

DIVERGENCE ANALYSIS IN *VICIA FABA* L. FOR NUTRITIONAL AND ANTINUTRITIONAL ATTRIBUTES

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ABSTRACT

Genetic divergence among 25 genotypes of *Vicia faba* on the bases of nutritional and antinutritional substances present in seed was assessed through Mahalanobis' D^2 analysis. Four groups were formed on the basis of nutritional and three on the basis of antinutritional characters.

Key words: Divergence, nutritional factors, antinutritional factors, *Vicia faba*.

Genetic diversity in a trait is essential for crop improvement programmes. Nutritional and antinutritional factors present in seed are vital to the utilization of pulse crops. Faba bean (*Vicia faba* L.) is known to have several antinutritional factors. The present study has been undertaken to assess the diversity in *Vicia faba*, for nutritional and antinutritional attributes.

MATERIALS AND METHODS

Twenty five genotypes of faba bean were grown in a randomized complete block design with four replications at the Livestock Farm, J.N.K.V.V., Jabalpur. Seeds from ten normal looking randomly selected plants from each genotype were used for assaying the various nutritional characters: protein [1], carbohydrate [2], total amino acids [3], phosphorus [4], potassium (flame photometer), calcium [5], magnesium [5], zinc, iron, manganese and copper (atomic absorption spectrophotometer) contents and antinutritional traits, namely, phenol [6], tannin [7], sucrose [8], raffinose [8], stachyose [9] and phytic acid [10] contents and trypsin inhibitor (TIU) [11] and hemagglutinin (HAU) [12] activities.

The data were subjected to the appropriate analysis of variance; characters showing significant differences among genotypes were used for multivariate analysis [13], and the genotypes were divided on the basis of minimum generalized distances using Tocher's method as described by Rao [14].

RESULTS AND DISCUSSION

On the basis of nutritional characters, the 25 genotypes were grouped into four clusters (Table 1). Cluster II includes the maximum number of genotypes (8), followed by cluster I (7). On the basis of antinutritional attributes, three clusters were formed with the maximum number of genotypes (13) in cluster I and the minimum (1) in cluster III (Table 1).

The maximum intercluster distance was observed between clusters I and II (Table 2) of nutritional characters and the minimum distance between clusters II and IV; the maximum intracluster distance was present in cluster III and the minimum in IV. For the antinutritional attributes, the maximum intercluster distance was observed between clusters I and II, and the minimum between clusters I and III; the maximum intracluster distance was seen in cluster I (Table 2).

Table 1. Compositions of the clusters for nutritional and antinutritional characters of *Vicia faba* seeds

Cluster	Genotypes included in the cluster	Total genotypes	Source
Nutritional characters			
I	JV 2, JV 3, JV 4	3	UP
	JV 1, JV 35, JV 44	3	IARI
	JV 21	1	Bihar
II	JV 9-80, JV 10, JV 31	3	Bihar
	JV 68, JV 83-1	2	Malwa
	JV 7, JV 70-81, No. 21	3	U.P., Haryana, Rajasthan
III	JV 11, JV 29	2	Bihar
	No.9, No. 11	2	Malwa
	JV 77-82	1	Haryana
IV	JV 15, JV 32, JV 33	3	Bihar
	JV 77-81, JV 83-2	2	Haryana, Hoshangabad
Antinutritional characters			
I	JV 9-80, JV 21, JV 29, JV 32, JV 33	5	Bihar
	JV 68, JV 83-1, No. 9, No.11	4	Malwa
	JV 1, JV 35	2	IARI
	JV 7, JV 77-82	2	U.P., Haryana
II	JV 10, JV 11, JV 15, JV 31	4	Bihar
	JV 2, JV 3, JV 4	3	U.P.
	JV 70-81, JV 77-81	2	Haryana
	JV 44, No. 21	2	IARI Rajasthan
III	JV 83-2	1	Hoshangabad

Table 2. Average inter- and intracluster (in bold) D^2 values on the basis of nutritional and antinutritional characters of *Vicia faba* seeds

Clusters	I	II	III	IV
Nutritional Characters				
I	23898.1	606443.1	396916.5	500378.8
II		24738.9	389749.7	231163.5
III			25138.7	267362.4
IV				12553.0
Antinutritional Characters				
I	17466.0	951583.8	50397.3	
II		14724.3	77260.9	
III			0.0	

Table 3. Mean values and range of different nutritional characters of faba bean

Character	Character means and seed range of different clusters			
	I	II	III	IV
Protein (%)	24.7 (18.5–26.3)	23.4 (17.3–28.4)	22.7 (19.7–29.9)	23.2 (18.2–27.1)
Oil (%)	1.3 (1.0–1.9)	1.3 (1.0–1.7)	1.1 (1.0–2.0)	1.30 (1.0–1.6)
Carbohydrates (%)	40.0 (37.0–46.7)	45.2 (39.0–53.0)	40.2 (39.0–43.0)	46.1 (39.0–63.2)
Total amino acids (%)	1.25 (0.83–1.49)	0.85 (0.71–1.03)	0.90 (0.77–1.23)	0.96 (0.71–1.10)
Potash (%)	1.04 (0.87–1.25)	1.08 (0.87–1.44)	1.00 (0.91–1.49)	1.11 (0.89–1.39)
Phosphorus (%)	0.72 (0.49–8.85)	0.66 (0.47–0.84)	0.62 (0.53–0.90)	0.62 (0.47–0.86)
Calcium (%)	0.86 (0.63–0.96)	0.80 (0.63–1.01)	0.85 (0.75–1.19)	0.80 (0.63–1.01)
Mg (%)	1.06 (0.99–1.59)	1.08 (0.90–1.59)	1.24 (0.31–1.44)	1.03 (0.93–1.18)
Cu (ppm)	0.99 (0.90–1.40)	1.00 (0.37–1.33)	1.07 (0.95–1.26)	0.99 (0.91–1.03)
Fe (ppm)	4.36 (3.03–4.85)	4.26 (3.79–5.01)	4.46 (5.03–9.70)	4.42 (4.23–5.05)
Mn (ppm)	15.3 (14.8–16.6)	15.9 (14.5–16.3)	15.3 (14.4–16.0)	15.4 (15.1–16.6)
Zn (ppm)	4.96 (4.26–6.05)	6.80 (5.26–7.01)	5.05 (4.27–6.13)	6.36 (6.29–7.29)

Cluster I based on nutritional characters showed the maximum mean for protein, total amino acid and phosphorus content (Table 3), while cluster IV had minimum protein but the maximum oil, carbohydrate and potash content. Similarly, cluster I for the antinutritional substances (Table 4) had minimum content of raffinose, TIU and sucrose, while cluster II had minimum tannin, stachyose, phytic acid and hemagglutinin.

The ideal genotype should preferably be rich in nutrients like protein, carbohydrates and minerals, and have acceptably low content of antinutritional substances. For the improvement of nutrients like protein, the parent strains from cluster I of nutritional characters would be desirable, while for increasing oil, carbohydrate and minerals, genotypes should be selected from cluster II. Genotypes from cluster I of antinutritional substances would be useful in breeding for reduced antinutritional, mainly flatulence producing substances while genotypes of cluster II will be useful in increasing the availability of nutrients.

Table 4. Mean values and range of different antinutritional characters in the *Vicia faba* seeds

Character	Character mean and range of different clusters		
	I	II	III
Phenol (mg/g)	0.53 (0.21-0.89)	0.76 (0.29-0.98)	0.14
Tannin (mg/g)	0.64 (0.39-0.89)	0.52 (0.37-0.95)	0.89
Raffinose (mg/g)	0.17 (0.05-0.25)	0.15 (0.09-0.27)	0.16
Stachyose (mg/g)	0.53 (0.25-0.74)	0.46 (0.33-0.79)	0.77
Sucrose (mg/g)	1.39 (0.98-2.25)	1.96 (1.19-2.88)	1.39
TIU/mg	1.16 (0.51-2.36)	2.23 (1.27-3.1)	1.89
Phytic acid (mg/g)	0.65 (0.47-0.39)	0.54 (0.37-0.85)	0.67
HAU (mg/g)	3.02 (1.06-5.19)	2.79 (1.48-4.45)	3.23

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