Loss of pod strings in common bean is associated with gene duplication, retrotransposon insertion and overexpression of *PvIND*

Travis A. Parker,Jose Cetz,Lorenna Lopes de Sousa,Saarah Kuzay,Sassoum Lo,Talissa de Oliveira Floriani,Serah Njau,Esther Arunga,Jorge Duitama,Judy Jernstedt,James R. Myers,Victor Llaca,Alfredo Herrera-Estrella,Paul Gepts

First published: 16 June 2022: **https://doi.org/10.1111/nph.18319**

Summary

- Fruit development has been central in the evolution and domestication of flowering plants. In common bean (*Phaseolus vulgaris*), the principal global grain legume staple, two main production categories are distinguished by fibre deposition in pods: dry beans, with fibrous, stringy pods; and stringless snap/green beans, with reduced fibre deposition, which frequently revert to the ancestral stringy state. Here, we identify genetic and developmental patterns associated with pod fibre deposition.
- Transcriptional, anatomical, epigenetic and genetic regulation of pod strings were explored through RNA-seq, RT-qPCR, fluorescence microscopy, bisulfite sequencing and whole-genome sequencing.
- Overexpression of the *INDEHISCENT* (‘*PvIND*’) orthologue was observed in stringless types compared with isogenic stringy lines, associated with overspecification of weak dehiscence-zone cells throughout the pod vascular sheath. No differences in DNA methylation were correlated with this phenotype. Nonstringy varieties showed a tandemly direct duplicated *PvIND* and a *Ty1-copia* retrotransposon inserted between the two repeats. These sequence features are lost during pod reversion and are predictive of pod phenotype in diverse materials, supporting their role in *PvIND* overexpression and reversible string phenotype.
- Our results give insight into reversible gain-of-function mutations and possible genetic solutions to the reversion problem, of considerable economic value for green bean production.

Key words:
bHLH transcription factor,differential expression, domestication, gainof-function; mutation, gene duplication, Phaseolus vulgaris, pod dehiscence, Ty1-copia retrotransposon.