

Progress on Male Sterility Research in Pepper (*Capsicum annuum*) at World Vegetable Center

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Introduction

- In a number of crops including pepper, male sterile lines are used for cost effective hybrid seed production.
- Both genic male sterility (GMS) and cytoplasmic male sterility (CMS) are used in pepper.

Development, release and use of CMS lines

- WorldVeg converted 18 improved lines and 8 accessions (originating from six countries) into A-, B- and R-lines through backcross breeding. These combinations included 12 hot pepper and 6 sweet peppers (Fig. 1, Table 1).
- Since 1999, more than 300 CMS pairs have been distributed in 34 countries. Breeders used them either directly as female parent or as source of S-cytoplasm [1].

Development, validation and use of molecular markers

- Available molecular markers associated with CMS cytoplasm (S-cytoplasm) and the *Restorer-of-fertility* (*Rf*) gene were evaluated for their efficacy in an array of lines [2].
- A co-dominant SCAR marker (S_{130}/N_{140}) for S-cytoplasm and a dominant SCAR marker (CRF-S₈₇₀) for the *Rf* gene were found to be reliable [2].
- SCAR marker (S_{130}/N_{140}) was very efficiently used to quickly demonstrate that ~8% of pepper germplasm possess S-cytoplasm [2].
- Case specific use of dominant SCAR marker (CRF-S₈₇₀) for the *Rf* gene has been demonstrated in restorer breeding of sweet pepper (Fig. 2)[3].
- Most recently, we have developed markers linked to two non-allelic GMS genes, *ms3* and *ms_w* (*ms₁*) in hot and sweet pepper, respectively, through Genotyping by sequencing (GBS) via bulk segregant analysis (BSA) (Fig. 3) [4].
- Recently, we also identified the entire Pentatricopeptide repeat (PPR) gene family in pepper, and characterized 12 *Rf*-like (*RFL*) genes [5]. These *RFL* genes provided insights into the complex nature of fertility restoration in pepper.

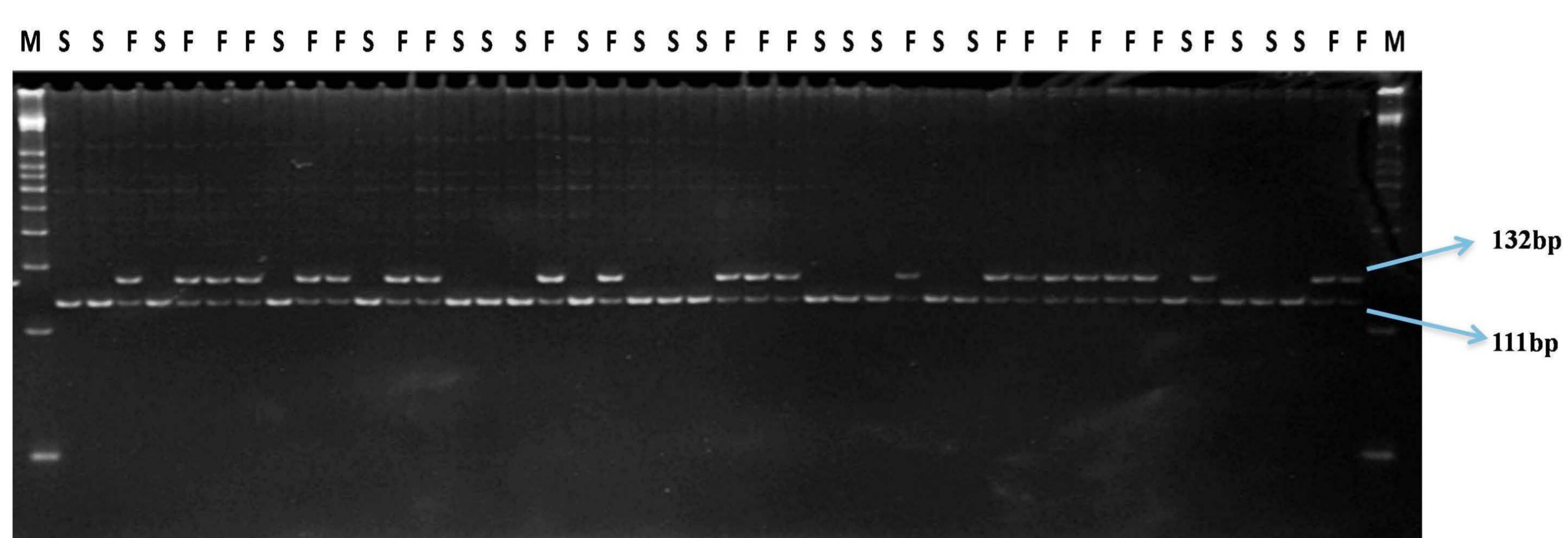


Figure 3. Gel profile of SPGMS1-dCAPS marker linked to *ms_w* gene in a F₆ inbred NIL; M, 50 bp DNA ladder; F, male fertile (*Ms_wms_w*) and S, male sterile (*ms_wms_w*)

Future outlook

- Advancement of sweet pepper *Rf* lines and conversion of new CMS and GMS pepper lines
- Attempt to isolate new S-cytoplasm and search for existence of fertilizing cytoplasm in *Capsicum*

References

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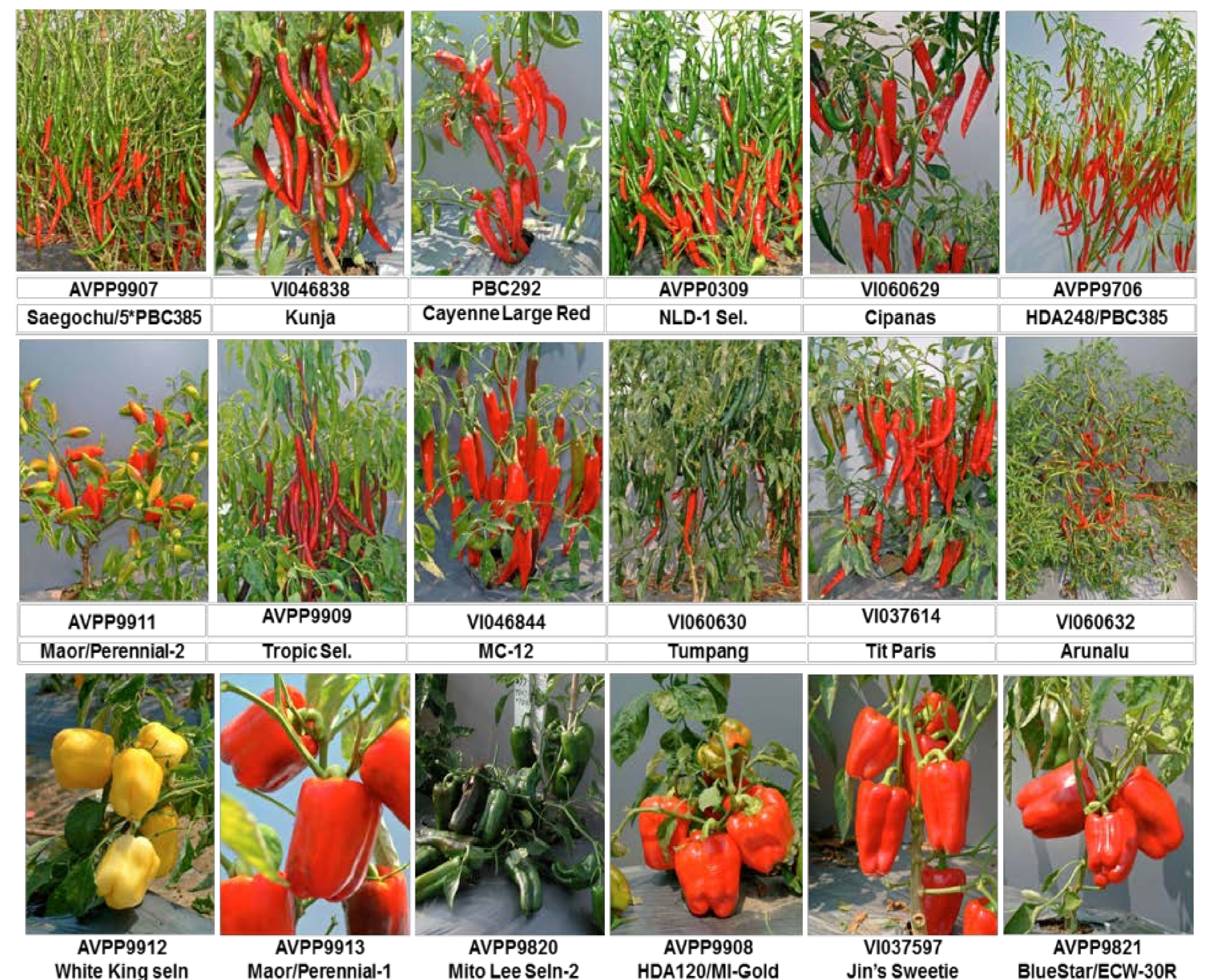


Figure 1. Plant type, fruit size and shape of isoplasmic maintainer of CMS lines developed by WorldVeg

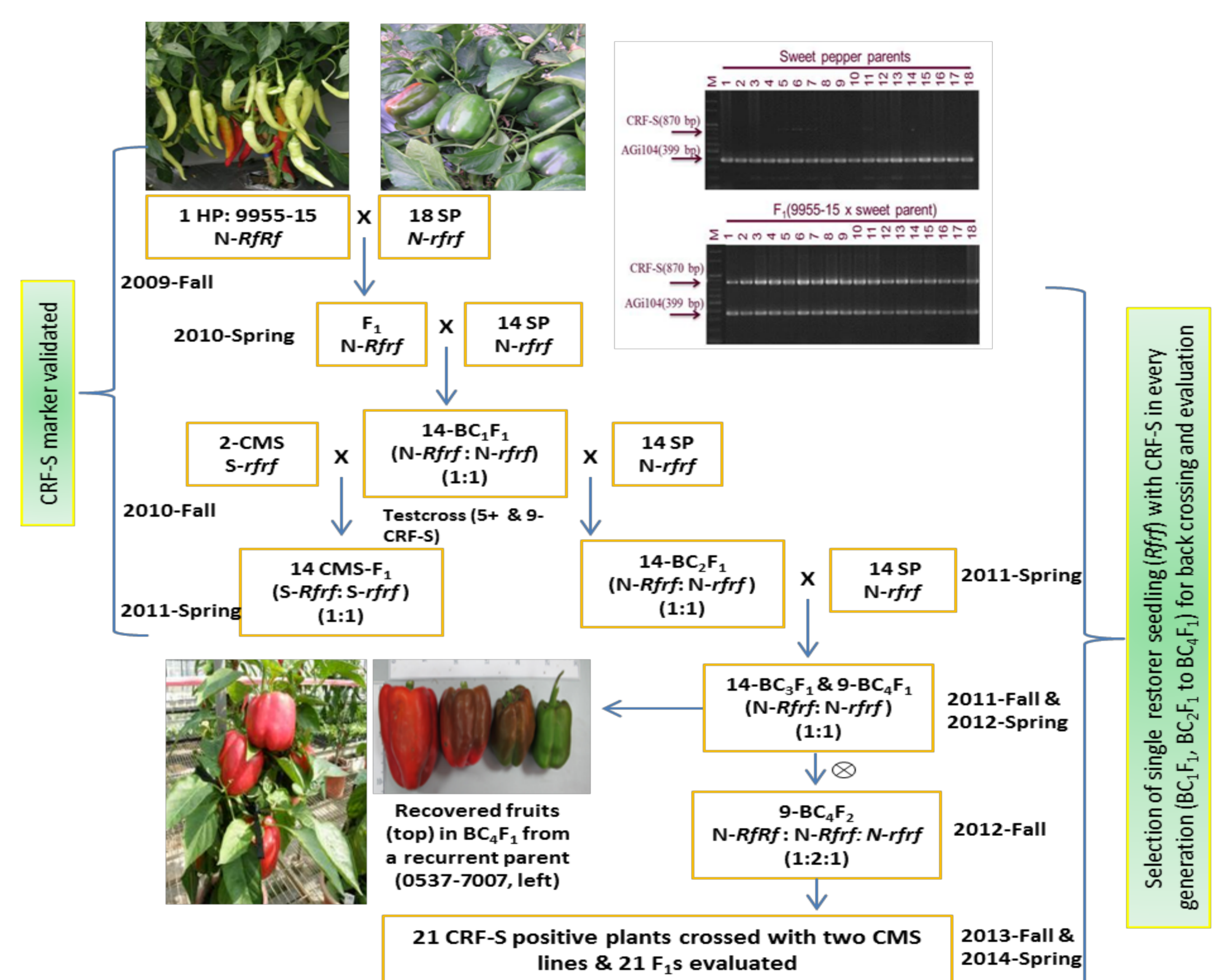


Figure 2. Steps involved in employing CRF-S₈₇₀ (validation and MAB) to move *Rf* allele from hot pepper into sweet pepper (HP = hot pepper, SP = sweet pepper; N = normal cytoplasm, S = male sterile cytoplasm; *Rf* = *Restorer-of-fertility*)

Table 1: WorldVeg CMS pairs currently available for distribution (<https://avrdc.org/seed/seeds/>)

CMS line	Maintainer line	Origin
Hot pepper		
AVPP9907-S	AVPP9907/9907-9611	WorldVeg
AVPP9911-S	AVPP9911/9946-2141	WorldVeg
AVPP0516-S	VI037614/PBC380	Indonesia
AVPP0517-S	VI060632/PBC483	Sri Lanka
AVPP0709-S	VI060627/PBC362	Korea
AVPP0710-S	VI046838/PBC292	USA
Sweet pepper		
AVPP9607-S	VI037597/PBC84	Peru
AVPP9820-S	AVPP9820/9847-4754	WorldVeg
AVPP9908-S	AVPP9908/9946-2162	WorldVeg
AVPP9913-S	AVPP9913/9946-2138	WorldVeg