Inheritance of Immature Fruit Color in *Cucurbita maxima* var. Zapallito (Carrière) Millán

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Introduction. *Cucurbita* is characterized by its ample variation in forms and colors of fruits. In *C. pepo* the inheritance of both mature and immature fruit color has been revealed (2,5). In *C. maxima*, however, the studies of color have been concentrated in the mature state (1,6), the most popular form of consumption in North America and Europe. In southern Latin America *C. maxima* has been largely bred for immature fruit consumption given rise to the so-called zapallito varieties (4). This culinary use is very popular and has pre-Columbian cultural roots (4). Fruits which are green and round in shape are normally harvested, depending on air temperatures, 9 to 18 days past anthesis (dpa). In a segregant population of zapallito a plant bearing a new variant of light green color was recognized. The fruits were similar to those of plain light green color described for subspecies *andreana* by Millán (3). In this report a first approach is advanced in the inheritance of immature fruit color of zapallito.

Material and Methods. In 1996, in a segregant population of the Rosario National University zapallito breeding stock, a plant bearing light green color was recognized and selfed for three seasons; rendering in all instances uniform light green immature fruits. The line was identified as I-18. An advanced inbred line (Germ-4) derived from zapallito cultivar 'La Germinadora' was used as a parent of normal green fruits (Figure 1). During 1999 and 2000, F_1, F_2 and backcrosses were advanced. These generations and parents were evaluated for immature fruit color during 2001 and 2002. In both seasons the normal planting grid of 1.4 m between lines and 0.80 m within plants in the line was used. Two weeks after emergence hills were thinned to one plant. Fruits were visually examined for color when they reached 5-10 cm in diameter (commercial size). Each plant was assessed at least twice.

Results and Discussion. Results of the generation analysis for fruit color are presented in Table 1. Monogenic and digenic hypothesis (3:1, 9:7, 13:3 and 15:1) failed to explain the observed segregation. However, as in *C. pepo* for 15-18 dpa fruits (5), a three loci model fitted. In this model two complementary genes interact with a third independent locus. Light green color would be the result of recessive homozigosity in the third locus and, at least, in one of the two complementary genes. These give an expected 57:7 and 5:3 normal to light green ratio in F_2 and BC_2 respectively. In *C. pepo* the third locus (*D*) is responsible for stem color, with a pleiotropic effect on fruit color. The dominant allele renders dark green stems. In our experience, unfortunately, stem color was assessed only in plants of the light green color class, which were all classified as possessing light green stems.

In conclusion, the segregations observed for immature fruit color in zapallito is in agreement with a three loci model, like that proposed in *C. pepo* for 15-18 dpa fruits. A combined inheritance study with stem color should be conducted in order to verify if stem color has a pleiotropic effect on fruit color. Crosses to materials of *C. maxima* ssp. *andreana* bearing light green fruits should be advanced to test allelism for these loci.

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Table 1. Results of the two years analysis for normal green and light green fruits of zapallito.

Year	Generation	Description	N° of Plants			Expected Ratio	χ^2	*P*
			Normal green	Light green	Total			
2001	P_1	Germ-4	20	-	20			
	P_2	I-18	-	15	15			
	F_1	(P_1xP_2)	22		22			
	F_2	(P_1xP_2)@	142	19	161	57:7	0.12	0.97-0.90
	BC_1	(P_1xP_2) x P_1	21	-	21			
	BC_2	(P_1xP_2) x P_2	18	6	24	5:3	1.6	0.50-0.10
2002	P_1	Germ-4	18	-	18			
	P_2	I-18	-	15	15			
	F_1	(P_1xP_2)	15		15			
	F_1	(P_2xP_1)	17		17			
	F_2	(P_1xP_2)@	80	9	89	57:7	0.06	0.90-0.50
	BC_1	(P_1xP_2) x P_1	36	-	36			
	BC_2	(P_1xP_2) x P_2	13	6	19	5:3	0.28	0.90-0.50
2001-2002	F_2	(P_1xP_2)@	222	28	250	57:7	0.01	0.90-0.50
	BC_2	(P_1xP_2) x P_2	31	12	43	5:3	1.68	0.50-0.10
Heterogeneity	F_2	(P_1xP_2)@				57:7	0.18	0.97-0.90
	BC_2	(P_1xP_2) x P_2				5:3	0.19	0.50-0.10

Figure 1. Light green (left) and normal green (right) immature fruits of zapallito.

Literature Cited

1. Hutchins, A.E. 1935. The interaction of blue and green color factors in Hubbard squash. Proc. Amer. Soc. Hort. Sci. 33:514.
2. Hutton, M.G. and R.W. Robinson. 1992. Gene list for *Cucurbita* spp. Cucurbit Genetics Coop. Rpt 15:102-109.
3. Millán, R. 1945. Variaciones del zapallito amargo *Cucurbita andreana* y el orígen de *Cucurbita maxima*. Revista Argentina de Agronomía 12:86-93.
4. Millán, R. 1947. Los zapallitos de tronco de Sudamérica extratropical. Darwiniana 7:333-345.
5. Paris, H.S. and H. Nerson. 1986. Genes for intense fruit pigmentation of squash. The Journal of Heredity 77:403-409.
6. Robinson, R.W., Munger, H.M., Whitaker, T.W. and G.W. Bohn. 1976. Genes of the Cucurbitaceae. HortScience 11:554-568.