

## Karyotype Analysis in Faba Bean

N.K. Sharma<sup>1</sup> and B. Ramesh

Department of Agricultural Botany, Meerut University, Meerut 250 005, India

**Abstract:** The chromosome complements of 5 accessions of faba bean (*Vicia faba* L.) had considerable intraspecific differences in total chromosome length and volume. Total chromatin length of haploid complement ranged from 65.8  $\mu\text{m}$  to 48.57  $\mu\text{m}$ , and chromatin volume from 84.5  $\mu\text{m}^3$  to 43.6  $\mu\text{m}^3$ . The karyotypes are highly asymmetrical and belong to 3B category of Stebbins. S% and TF% estimates also indicate the asymmetric nature of the *Vicia faba* karyotypes. Based on chromosome morphology, three chromosomes of the haploid complement can be readily identified individually.

**Key words:** Chromatin length, chromatin volume, karyotype analysis, sat-chromosome, *Vicia faba*.

The genus *Vicia* L. (Fabaceae) comprises 180 species (Hooker, 1973), of which, about 40 species are widely grown for forage, vegetable, pulse, green manure and cover crop value. *V. faba* (commonly known as faba bean, broad bean and faba pea), with very high protein content (up to 35%), is an excellent source of lysine and supplements a cereal-based diet (Elsayed, 1984). Detailed chromosomal studies are helpful in successful planning of crop improvement programmes. *V. faba*, a classical material for any cytological study because of its low chromosome number and large chromosome size, has yielded several fundamental discoveries (Chapman, 1984). However, there is evidence of variability in karyotype, including translocation (cf. Bond, 1976). The present paper deals with detailed karyotype analysis in five accessions of *V. faba*.

## Materials and Methods

Seeds of five accessions of *Vicia faba*, received from International Center for Agricultural Research in Dry Areas (ICARDA), Syria, were used for cytological preparations. Chromosome measurements were made with the help of Olympus micrometer utilizing good metaphase cells. Photomicrographs were taken from fresh preparations. Karyograms were prepared by cutting the photographs of the chromosomes and arranging them in order from longest to shortest. The chromosomes were given numbers 1 to 6 in a descending order of length. For chromosomal classification, the scheme proposed by Levan *et al.* (1964) was followed. Relative length, arm ratio, TF%, S% and chromatin volumes were calculated using standard formulae.

## Results and Discussion

The data on chromosome morphology are presented in Table 1, while the photographs of representative somatic chro-

<sup>1</sup> Agricultural Research Station, Keshwana, Jalor 343 001, India.

Table 1. Data on chromosome length and volume, arm ratio, S% and TF% of five accessions of *Vicia faba*

Acc. No.		Chromosome number						Total chromosome length ( $\mu\text{m}$ )	Total chromosome volume ( $\mu\text{m}^3$ )	S%	TF%
		1	2	3	4	5	6				
EC 312439	AL	15.45 $\pm$ 3.18*	10.77	9.98	9.43	8.79	8.20	65.80	84.50	44.02	21.51
	RL	28.31	16.37	15.17	14.23	13.36	12.46				
	AR	1.18	7.55	7.11	7.42	6.47	9.00				
EC 312445	AL	14.88 $\pm$ 2.73*	9.28	8.70	8.55	8.17	7.85	60.16	65.98	44.58	22.14
	RL	29.27	15.43	14.46	14.21	13.58	13.05				
	AR	1.19	6.55	7.45	6.70	7.25	7.53				
EC 312441	AL	13.99 $\pm$ 2.73*	9.34	8.36	8.08	7.96	7.22	57.68	52.29	43.18	20.87
	RL	28.99	16.19	14.49	14.01	13.80	12.52				
	AR	1.19	7.12	8.39	8.98	8.26	9.31				
EC 312443	AL	12.49 $\pm$ 2.75*	8.38	7.93	7.61	7.38	7.13	53.67	45.85	46.79	21.29
	RL	28.39	15.61	14.78	14.18	13.75	13.29				
	AR	1.05	7.64	7.91	9.87	9.11	8.90				
EC 312448	AL	11.44 $\pm$ 2.95*	8.17	7.35	6.78	5.99	5.89	48.57	43.60	40.93	23.88
	RL	29.63	16.82	15.13	13.96	12.33	12.13				
	AR	1.12	7.42	7.17	6.37	5.31	4.54				

AL=Absolute length of chromosome in microns, RL=Relative length of chromosome in per cent volume, AR=Arm ratio, \*=length of satellite, m=metacentric, a=acrocentric.

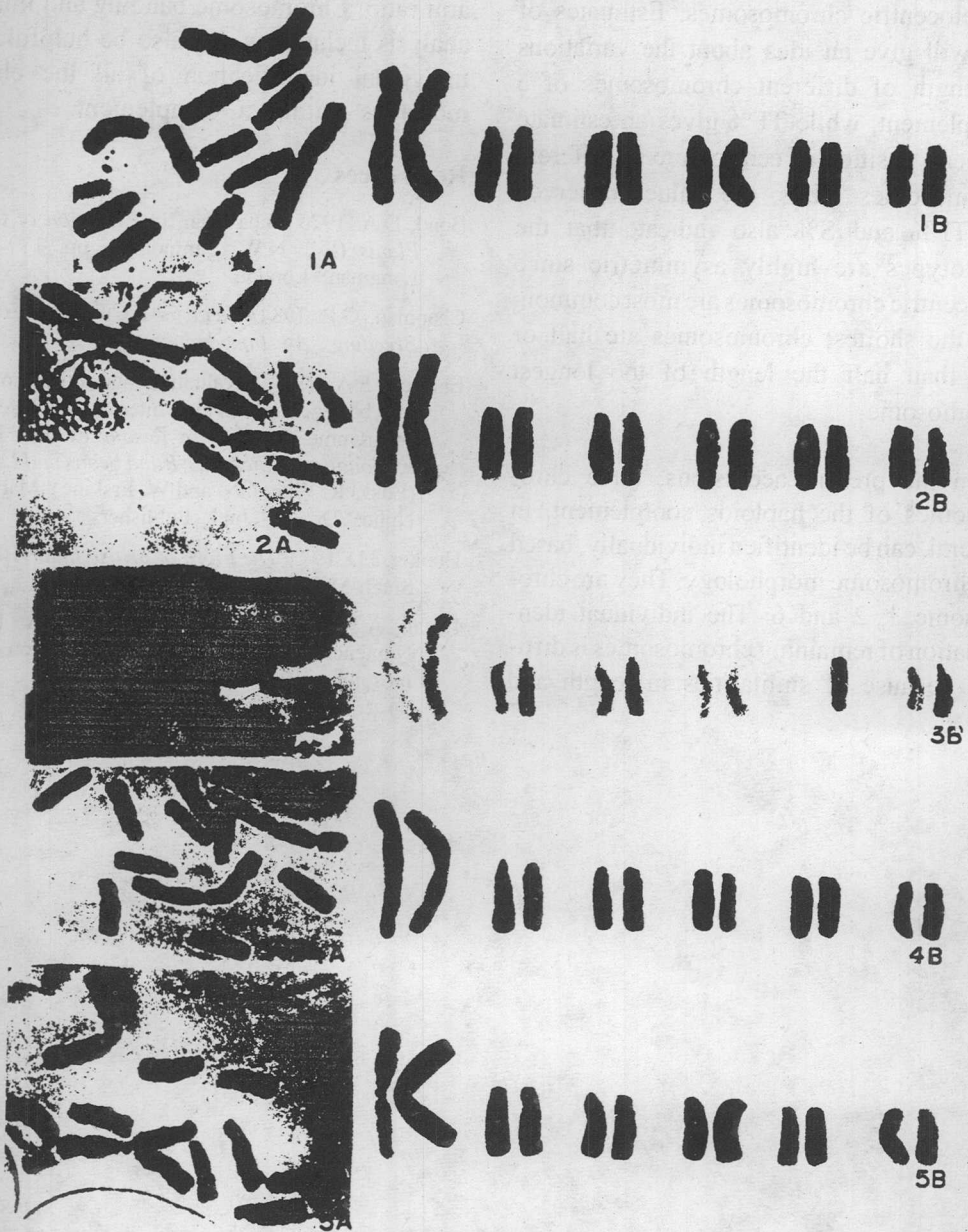
Karyotype formula:  $1^m \pm 5^a$ .

mosomes and karyograms are given in Figs. 1-5. Chromosome number in all the accessions of *Vicia faba* studied was  $2n=2x=12$ . The haploid chromosome complements, in general, consisted of one pair of very long and five pairs of short subtelocentric chromosomes. The short arm of longest chromosome has secondary constriction separating a large satellite from the rest of the chromosome.

Considerable variation in total chromatin length and volume was observed among the five accessions of faba bean studied. Total chromosome length of haploid complement ranged from  $65.8 \mu\text{m}$  in EC 312439

to  $48.57 \mu\text{m}$  in EC 312448. The trend for total chromosome volume was also similar with the values varying between  $84.50 \mu\text{m}^3$  (EC 412439) and  $43.60 \mu\text{m}^3$  (EC 312448). The observed intraspecific variation for chromatin content may be attributed to structural changes and loss or gain of heterochromatin segments. Bond (1976) reported the evidence of variability in karyotypes due to translocation. Not much difference in the length of the satellite was observed among the faba bean accessions studied.

The karyotypes are asymmetrical with one pair of metacentric and five pairs of



Figs. 1 to 5

Figs. 1-5. Mitotic metaphase plates (1a, 2a, 3a, 4a and 5a) and karyograms (1b, 2b, 3b, 4b and 5b) of five accessions of *Vicia faba*.

subtelocentric chromosomes. Estimates of S% will give an idea about the variations in length of different chromosomes of a complement, while TF% gives an estimate of mean position of centromere in different chromosomes. Thus, the values observed for TF% and S% also indicate that the karyotypes are highly asymmetric since acrocentric chromosomes are most common, and the shortest chromosomes are half or less than half the length of the longest chromosome.

In the present accessions, three chromosomes of the haploids complement, in general, can be identified individually, based on chromosome morphology. They are chromosome 1, 2 and 6. The individual identification of remaining chromosomes is difficult because of similarities in length and

arm ratio. Chromosome banding and image analysis techniques can also be helpful for individual identification of all the chromosomes within a complement.

### References

- Bond, D.A. 1976. Faba bean. In *Evolution of Crop Plants* (Ed., N.W. Simmonds), pp. 179-182. Longman, London.
- Chapman, G.P. 1984. *Vicia faba Cytogenetics and Breeding: An Introduction*.
- Elsayed, F.A. 1984. Evaluation and utilization of faba bean germplasm in an international breeding programme. In *Genetic Resources and Their Exploitation: Chickpeas, Faba beans and Lentils* (Eds. J.R. Witcombe and W. Erskine). Martinus Nijhoff/Dr. W. Junk Publishers.
- Hooker, J.D. 1973. *The Flora of British India*. Bishen Singh-Mohendar Pal Singh, India.
- Levan, A., Fredga, K. and Sandberg, A.A. 1964. Nomenclature for centrometric position on chromosomes. *Hereditas* 52: 201-220.