

# Inheritance of short-petiole trait in groundnut(1)

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**Abstract.** — The inheritance of the short-petiole character in groundnut was studied in F<sub>1</sub>, F<sub>2</sub>, and F<sub>3</sub> generations of three crosses involving a short-petioled genotype and three normal-petioled genotypes. The F<sub>1</sub> plants in all the three crosses had normal petioles indicating the recessive nature of the short-petiole trait. The F<sub>2</sub> segregation showed a satisfactory fit for 63 normal (N) to 1 short-petioled (S) plants suggesting that three recessive genes govern the inheritance of short-petiole trait. The three recessive gene hypothesis was further confirmed by the segregation in F<sub>3</sub> families. In two of the three crosses, the ratio of segregating to nonsegregating normal F<sub>2</sub>-derived F<sub>3</sub> families showed a good fit to the expected 37 true breeding to 26 segregating families. In all three crosses, the segregating families showed a good fit to the expected ratio of 4 families with 63 N:1 S, 16 with 15 N:1 S, and 3 with 3 N:1 S segregation. The proposed gene symbols for the short-petiole trait in groundnut governed by 3 recessive genes are sp<sub>1</sub> sp<sub>1</sub> sp<sub>2</sub> sp<sub>2</sub> sp<sub>3</sub> sp<sub>3</sub>.

**Key words.** — *Arachis hypogaea*, genetics, peanut, triplicate factor inheritance.

## INTRODUCTION

A short-petioled variant was isolated from a normal-petioled groundnut germplasm accession, 60-1 (ICG 10144) which originated in Zimbabwe. The short-petioled variant is being maintained as a genetic stock, ICG 10145 (60-1-2) in the Genetic Resources Unit of ICRISAT Center. It is a sequentially branching, spanish type (*ssp. fastigiata*; var. *vulgaris*) and matures in about 105 to 110 days in the rainy season at ICRISAT Center. The petiole length in the genotype ICG 10144 ranges from 0.52 cm to 0.90 cm, whereas in the normal genotypes it ranges from 4.0 to 6.5 cm. The short nature of its petioles makes the leaf orientation of the variant different from that of normal-petioled plants, and its leaves appear crowded on the branches (Fig. 1). Some dwarf mutants referred to as 'sterile brachytic' types have been reported to possess shorter petioles, internodes and leaf rachises associated with sterility [5]. The short-petioled variant used in the present study is fertile and produces normal flowers and pods. Similarly this variant differs from the apetiololed leaf mutant which is completely devoid of petioles and is inherited as a monogenic recessive trait [2]. In this paper we report the genetics of short-petiole character, which has not previously been described.

## MATERIALS AND METHODS

The short-petioled (petiole length: 0.69 ± 0.319 cm) genotype, ICG 10145 was crossed with three normal-petioled genotypes. These included a spanish variety, TMV 2 (ICG221), a valencia variety (*ssp. fastigiata* var. *fastigiata*), Gangapuri (ICG 2738), and a virginia bunch variety (*ssp. hypogaea* var. *hypogaea*), Kadiri 3 (ICG 799). The petiole length is 5.44 ± 0.287 cm in TMV 2, 5.62 ± 0.668 cm in Gangapuri and 5.32 ± 0.783 cm in Kadiri 3. The parents, F<sub>1</sub>, F<sub>2</sub>, and F<sub>3</sub> generations were studied for the petiole character

during the 1984 to 1987 period at ICRISAT Center. During the 1987 rainy season, F<sub>3</sub> families were raised from all short-petioled F<sub>2</sub> plants and 150 random normal-petioled F<sub>2</sub> plants in each cross. The F<sub>3</sub> families which had less than 20 plants due to mortality by seed and seedling diseases were discarded. The plants in the segregating generations were visually classified into two phenotypic classes, i.e. short-petioled (S) and normal petioled (N), without difficulty as no intermediate types were observed. While working out the genetic segregation ratios, Chi-square tests were applied on data to test the validity of different genetic ratios.

## RESULTS AND DISCUSSION

In all the three crosses, the F<sub>1</sub> plants had normal petioles similar in length to that of the normal-petioled parents, indicating the completely recessive nature of the short-petiole trait. In the F<sub>2</sub> generation, the plants segregated into two extreme classes resembling either of the parents without any intermediate types. The segregation pattern in F<sub>2</sub> of the three crosses is given in table I. In all the crosses, the segregation showed a good fit to 63 N to 1 S types suggesting the involvement of three recessive genes in controlling the short-petiole trait.

The F<sub>3</sub> families derived from normal-petioled F<sub>2</sub> plants of two crosses, TMV 2 × ICG 10145 (X<sup>2</sup> value = 0.718; P 0.50-0.40) and Kadiri 3 × ICG 10145 (X<sup>2</sup> value = 0.392; P 0.60-0.50) showed a good fit to the expected ratio of 37 nonsegregating to 26 segregating families. However, the cross Gangapuri × ICG 10145 did not show good fit (X<sup>2</sup> value = 5.837; P 0.02-0.01) and showed a higher number of segregating families.

In theory, the F<sub>3</sub> segregating families derived from F<sub>2</sub> normal plants should show 3 classes of phenotypic segregation. The genotypes heterozygous at all the three loci will segregate into 63 N to 1 S phenotypes; those heterozygous at two loci and homozygous recessive at the third locus will segregate into 15 N to 1 S phenotypes and those heterozygous at one locus and homozygous recessive at the other two loci into 3 N to 1 S phenotypes. The individual segregating F<sub>3</sub> families derived from the normal-petioled F<sub>2</sub> plants in each

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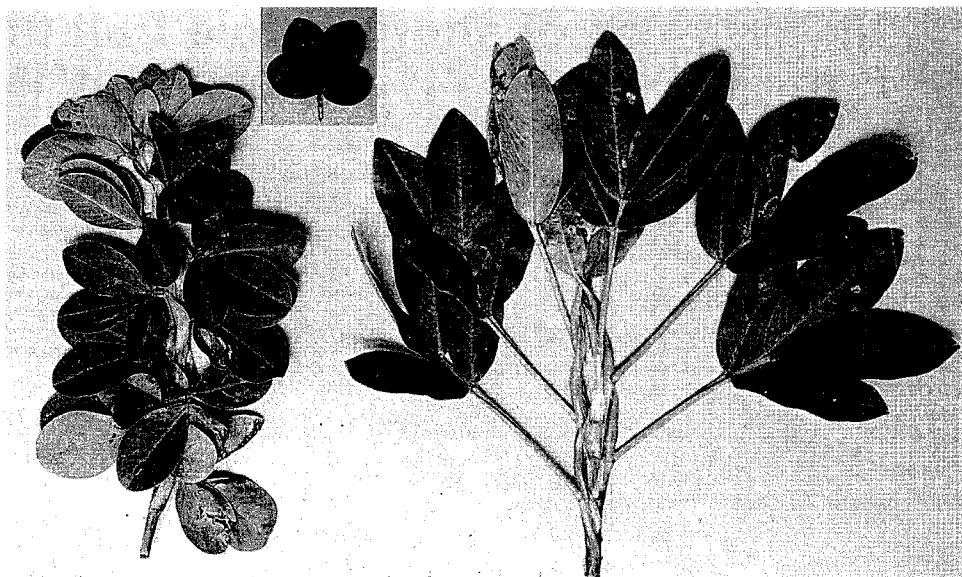


FIG. 1. — Branch and leaf (in set) of a short-petioled genotype, ICG 10145 (left) and branch of a normal-petioled (right) groundnut genotype (Kadiri 3)

TABLE I. — Chi-square test for segregation of 63 normal- and 1 short- petioled plants in F<sub>2</sub> generation of three normal X short-petioled groundnut crosses.

Cross	Number of F <sub>2</sub> plants		df	X <sup>2</sup> (63:1)	P value
	Normal petiole	Short petiole			
TMV 2 × ICG 10145	346	8	1	1.121	0.30-0.25
Gangapuri × ICG 10145	591	6	1	1.766	0.20-0.15
Kadiri 3 × ICG 10145	503	10	1	0.499	0.50-0.45
Pooled	1440	24	1	0.056	0.85-0.80
Heterogeneity			2	3.330	0.20-0.15

TABLE II. — Chi-square tests for the various expected ratios [63 normal (N) to 1 short-petioled (S), 15N: 1S, and 3N: 1S] in the segregating F<sub>3</sub> families derived from F<sub>2</sub> normal-petioled plants in three groundnut crosses.

Cross	Number of families segregating into			df	X <sup>2</sup> (4:6:3)	P value
	63:1	15:1	3:1			
TMV 2 × ICG 10145	22	30	12	2	0.797	0.70-0.65
Gangapuri × ICG 10145	21	36	13	2	1.051	0.60-0.55
Kadiri 3 × ICG 10145	19	32	10	2	1.709	0.45-0.40
Pooled	62	98	35	2	3.0	0.25-0.20
Heterogeneity				4	0.557	0.98-0.95

TABLE III. — Chi-square test for a segregation ratio of 24 normal- to 1 short- petioled plants in F<sub>3</sub> bulk populations derived from F<sub>2</sub> normal plants in three groundnut crosses

Cross	F <sub>3</sub> plants		df	X <sup>2</sup> (24:1)	P value
	Normal petiole	Short petiole			
TMV 2 × ICG 10145	5544	215	1	1.067	0.35-0.30
Gangapuri × ICG 10145	5181	202	1	0.858	0.35-0.30
Kadiri 3 × ICG 10145	4595	197	1	0.154	0.70-0.65
Pooled	15320	614	1	0.891	0.35-0.30
Heterogeneity			2	1.188	0.55-0.50

cross were each subjected to  $X^2$  tests for all the three expected ratios and separated into three classes showing best fit to either 63:1, 15:1, or 3:1 ratios. Goodness-of-fit tests showed a good agreement with the expected ratio of 4:6:3 for families with 63 N: 1 S, 15 N: 1 S, and 3 N: 1 S segregation, respectively, in all the three crosses (Table II). Also goodness-of-fit tests on the bulked N and S plants in  $F_3$  families derived from N  $F_2$  plants in each cross (Table III) showed a good fit to the expected ratio of 24 N to 1 S plants. These observations confirm the trigenic recessive nature of

the short-petiole trait in groundnut. The gene symbols proposed for this trait are  $sp_1 sp_1 sp_2 sp_2 sp_3 sp_3$ .

In the allotetraploid groundnut, triplicate-factor inheritance has been reported earlier for albinism [1, 4] and for bifurcated leaf [3]. This report adds yet another character that is governed by triplicate genes in groundnut.

Utility of this character is not known. However it will be interesting to see how this genotype behaves under drought stress because of its different leaf orientation.

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## RESUME

### L'hérédité du caractère pétiole court chez l'arachide

L.J. REDDY, S.N. NIGAM et V. RAMANATHA RAO, *Oléagineux*, 1993, 48, N°4, p. 191-194

L'hérédité du caractère pétiole court a été étudiée chez l'arachide sur les générations  $F_1$ ,  $F_2$  et  $F_3$  de trois croisements, dont un génotype à pétiole court et trois génotypes à pétiole normal. Les plantes  $F_1$  des trois croisements présentaient un pétiole normal, ce qui indique la nature récessive du caractère pétiole court. La ségrégation  $F_2$  a mis en évidence une correspondance satisfaisante avec 63 plantes à pétiole normal (N) contre une plante à pétiole court (C), ce qui laisse penser que l'hérédité du caractère pétiole court soit gouvernée par trois gènes récessifs. L'hypothèse de trois gènes récessifs est également confirmée par la ségrégation chez les familles  $F_3$ . Pour deux des trois croisements, le rapport entre les familles  $F_2$  normales -  $F_3$  dérivées ségréгатives et non-ségréгатives correspondait bien aux 37 familles à sélection normale et aux 26 familles ségréгатives attendues. Pour les trois croisements, les familles ségréгатives correspondaient bien au rapport attendu, à savoir 4 familles présentant une ségrégation 63 N/1C, 16 avec 15N/1C et 3 avec 3N/1C. Les symboles génétiques proposés pour le caractère pétiole court chez l'arachide gouverné par trois gènes récessifs sont  $pc_1$ ,  $pc_1$ ,  $pc_2$ ,  $pc_2$ ,  $pc_3$ ,  $pc_3$ .

**Mots clés.** — *Arachis hypogaea*, génétique, arachide, hérédité à facteur triple.

## RESUMEN

**Herencia del carácter de pecíolo corto en el maní**

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Se estudió la herencia del carácter de pecíolo corto en el maní en las generaciones F1, F2 y F3 de tres cruzamientos, un genotipo de ellos con pecíolo corto y 3 genotipos con pecíolo normal. Las plantas F1 de la totalidad de los tres cruzamientos presentaban un pecíolo normal, lo que señala la naturaleza recesiva del carácter de pecíolo corto. La segregación F2 evidenció una correspondencia satisfactoria con 63 plantas de pecíolo normal (N) para una planta de pecíolo corto (C), lo que deja pensar que la herencia del carácter de pecíolo corto sea regida por tres genes recesivos. También se confirma la hipótesis de 3 genes recesivos por segregación en las familias F3. Para dos de los tres cruzamientos, la relación entre las familias F2 normales y F3 derivadas segregativas y no-segregativas correspondía efectivamente a las 37 familias con selección normal y 26 familias segregativas esperadas. Para la totalidad de los tres cruzamientos, las familias segregativas correspondían efectivamente a la relación esperada, a saber 4 familias que mostraban una segregación 63 N/1C, 16 con 15N/1C y 3 con 3N/1C. Los símbolos genéticos propuestos para definir el carácter de pecíolo corto en el maní que es regido por tres genes recesivos son pc1, pc1, pc2, pc2, pc3, pc3.

**Palabras claves.** — *Arachis hypogaea*, genética, maní, herencia de triple factor