

# Confirmation of a Dominant Hard Rind (*Hr*) Locus in a *Cucurbita argyrosperma* ssp. *sororia* x *C. moschata* Cross

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**Introduction:** One of the traits that often characterize fruits of non-domesticated *Cucurbita* is lignified (hard) rinds. Fruit of domesticated *Cucurbita* can have either lignified or nonlignified (soft) rinds. Schaffer et al. (6) noted that many summer squash cultivars of *C. pepo*, which are usually consumed within 10 days post-anthesis, have lignified rinds at maturity. On the other hand, winter squash cultivars, which need to be cut open at maturity for consumption, often are not lignified. Inheritance of lignification in *Cucurbita* was first studied by Mains (2) in both gourd and cultivated types of *C. pepo*. He concluded that this trait is controlled by a single dominant gene which was later given the symbol *Hr* by Robinson et al. (5). Schaffer et al. (6) confirmed that this is a single dominant trait in *C. pepo*.

In *C. maxima* control of rind lignification is more complex. Herrington and Brown (1988, as cited by Koch and Della Vecchia [1] and Paris and Brown [3]) studied rind lignification in crosses between soft rind *C. maxima* cv. Queensland Blue x hard rind *C. ecuadorensis* and noted that F1 progeny had soft rinds. They concluded that a dominant gene, *Hard rind inhibitor* (*Hi*), inhibits formation of a hard (lignified) rind in the presence of what is presumably the *Hr* gene in *C. maxima*. The hard rind of *C. ecuadorensis* presumably resulted from a *HrHr/hihi* genotype. Koch and Della Vecchia (1) carried out crosses between a hard rind *C. maxima* line and various soft rind *C. moschata* cultivars. All F1 progeny had hard rinds. In contrast, in crosses between the same hard rind *C. maxima* line and soft rind *C. maxima* cultivars, all F1 progeny had soft rinds. F2 progeny of these same crosses segregated 3:1 for soft:hard rind. Thus, Koch and Della Vecchia's study (1) suggests that many *C. maxima* cultivars are *HrHr* and are thus capable of producing lignified rinds, but instead have soft rinds because they are *HiHi* at the *Hard rind inhibitor* locus. The Japanese *C. moschata* cultivars used in the Koch and Della Vecchia (1) study were either *hrhr/hihi* or were *hrhr* without a corresponding *Hard rind inhibitor* locus (due to lack of complete homology between chromosomes of the two species). Whether the *Hi* locus is present in *Cucurbita* other than *C. maxima* needs further study.

In *C. moschata* and the closely related wild species *C. argyrosperma* ssp. *sororia*, previous work by this author and colleagues (Piperno et al. [4]) found that rind lignification is controlled by a single dominant gene *Hr* (*Hard rind*) in crosses between these species. However, this 2002 study (4) was primarily focused on the association between production of phytoliths and the hard rind trait (the association was confirmed). Phytoliths are solid particles of silicon dioxide found within the cells of *Cucurbita* species. The presence of phytoliths in soil samples can be used as a diagnostic tool in archeological studies of this genus. However, only small numbers of progeny were studied in the two F2 populations included in the study: 20 individuals in one population and 30 individuals in the other population. No reciprocal crosses were made. Therefore, the purpose of this study was to confirm the monogenic dominant inheritance of rind lignification in *C. sororia* x *C. moschata* with additional reciprocal backcross data.

**Materials and Methods:** *C. argyrosperma* ssp. *sororia* (Sor) accession Sor177 (of Mexican origin) was crossed with pollen parent *C. moschata* 'PRShortvine' (Mos) (an experimental line from the University of Puerto Rico, Mayaguez breeding program) to produce F1 seed. A single F1 plant was backcrossed to *C. moschata* 'PRShortvine', using the latter as both the pollen and seed parent (reciprocal backcrosses). Backcross seed was planted at Isabela, Puerto Rico. Several plants of each parent were also grown at the same time. A single fruit was harvested from each of 88 F1 x Mos progeny and 65 Mos x F1 progeny. A small rind sample (about 3 cm x 8 cm, with flesh removed) was taken from each fruit and oven dried.

**Results and Discussion:** When progenies were classified on the basis of rind lignification, both backcross populations segregated 1:1 (lignified:non-lignified) (Table 1). Samples of non-lignified rinds remained soft and somewhat leathery, and curled as they dried. Lignified rinds retained most of their shape (minimum curling) and were very hard once dried. Thickness of lignified rinds in the *C. sororia* parent averaged about 1.5 mm. In backcross progeny thickness of lignified rinds varied from 1 mm to as much as 3 mm. For unknown

reasons progenies from the Mos x F1 backcross had a larger number of very thick rinds compared to the F1 x Mos backcross (data not shown). The range in rind thickness in the backcross populations suggests that there may be other genes modifying deposition of lignin in the rind. The author has tested a large number of genotypes of both *C. sororia* and *C. moschata* in crosses and has always observed hard (lignified) rind to be dominant in the F1 in contrast to what Herrington and Brown (1988, as cited by Kock and Della Vecchia[1] and Paris and Brown [3]) observed in *C. maxima* x *C. ecuadorensis*. The author has also tested F1 progeny of lignified x non-lignified *C. moschata* and observed these fruit to always be lignified. These observations along with the data presented here confirmed rind lignification (*Hard rind, Hr*) to be a single dominant trait in *C. moschata* and *C. argyrosperma* ssp. *sororia*. These observations also suggest that the *Hi* (*Hard rind inhibitor*) locus does not occur in *C. moschata* and *C. argyrosperma* ssp. *sororia* or that most or all genotypes of these species carry both recessive alleles (*hihi*).

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## Literature Cited

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**Table 1. Observed and expected numbers of lignified and non-lignified fruits in wild (Sor 177 = *Cucurbita argyrosperma* ssp. *sororia*) and domesticated (Mos = *C. moschata* 'PRShortvine') *Cucurbita* and their reciprocal backcross progeny.**

Population	Lignified rind	Non-lignified rind	Expected ratio	Chi-square	Prob
Sor 177 (Sor)	5	0	1:0		
Mos	0	6	0:1		
(Sor x Mos) x Mos	39	49	1:1	1.14	0.286
Mos x (Sor x Mos)	26	39	1:1	2.60	0.107