Occurrence and Inheritance of a Puckered-Leaf Shape in Peanut[1]

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ABSTRACT

An abnormal puckered-leaf shape was recently found in the cultivated peanut (*Arachis hypogaea* L.). Upon crossing this true-breeding genotype between and within both subspecies, inheritance data indicated two genes with epistatic interaction controlled this unusual trait which resembles tobacco thrips (*Frankliniella fusca* Hind) injury on peanut leaves. No maternal or cytoplasmic effects were detected among progenies from reciprocal hybridization. Subsequent allelism tests also detected no difference between the two similar occurring puckered-leaf mutants that were independently found in different genetic lineages. A new gene symbol, puc_1 Puc_2, for the puckered-leaf shape is being proposed to distinguish it from the narrow leaf gene, *nl*, as previously reported.

Key Words: *Arachis hypogaea* L., groundnut, mutant, epistatic interaction, gene symbol.

Genetic studies of several abnormal leaf shapes of the cultivated peanut (*Arachis hypogaea* L.) have been reported (Hammons, 1973; Wynne and Coffelt, 1982; Murthy and Reddy, 1993). Some of the more aberrant leaf shapes included Krinkle-leaf (Hammons, 1964), Cup, Flop, Ilex, Hedera, and Corduroy-leaves (Loesch and Hammons, 1968), Narrow-leaves (Gopani and Vaishnani, 1970), Flop-leaf (Branch and Hammons, 1981), and Curley-leaf (Branch, 1987).

In 1996, three plants with puckered leaves were found in the spanish-type cultivar 'Tamspan 90' (Smith *et al.*, 1991). These plants appeared to exhibit typical leaf puckering symptoms of tobacco thrips (*Frankiniella fusca* Hinds) injury even following systemic insecticide application at planting. Puckered leaves have a partially wrinkled appearance with some chlorosis along leaf margins. The puckering seems more pronounced on the younger leaves as compared to the old leaves and becomes quite apparent within the first 3–4 weeks after emergence. Individual plants were selected for further testing as Tamspan 90-normal and Tamspan 90-puckered, respectively. Progeny rows from each selection have bred true-to-type for the past seven years.

Subsequent thrips counts from Tamspan 90-puckered and Tamspan 90-normal actually revealed more thrips larvae (53 vs 23) in the leaf terminals of the Tamspan 90-normal as compared to Tamspan 90-puckered (JW Todd, unpublished data). Additional tests conducted to evaluate a possible preplant herbicide × systemic insecticide interaction at varying rates of each pesticide likewise showed no significant effect between either selection (WC Johnson III, unpublished data). The distinct plant type of Tamspan 90-puckered appeared to be under genetic control. The objective of this study was thus to determine the inheritance of the puckered-leaf shape found in Tamspan 90.

Materials and Methods

Reciprocal crosses were made in the greenhouse between the puckered-leaf Tamspan 90 selection and the normal leaf Tamspan 90 selection. Both of these selections would be classified as *A. hypogaea* subsp. *fastigiata* var. *vulgaris*. Reciprocal crosses were also made between the puckered-leaf Tamspan 90 selection and the normal leaf 'Georgia Browne' cultivar that belongs to *A. hypogaea* subsp. *hypogaea* var. *hypogaea* (Branch, 1994). Such crossings between and within subspecies should provide for a wider range of genetic diversity and recombination.

Another puckered-leaf mutant genetic stock ICGL 6 (PI 561916) from ICRISAT was obtained and grown in the greenhouse. Plants of both Tamspan 90-puckered and PI 561916 had very similar phenotypes. Cross combinations for allelism tests were made between the puckered-leaf Tamspan 90 selection and the puckered-leaf mutant genetic stock ICGL 6 (PI 561916).

During 1998, 1999, and 2000, the F_1, F_2, and F_3 generations were respectively field grown in space-planted nurseries at the agronomy research farm near the University of Georgia, Coastal Plain Experiment Station, Tifton, GA. Data from visual classification of normal leaf and puckered-leaf among segregating individual plants and progeny

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Table 1. F_2 plant segregation and χ^2 test results from peanut crosses involving the puckered-leaf shape of Tamspan 90.

Cross	No. families	F_2 leaf shape		χ^2	
		normal	puckered	(13:3)	*P*
Tamspan 90-normal × Tamspan 90-puckered	3	118	38	3.222	0.05–0.10
Tamspan 90-puckered × Georgia Browne	5	715	164	0.005	0.90–0.95
Total				3.227	0.10–0.25
Pooled	8	833	202	0.400	0.50–0.75
Homogeneity				2.827	0.05–0.10

Table 2. F_3 progeny segregation and χ^2 test results from F_2 normal and puckered leaf shaped plants.

F_2 plants	$F_{2:3}$ progeny segregation		Exp. ratio	χ^2
	None	Seg.		
Normal leaf	16	24	(7:6)	3.086 *ns*
Puckered leaf	9	11	(1:2)	1.225 *ns*

ns = Not significantly different at P≤ 0.05.

rows were analyzed by the CHISQA program (Hanna *et al.*, 1978).

Results and Discussion

The F_1 leaf shape was normal for all crosses involving normal leaf × puckered-leaf combinations suggesting that the puckered-leaf trait was recessive. No maternal or cytoplasmic effects were detected among reciprocal crosses.

The F_1 leaf shape was puckered from the cross between the puckered-leaf Tamspan 90 selection × puckered-leaf mutant ICGL 6. This finding suggests no allelic difference between these two independently found genotypes for the puckered-leaf shape.

The F_2 segregation showed a good fit to a 13 normal leaf: 3 puckered-leaf genetic ratio (Table 1). Total, pooled, and homogeneity chi-square values were all found acceptable at P≥ 0.05. These data suggest two genes control the inheritance of the puckered-leaf shape trait with epistatic interaction. The presence of one homozygous recessive gene with the presence of one homozygous or heterozygous dominant gene is needed for the puckered-leaf shape.

The segregation of F_3 progenies from F_2 normal leaf plants did not deviate significantly from an expected two gene model of 7 none segregating:6 segregating ratio (Table 2). The segregation of F_3 progenies from F_2 puckered-leaf plants only fit an expected two gene model of 1 non- segregating:2 segregating ratio. Thus, the F_3 findings supported the 13:3 digenic epistatic model found in the F_2 generation.

These results agree and independently confirm the previous report involving different genetic lineages for the inheritance of the puckered-leaf shape trait found in the cultivated peanut (Dwivedi and Nigam, 1989). The genotype of this trait had been previously proposed as $nl_1\ nl_1\ Nl_2\ Nl_2$. (Nigam *et al.*, 1993). However, since the gene symbol *nl* was first used for narrow leaves (Matlock *et al.*, 1970) and to avoid further confusion in the literature, the gene symbol $puc_1\ Puc_2$ is being proposed to distinguish puckered-leaf from narrow leaf.

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