Title Characterizing plastome variation and its contribution to chilling injury tolerance in cucumber (*Cucumis sativus* L.)

Author Vanessa Gordon and Philipp W.Simon

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Abstract

Chilling damage can be a major determinant of yield reduction in cucumber production. Both plastidic ('Chipper', CH, tolerant) and nuclear (NC-76, *Ch*) components have been attributed to conferring chilling tolerance. This study evaluated expression of the chilling phenotype and plastomic factors which could affect chilling response. The persistence of the maternally inherited chilling response trait, in combination with varying degrees and sources of nuclear content, was found to be constant regardless of amount or type of nuclear contribution. Analysis of differences in plastidic population constitution conducted over the three plastomic single nucleotide polymorphisms (SNP) sites associated with chilling response (4813, 56561, and 126349) indicated that 'Chipper' is homoplastic, and monomorphic for the tolerant chilling-response specific 'suite' of SNP alleles. M29 (susceptible parent) exhibited low level heteroplasty (~ 4-6%) and was polymorphic at SNP sites 4813 and 56561. NC-76 was heteroplastic (~ 10%), monomorphic for the tolerant allele at 4813 and polymorphic at SNP sites 56561 and 126349. Plastid population architecture persisted through all generations tested. Expression analysis to quantify ptDNA levels and SNP expression during chilling stress indicated that both parental lines (i.e., CH and M29) contained the same relative quantities of DNA and SNP expression patterns during chilling as was observed without chilling. Molecular marker and phenotypic analysis of field studies demonstrated introgression of the tolerant plastid into elite germplasm was effective, and recovery of the recurrent parent complete at the BC_3 generation.