	0.056	0.020
100 seeds weight (g)	432.749**	0.100	1.666
Seed Yield per plant (g)	266.354**	0.225	0.633
Pod Yield per plant (g)	6505.673**	41.344	26.982

**Significant at 1% level of probability, *Significant at 5% level of probability.

3.2. Mean performance

The following discussion relies on the mean performance of 20 broadbean (*Viciafaba*) genotypes for various attributes (Table 2, Figure 1and Figure 2).

3.2.1. Plant height (cm)

One of the key characteristics for plant development and vigour is plant height(PH). The genotypes in the current study displayed substantial variations in plant height. The genotype Vf 11 (113.67) and Vf 17 (113.67) were the tallestfollowed by the genotypesVf 8 (107.67) and Vf 2 (104.00), whileVf 20 (72.67) andVf 7 (74.33)were dwarf genotypes followed by Vf 6 (84.17) and Vf 10 (90.83). Themeanheightrecordedwas95.27centimetres.Significant results were also foundfor plant height as reported by Ammar *et al.* (2015), Ahmed *et al.* (2016)and Singh *et al.* (2017).

3.2.2. Number of branches per plant

The maximum number of branches per plant(NBP) was observed in the genotype Vf 4 (3.70) and Vf 1 (3.50). The least number of branches were noticed in the genotype Vf 6 (1.90), followed byVf 20 (2.00). The mean value recorded for this trait was 2.60. These outcomes support the findings made by Ahmed *et al.* (2016) and Lourembam *et al.* (2022).

3.2.3. Days to 50% flowering

Earliness is an important attribute and so all the genotypes were evaluated on the basis of days to 50% flowering(DF) and days to maturity(DM). Early flowering was noticed in the genotype Vf 14 (52.71) while late flowering was noticed inVf 16 (63.97) and Vf 6 (62.51). The mean number of days taken for 50 % flowering was 58.24. Ahmed *et al.* (2016), Singh *et al.* (2017) and Lourembam *et al.* (2022) also noticed wide variability for this trait.

3.2.4. Days to maturity

The Days to maturity (DM) is highly ideal for all vegetables to attain early maturity. The genotype Vf 14 (147.00) was found to be the early maturing and the genotype Vf 16 (163.50) was late maturing. The mean number of days taken for maturity was 156.25. The results agree with those of Ammar *et al.* (2015), Ahmed *et al.* (2016) and Singh *et al.* (2017).

3.2.5. Pod length (cm)

The number of seeds per pod increases with pod length(PL), leading to better yields. Significant variations for this attribute were seen between the genotypes under investigation. The genotype Vf 17 (12.85) had the greatest pod length, followed by the genotypesVf 8 (12.77) and Vf 11 (12.42).The genotype Vf 7 had the shortest pod length (9.48), which was followed by the genotypes Vf 15 (9.77) and Vf 18 (10.08)with a mean performance of 11.01 cm. Differences for pod length was also reported by Suso *et al.* (1996), Singh *et al.* (2017) and Lourembam *et al.* (2022).

3.2.6. Pod width (cm)

The maximum pod width(PW) was observed in the genotypesVf 19 (1.76) and Vf 2 (1.73) followed byVf 1 (1.68). The genotype Vf 13 (1.49) recorded the smallest pod width, which was followed by Vf 20 (1.52) and Vf 12 (1.52). The mean performance recorded was 1.58 cm. These findings are coincided with those ofAl-Rifaee *et al.* (2004)and Singh *et al.* (2017).

3.2.7. Number of pods per cluster

The number of pods per cluster(NPC) was maximum in the genotype Vf 8 (3.35) and minimum in the genotype Vf 4 (1.65). The mean number of pods per cluster recorded was 2.43. Variation for number of pods per cluster has also been reported by Abid *et al.* (2015), Singh *et al.* (2017) and Lourembam *et al.* (2022).

3.2.8. Number of pods per plant

The genotypes Vf 1 (29.00) and Vf 8 (26.83) recorded the maximum number of pods per plant(NPP) followed by Vf 2 (26.67) and Vf 17 (22.83) with a mean performance of 17.25. The minimum number of pods per plant was recorded in Vf 20 (11.17) followed by the genotype Vf 6 (11.83). A wide variation for number of pods per plant was also noticed by Ammar *et al.* (2015),Singh *et al.* (2017) and Lourembam *et al.* (2022).

3.2.9. Number of seeds per pod

The maximum number of seeds per pod(NSP) was recorded in Vf 17 (3.25) followed by Vf 10 (3.13) with a mean performance of 2.58. The minimum number of seeds per pod was recorded in the genotypeVf 7 (1.88) followed by the genotypes Vf 6(2.13) and Vf 20 (2.13). Similar findings were reported by Aziz and Osman (2015), Ahmed *et al.* (2016)and Lourembam *et al.* (2022).

3.2.10. The 100 seed weight (g)

A crucial characteristic that increases seed yield per plant is 100-seed weight (g). The highest 100 seed weight(SWT) was recorded in the genotypes Vf 2 (139.25) and Vf 19 (134.00) followed by the genotypesVf 1(129.25) and Vf 8(120.75). The lowest 100 seed weight was recorded in Vf 5 (79.50) followed by Vf 6 (86.50). The mean weight recorded was 109.78. The outcomes concur with the findings of Singh *et al.* (2017) and Lourembam *et al.* (2022).

3.2.11. Seed yield per plant (g)

Due to the crop's dual utility as a vegetable and a pulse crop, seed output per plant is alsoa crucial attribute. In this context the highest seed yield per plant(SYP) was recorded in Vf 1 (81.50) followed by Vf 2 (78.00) and Vf 8 (76.50). The lowest seed yield per plant was recorded in Vf 20 (45.00) followed by Vf 7 (45.25).The mean yield per plant recorded was 64.73.Aziz and

Osman (2015), andSingh *et al.* (2017) have also found variations in the amount of seeds produced per plant.

3.2.12. Pod yield per plant (g)

Pod yield is the most significant features since it highly influences the genotype's marketing potential. Each genotype showed a substantial amount of divergence for this attribute. The highest pod yield per plant(PYP) was recorded in the genotype Vf 2 (273.67) and Vf 8 (245.83) followed by the genotypes Vf 1 (234.67), Vf 9 (217.67) and Vf 19 (204.17). The lowest yield per plant was recorded in the genotype Vf 6 (51.67) followed by Vf 7 (79.83). The mean yield per plant was observed to be160.00. The results are in agreement with the finding of Singh *et al.* (2017),De Cillis *et al.* (2019) and Lourembam *et al.* (2022). The greater performance of these genotypes for number of branches per plant, pod length, number of pods per cluster, number of pods per plant, seed yield per plant, and 100-seed weight is primarily responsible for their improved fresh pod yield per plant.

Table 2: Mean performance of broad bean(*Viciafaba*)genotypes for different traits.

Genotype	PH	NBP	DF	DM	PL	PW	NPC	NPP	NSP	SWT	SYP	PYP
Vf 1	98.00	3.50	53.67	150.00	11.33	1.68	3.00	29.00	2.88	129.50	81.50	234.67
Vf 2	104.00	2.60	56.42	153.00	11.90	1.73	3.00	26.67	2.75	139.25	78.00	273.67
Vf 3	95.17	2.30	58.70	156.00	10.83	1.57	2.00	17.17	2.50	110.25	67.50	140.00
Vf 4	93.00	3.70	60.30	157.00	11.13	1.59	1.65	17.50	2.75	118.00	75.75	185.50
Vf 5	94.67	2.40	57.28	155.50	10.68	1.55	2.00	12.00	2.25	79.50	52.50	109.83
Vf 6	84.17	1.90	62.51	162.50	10.13	1.54	2.00	11.83	2.13	86.50	47.00	51.67
Vf 7	74.33	2.40	61.47	162.00	9.48	1.53	2.00	14.67	1.88	105.00	45.25	79.83
Vf 8	107.67	3.40	56.74	154.00	12.77	1.61	3.35	26.83	2.88	120.75	76.50	245.83
Vf 9	93.00	3.00	57.34	155.50	11.17	1.59	2.00	18.00	2.75	110.75	75.50	217.67
Vf 10	90.83	2.80	58.25	156.50	12.02	1.55	3.00	15.33	3.13	108.25	75.00	161.83
Vf 11	113.67	2.60	54.34	151.50	12.42	1.61	3.00	16.50	3.00	114.25	76.00	192.17
Vf 12	91.83	2.50	61.09	161.00	10.88	1.52	3.00	13.50	2.25	104.25	54.25	120.50
Vf 13	92.67	2.20	57.69	156.50	10.33	1.49	2.00	14.83	2.38	105.75	62.25	114.00
Vf 14	101.67	2.30	52.71	147.00	11.10	1.56	2.50	16.50	2.63	113.50	66.75	171.67
Vf 15	91.17	2.30	55.36	154.00	9.77	1.56	2.00	12.83	2.63	103.25	60.00	152.17
Vf 16	96.83	2.10	63.97	163.50	11.02	1.58	2.85	15.17	2.50	95.75	64.25	140.17
Vf 17	113.67	2.30	60.24	157.50	12.85	1.60	2.15	22.83	3.25	107.00	63.00	162.00
Vf 18	93.50	2.40	57.68	156.00	10.08	1.56	2.00	14.67	2.38	115.50	58.00	139.17
Vf 19	102.83	3.30	58.67	156.50	11.22	1.76	2.85	18.00	2.50	134.00	70.50	204.17
Vf 20	72.67	2.00	60.33	158.00	10.28	1.52	2.15	11.17	2.13	94.50	45.00	103.50
Minimum	72.67	1.90	52.71	147.00	9.48	1.49	1.65	11.17	1.88	79.50	45.00	51.67
Maximum	113.67	3.70	63.97	163.50	12.85	1.76	3.35	29.00	3.25	139.25	81.50	273.67
Mean	95.27	2.60	58.24	156.25	11.01	1.58	2.43	17.25	2.58	109.78	64.73	160.00
S.E (M) ±	2.40	0.20	0.49	0.78	0.03	0.01	0.18	0.64	0.10	0.91	0.56	3.67
CD at 5%	7.11	0.59	1.46	2.31	0.10	0.02	0.52	1.89	0.30	2.70	1.67	10.87

S.E (m) ±- Standard Error of mean; CD- Critical difference

PH- Plant height (cm)
NBP- Number of branches per plant
PL- Pod length (cm)
PW- Pod width (cm)
NSP- Number of seeds per pod
SWT- 100 seed weight (g)

DF- Days to 50% flowering
DM- Days to maturity
NPC- Number of pods per cluster
NPP- Number of pods per plant
SYP- Seed yield per plant (g)
PYP- Pod yield per plant (g)

4. Conclusion

The mean performance of the genotypes for several morphological traits revealed that the number of branches per plant, pod length, number of pods per cluster, number of pods per plant and 100-seed weight have mainly attributed to the increased pod yield and seed yield of the crop. Based on the mean performance, the genotypes Vf 2 (273.67) and Vf 8 (245.83) has recorded the highest green pod yield per plant, outperforming all other genotypes. Their improved performance in terms of number of branches per plant, pod length, number of pods per cluster, number of pods per plant, and 100-seed weight contributed towards an increased yield. Significant heterogeneity is observed among the genotypes for the morphological traits. Hence the top-performing genotypes could be utilised in hybridization programmes or for further investigation in multiple environments for developing improved varieties of broad bean (*Viciafaba*).

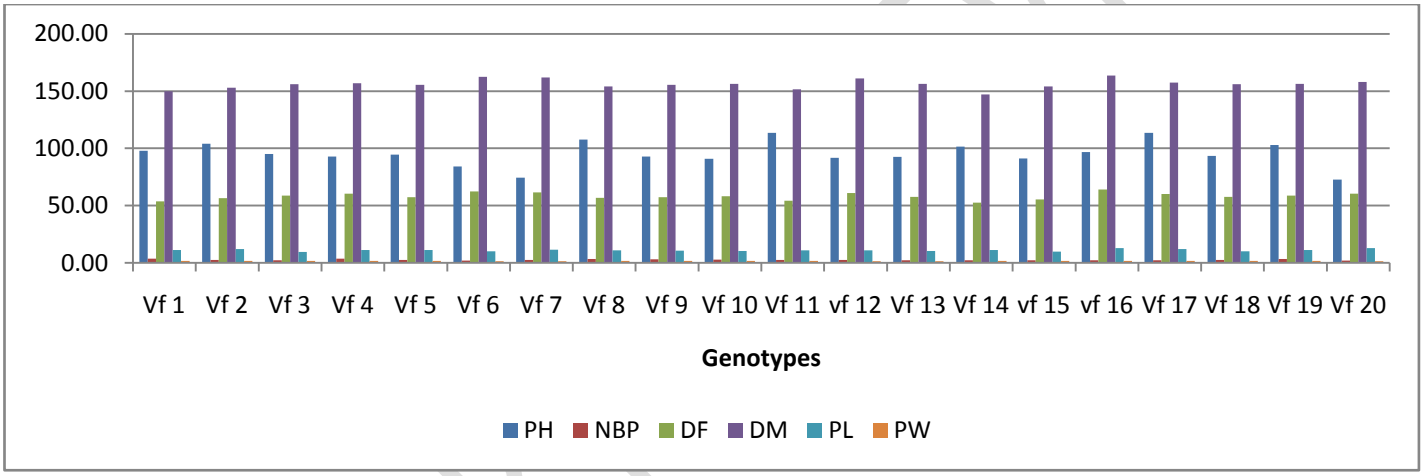

Fig. 1. Mean performance of broad bean (*Viciafaba*) genotypes for plant height (cm), number of branches per plant, days to 50% flowering, days to maturity, pod length (cm), pod width (cm).

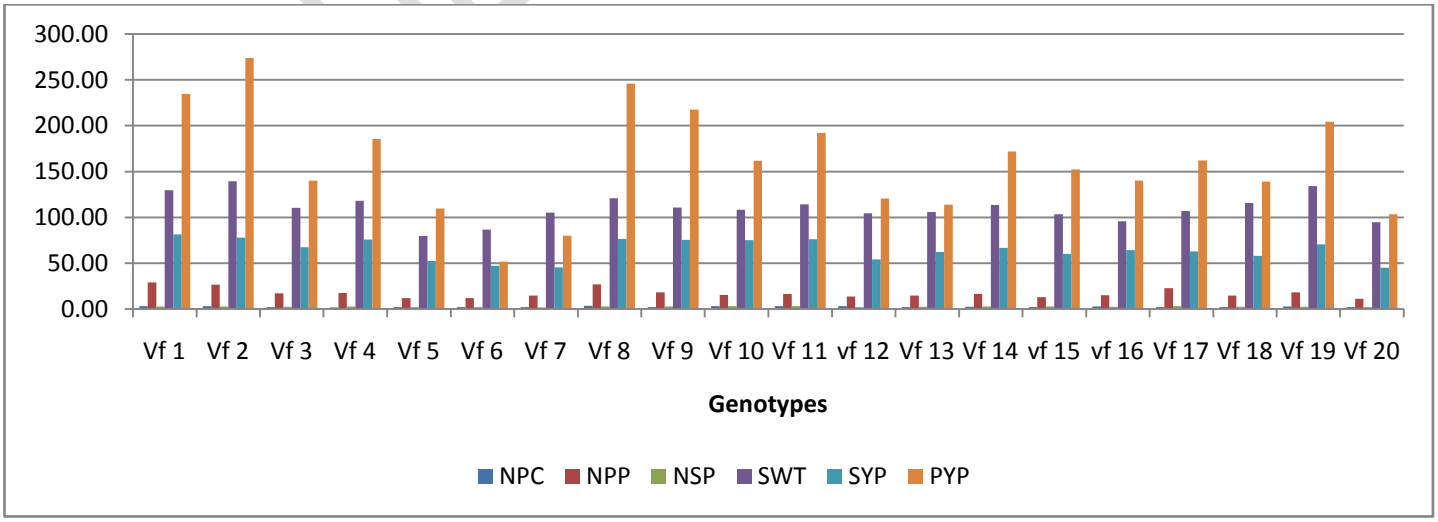

Fig. 2. Mean performance of broad bean (*Viciafaba*) genotypes for number of pods per cluster, number of pods per plant, number of seeds per pod, 100 seed weight (g), seed yield per plant (g) and pod yield per plant (g).

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