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MORPHOLOGICAL DIVERGENCE VISUALIZED THROUGH THE QUALITATIVE AND QUANTITAVE ATTRIBUTES WITHIN *Vicia faba*.

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Key words : Faba bean, Qualitative and Quantitative characters, divergence, Taxonomy

Twelve cultivars of *Vicia faba* were analysed in terms of some selected morphological attributes to visualize the divergence. The present investigation aimed to look for the level of qualitative and quantitative dimensions showing the intraspecific variations in the selected taxa of *Vicia faba*.

INTRODUCTION

Vicia faba is an important legume of the tribe Vicieae of the family Fabaceae commonly called Faba bean. This legume is cultivated on a large scale throughout the world. Ever since the beginning of the science of systematics, morphological characteristics have been assigned special place as they have produced rewarding results on which certain definite conclusions can be derived while making comparisons between the related taxa. In fact, this is the most easiest of the characters approach without the aid of much instrumentation. The validity, charm and authenticity of morphological characters have won special place in the field of taxonomy (Heywood 1984, Moore 1984, Roy 1988, Smart, 1984, Vavilov 1926, 1949). Keeping this view in mind twelve *Vicia faba* cultivars were analysed in terms of some selected morphological attributes in order to visualize divergence. Such characters have been of both qualitative and quantitative dimension.

Table No. - 1.

Germ plasms of *Vicia faba* under investigation

Serial No	Cultivars	Source	Remarks
1	DHB - 94	Agriculture College Dholi, Pusa Samastipur	Seasonal Rabi crop.
2	DHB – 95	"	"
3	DHB – 96	"	"
4	DHB – 97	"	"
5	DHB – 98	"	"
6	DHB – 99	"	"
7	DHB – 100	"	"
8	HV – 1	Hisar Agriculture University	"
9	HV – 2	"	"
10	JV – 3	Agriculture College Dholi, Pusa Samastipur	In water stressed condition
11	Ranchi local	Birsa Agriculture University, Ranchi	"
12	Bhagalpur local	Agriculture College, Sabour	"

MATERIAL AND METHODS

The qualitative characters considered in the present investigation are the following :

(i) Nature, form and surface of the stem
(ii) Colour and position of the flowers
(iii) Shape and texture of the fruit
(iv) Shape and colour of the seed
(v) Shape and nature of lamina

In terms of quantitative morphological attributes, the following parameters were considered :

(i) Height of the plants
(ii) Root shoot ratio
(iii) Root penetrato area
(iv) No. of branching/plant
(v) Length of internodes.
(vi) No. of leaves/plant
(vii) Length of leaflets
(viii) Width of leaflets
(ix) No. of flowers/inflorescene
(x) No. of inflorescence/plant
(xi) Length of flower
(xii) Size of pods
(xiii) No. of seeds/pod
(xiv) Weights of seeds (100 in no./plant)

For every morphological trait under consideration, ten random data were scored and mean of the observed values were calculated and tabulated. Based on the procedure polygraphs were prepared for all the twelve cultivars which would present an overall picture of morphological divergence within *Vicia faba.*

OBSERVATION

Morphological parameters observed included the following:-

i. Habit

All the cultivars of *Vicia faba* included in the present investigation are annual herbs which come under "rabi" crop. All the cultivars of DHB range (DHB94 - DHB100) have been

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erect and are herebaceous delicate looking plants. The DHB series has shown branching pattern where number of branches per plant ranged from 4.01 in DHB-94 to as high as 4.84 in DHB-96. The cultivars like HV1, HV2 and JV2 have shown bushy habit of erect nature and have more branches in comparison to other cultivars. The number of branches per plant has been found to be 6.02 in JV2 which has incidentally the record of higher number of branches per plant. Two local varieties Ranchi local and Bhagalpur local presented the intermediate case in this regard. The habit sketch of these two local varieties have been little different due to their vigorous growth pattern in comparison to their counterparts.

ii. Plant Height

The height of cultivars under observation have shown that this ranged from 49.89 cm to 59.66 cm in JV2 and in Bhagalpur local which was the tallest. The plant height in DHB-series has been quite uniform, the cultivars like HV1, HV2 and JV2 appeared under small category. The local varieties have been found to be taller.

iii. Stem

In stem certain parameters like number of branches/plant, length of internodes, etc., were considered and the results have been depicted in Table No. 2. The stem has been semi-cylindrical and ribbed in Bhagalpur local. In bushy cultivars like HV1, HV2 and JV2 the internodes have been recorded in cultivars like Ranchi local and Bhagalpur local. DHB-series has presented intermediate picture where an average length record has been found to be 4.5 cm.

Table No. - 2.

Morpholgical characters analysed in cultivars of *Vicia faba*

Character	Plant Height (in cm)	No. of Branches per Plant	Inter node Length (in cm)	Leaflet Length (in cm)	Leaflet Width (in cm	No. of flowers per inflore scence	Length of flower (in cm)	Length of pod (in cm)	Gross look
DHB-94	54.16±1.45	4.01±0.75	4.44±0.96	3.71±0.81	2.14±0.91	2.6±0.52	2.26±0.85	4.68±0.13	Erect & stout
DHB-95	56.56±1.06	4.26±0.88	4.56±0.86	3.66±0.68	2.16±0.88	2.8±0.51	2.28±0.65	4.54±0.28	Erect & stout
DHB-96	56.25±0.96	4.84±0.25	4.33±0.94	3.70±0.64	2.42±0.66	2.6±0.64	2.30±0.64	4.46±0.32	Erect & stout
DHB-97	55.26±0.88	4.86±0.36	4.58±0.31	3.75±0.86	2.26±0.68	2.7±0.48	2.32±0.22	4.56±0.56	Erect & stout
DHB-98	54.94±1.02	4.26±0.82	4.56±0.78	3.68±0.75	2.34±0.78	2.8±0.44	2.34±0.88	4.55±0.54	Erect & stout
DHB-99	54.33±0.84	4.11±0.66	4.26±0.68	3.72±0.78	2.42±0.26	2.6±0.62	2.22±0.26	4.60±0.58	Erect & stout
DHB-100	53.86±1.22	4.36±0.54	4.38±0.76	3.77±0.88	2.18±0.76	2.4±0.66	2.18±0.64	4.58±0.44	Erect & stout
HV1	50.12±0.65	5.88±0.33	3.94±0.26	2.98±0.64	1.98±0.28	2.8±0.12	2.64±0.68	3.68±0.26	Erect & Bushy
HV2	50.82±0.45	5.96±0.66	5.88±0.32	3.21±0.23	2.08±0.54	2.9±0.48	2.68±0.26	3.78±0.66	Erect & Bushy
JV2	49.89±0.26	6.02±0.35	3.36±0.36	3.14±0.48	2.06±0.44	3.1±0.64	2.68±0.62	3.86±0.64	Erect & Bushy
Ranchi Local	56.88±1.66	4.06±1.06	4.68±1.06	4.06±0.86	2.78±0.82	2.4±0.42	2.88±0.88	5.26±0.88	Erect & vigorous
Bhagalpur Local	59.66±1.82	4.66±1.22	5.14±0.88	4.26±1.02	2.86±0.88	2.5±0.44	2.78±0.94	5.52±0.92	Erect & vigorous

iv. Leaf

Leaves in all cultivars were studied in terms of dimension and several other details. All the taxa have uniform stipulate compound leaves. There have been marked differences in the length and width of leaves. The largest leaf was found in local varieties like Ranchi local and Bhagalpur local. Cultivars like HV1, HV2 and JV2 have the smallest leaves both in terms of length and width. The smallest leaf has been found in JV2 which measured only 3.36 cm. Intermediate length of leaves was recorded in DHB-series. Leaves of HV1 have characteristic appearance with minimal width and are apparently identified from the rest of the cultivars under study. Some of the top leaflets in local cultivars were narrow and tendrillar in nature.

v. Inflorescence

Flowers in all cases were produced in solitary and axillary inflorescence. Number of flowers per inflorescence in different cultivars have been found to be quite consistent. The highest number of flowers per inflorescence has been found to be maximum (3.1) in cultivar like JV2 and maximum number has been 2.4 in Ranchi local. However, as stated earlier, there has not been much variation in the number of flowers per inflorescence in the cultivars selected.

vi. Flowers

Flowers are mostly small, fabulous and sessile. They have been dull white in colour except the local variety where they look with a little bluish tinge. Local varieties Bhagalpur local and Ranchi local have produced comparatively robust flowers,

the largest being produced by Ranchi local which measured 2.88 cm. Different dimensions presented by other cultivars have been shown in Table No. - 2.

vii. Fruit

As a rule the fruit is a pod in every cultivar. The pod has been linear and compressed in all the studied cases. The largest size of pod was recorded in Ranchi local and Bhagalpur local. The smaller pods were produced in bushy cultivars like HV1, HV2 while average-sized pods were produced in DHB-series of cultivars.

viii. Seed

Seeds have been found to be oval and compressed. There has been variation of colour ranging from dull white, brown, greenish white to purple.

Table No. - 3.

Leaf epidermal profile of ***Vicia faba*** **cultivars**

Taxom	Size of epidermal cells in µ		Stomatal frequency		Stomatal size (l × w in µ)		Stomatal aperture (l × w in µ)	
	Lower surfcae	Upper surfcae	Lower surfcae	Upper surfcae	Lower surfcae	Upper surfcae	Lower surfcae	Upper surfcae
DHB-94	85.98±2.17	78.82±2.72	7.88±0.23	5.8±0.23	42.03±0.98	39.4±1.12	5.99±0.85	7.01±0.32
	×	×			×	×	×	×
	29.65±0.36	44.23±3.11			26±0.32	29.10±0.14	2.8±1.2	2.02±0.24
DHB-95	85.64±82.06	77.81±2.71	6.86±0.35	5.5±0.20	41.03±0.97	38.3±1.11	4.96±0.82	6.98±0.31
	×	×			×	×	×	×
	29.44±0.44	42.22±3.9			24±0.31	27.10±0.13	2.8±1.1	2.01±0.24
DHB-96	85.58±1.88	76.81±2.70	6.94±0.34	5.3±0.21	44.66±0.96	37.3±1.9	4.46±0.81	6.91±0.4
	×	×			×	×	×	×
	29.36±0.64	41.22±3.8			23±0.31	26.10±0.12	2.6±1.2	2.01±0.24
DHB-97	85.56±1.66	74.51±2.68	6.84±0.34	5.2±0.19	43.86±0.94	36.8±1.8	4.94±0.21	7.24±0.4
	×	×			×	×	×	×
	29.38±0.84	41.20±3.6			22±0.32	25.10±0.12	2.5±1.2	2.94±0.23
DHB-98	85.8 ± 1.34	73.48 ± 2.66	6.62±0.32	5.4±0.19	42.43±0.93	35.6±1.8	4.94±0.81	6.84±0.4
	×	×			×	×	×	×
	29.11 ± 0.12	39.20 ±2.8			22±0.32	25.10±0.12	2.6±1.2	2.64±0.23
DHB-99	86.32 ± 1.84	73.48 ± 2.66	6.86±0.33	5.3±0.18	41.62 ±0.93	34.3 ±1.8	5.48 ±0.81	6.88 ±0.4
	×	×			×	×	×	×
	29.86 ± 0.75	39.20 ±2.8			22±0.32	24.4±0.10	2.8±1.1	2.55±0.24
DHB-100	85.98 ± 1.06	74.43±2.65	6.21±0.34	5.5±0.20	49.22±0.92	38.4±1.8	5.46±0.81	6.26±0.3
	×	×			×	×	×	×
	29.22 ± 0.66	38.20 ± 2.6			22 ± 0.32	24.44± 0.10	24± 1.1	2.64± 0.24
HV 1	76.76 ± 2.04	72.66±1.80	5.86±0.38	4.58±0.15	36.22±0.86	35.36±1.26	4.84±1.02	5.58±1.22
	×	×			×	×	×	×
	26.32 ± 0.66	40.61±0.64			24.24±0.16	22.16±0.25	26.2±0.62	2.11±0.64
HV 2	78.75 ± 1.88	71.25±1.66	5.96±0.84	4.68±0.82	38.22±1.24	34.86±1.66	4.72±10.88	5.98±1.64
	×	×			×	×	×	×
	26.24±0.86	40.22±0.42			24.88±0.88	22.84±0.33	2.44±0.36	2.16±0.86
JV 2	74.32±0.34	70.61±1.28	8.98±1.64	4.44±0.86	36.12±0.36	33.96±1.22	4.21±0.66	5.25±0.88
	×	×			×	×	×	×
	32.88±0.46	38.32±0.82			22.68±0.88	21.89±0.26	2.12±0.35	2.12±0.34
RANCHI LOCAL	88.3 ±1.78	82.76 ±1.84	6.82±0.34	7.72±0.88	48.42 ±0.68	41.22 ±1.12	6.68 ±1.25	8.84 ±0.66
	×	×			×	×	×	×
	32.88±0.46	52.22±0.64			30.12±0.26	31.32±0.72	3.36±0.60	8.34±1.22
BHAGALPUR LOCAL	92.24±1.28	64.84±1.64	10.68±0.88	8.62±1.02	52.34±1.24	46.48±0.86	7.35±1.62	8.96±1.06
	×	×			×	×	×	×
	34.34±0.26	56.36±0.64			32.38±0.64	34.34±1.24	4.45±0.64	9.44±0.68

LEAF EPIDERMAL STUDIES

In recent taxonomical studies, leaf epidermis profile has been taken into serious consideration. This is chiefly because these exhibit quite appreciable range of variation, some of which can be profitably considered in taxonomical evaluation (Stebbins, 1956). Therefore it was thought to be wise to screen foliar epidermal traits, such as size of the epidermal cells, stomatal frequency, stomatal length and size of the stomatal aperture. The data thus observed and collected have been presented in Table-3. It is pertinent to mention that the structural details of the surfaces of the leaf have been taken into consideration.

Epidermal features in general and the stomatal frequency and size in particular have been very significant in evaluating water economy of the cultivars included in the present study. This has indicated higher stomatal frequency of 10.68 in local cultivars like Bhagalpur local and 8.98 in Ranchi local. More water dependent, the bushy cultivars like HV1, HV2, JV2 have shown lower stomatal frequency making these cultivars suitable for cultivation in water starved regions.

RESULTS AND DISCUSSION

Vicia faba cultivars have been studied in terms of certain stable morphological traits of both qualitative and quantitative nature. The details have been presented in Table - 2. Perusal of the table suggested that the range of morphological variations within the species has been quite comprehensive. In all three morphological groups cultivars can be categorized : one which includes mostly the cultivars of DHB-series, the second group producing erect and bushy plants with smaller height and profuse branching. They have been further marked with smaller pods. This group consists of JV1, HV1 and HV2 cultivars. The local cultivars have, however, shown a little different class of morphology where plants have higher length, erect and more vigorous habit. Since these cultivars have been under domestication, they have acquired different morphological stream. Rest of the cultivars have undergone choice selecting pressure, so have assumed different morphology.

In modern biosystematic studies, epidermal characters have also been given special impetus. Leaf epidermal studies involve quite great number of things like size of the epidermal cells, stomatal frequency, stomatal size, stomatal aperture and appendages. But in leaf epidermal studies, stomatal characters have won special appreciation for taxonomic characters categorization. It is not only the morphology but eco-physiological preludes have also been effected by stomatal characteristics. This sends straight and direct effects on the water economy of the plants. Stomatal characters in twelve cultivars of *Vicia faba* have been shown in Table - 3.

A study of this table suggested that the lowest stomatal frequency has been recorded in cultivars like HV1, HV2 and some cultivars of DHB-series. These cultivars further have small stomatal size, thus, can be preferred for cultivation in areas of water scarcity. Local cultivars, more specially Bhagalpur local show that epidermal traits lead to excess loss of water. So this cultivar requires better irrigation facilities. This study, further, has shown that the cultivars of DHB-series constitute a moderate group in terms of water economy.

CONCLUSION

Systematics is one of the oldest sciences and since its early days divergence of morphological characters have been utilized for the purpose of classification and also to enumerate phyletic distances between the taxa compared. Overall morphological making of an organism is the result of action, co-action and interaction of genotypes with the environment (Sinha and Upadhyaya,1985). The morphovariations apparently present the intrinsic picture of gene variations. Though it is a rough approximation, nevertheless, it yields some fruitful results. Though the taxa selected have been of below the level of species, accountability of variance is available at the intraspecific level.

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