PHYSIOLOGICAL TRAITS OF ENDORNAVIRUS-INFECTED AND ENDORNAVIRUS-FREE BELL PEPPER

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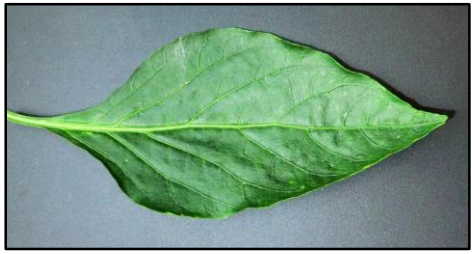
Plant viruses

Acute: Disease causing viruses

Persistent: Do not cause disease

Persistent viruses



Bell pepper endornavirus

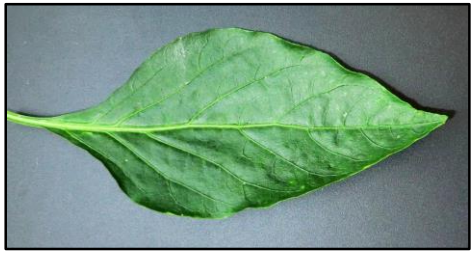
Do not cause detectable symptoms

Acute viruses

Tobacco mosaic virus

Cause symptoms and diseases

Persistent viruses



Bell pepper endornavirus

Do not cause detectable symptoms

Do not move from cell-to-cell

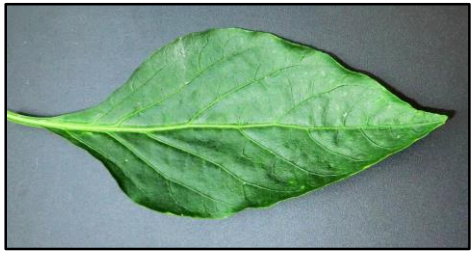
Acute viruses

Tobacco mosaic virus

Cause symptoms and diseases

Move from cell-to-cell and systemically

Persistent viruses



Bell pepper endornavirus

Do not cause detectable symptoms

Do not move from cell-to-cell

Present in all host cells and tissues

Acute viruses

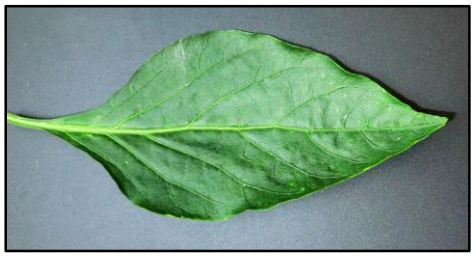
Tobacco mosaic virus

Cause symptoms and diseases

Move from cell-to-cell and systemically

Not present in all host cells and tissues

Persistent viruses



Bell pepper endornavirus

Do not cause detectable symptoms

Do not move from cell-to-cell

Present in all host cells and tissues

Transmitted only by seed (gametes)

Acute viruses

Tobacco mosaic virus

Cause symptoms and diseases

Move from cell-to-cell and systemically

Not present in all host cells and tissues

Transmitted: mechanically, vectors, seed, pollen, and grafting

Transmission properties of persistent plant viruses

Persistent viruses ARE NOT transmitted:

Mechanically

Graft

Dodder

Vectors

Transmitted only through the gametes:

80-100 % maternally (egg cell)

60-100 % paternally (pollen)

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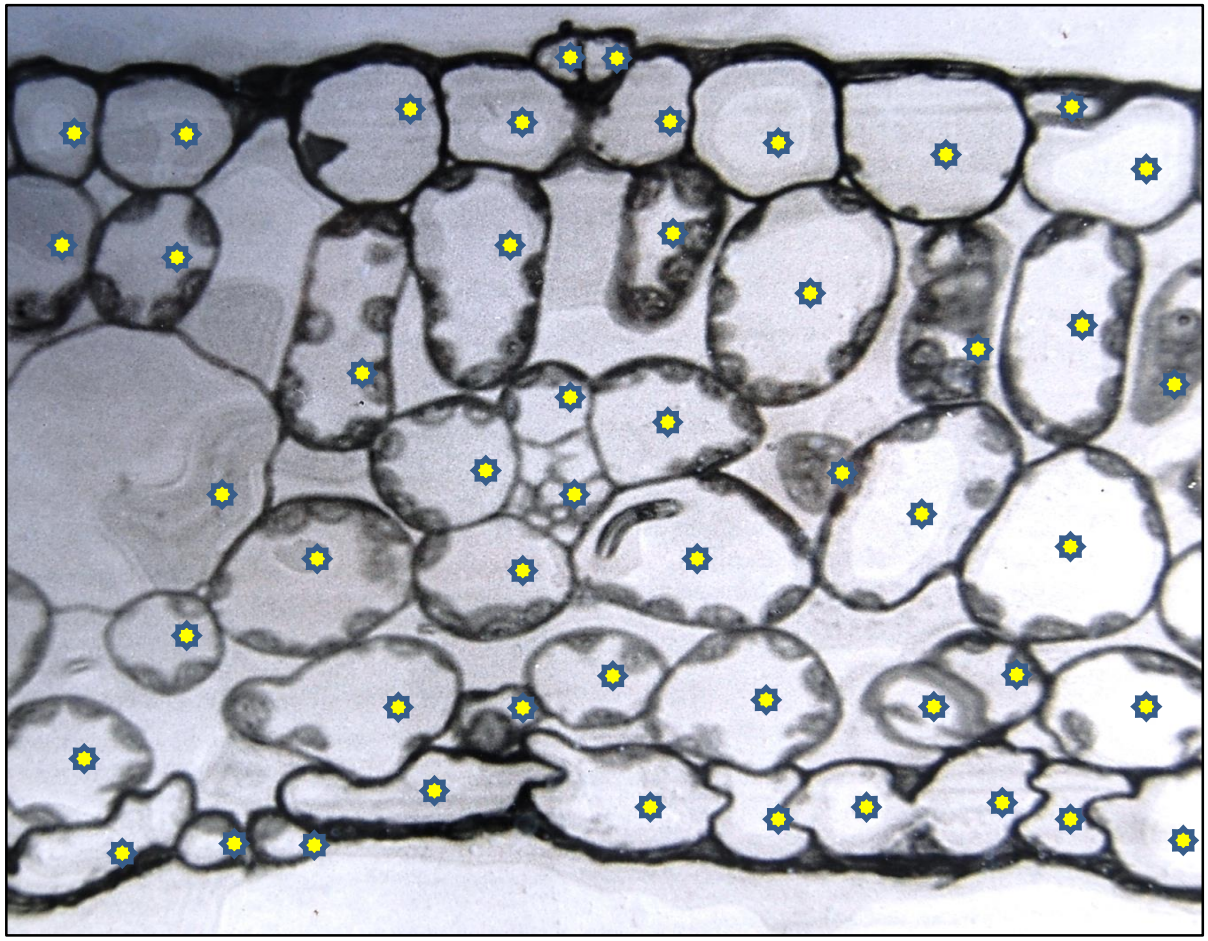
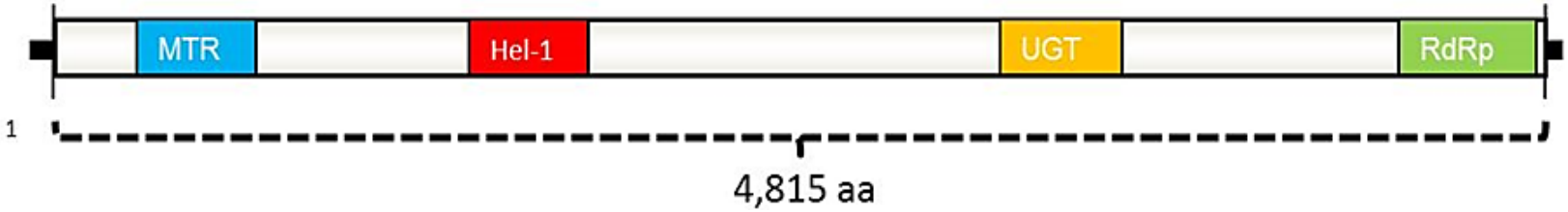
Persistent plant viruses:

Endosymbionts present in all plant cells without causing visible symptoms

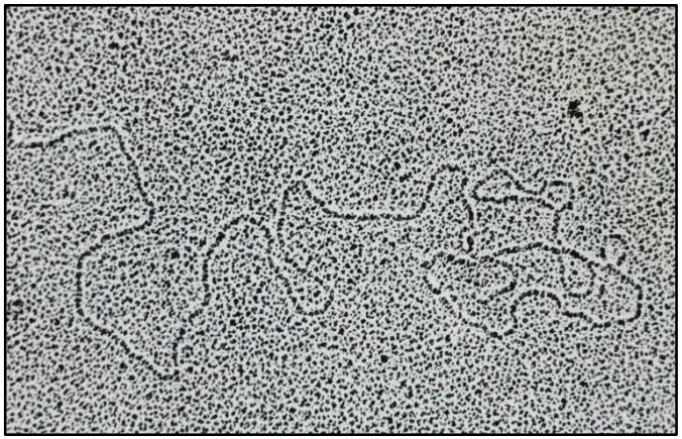


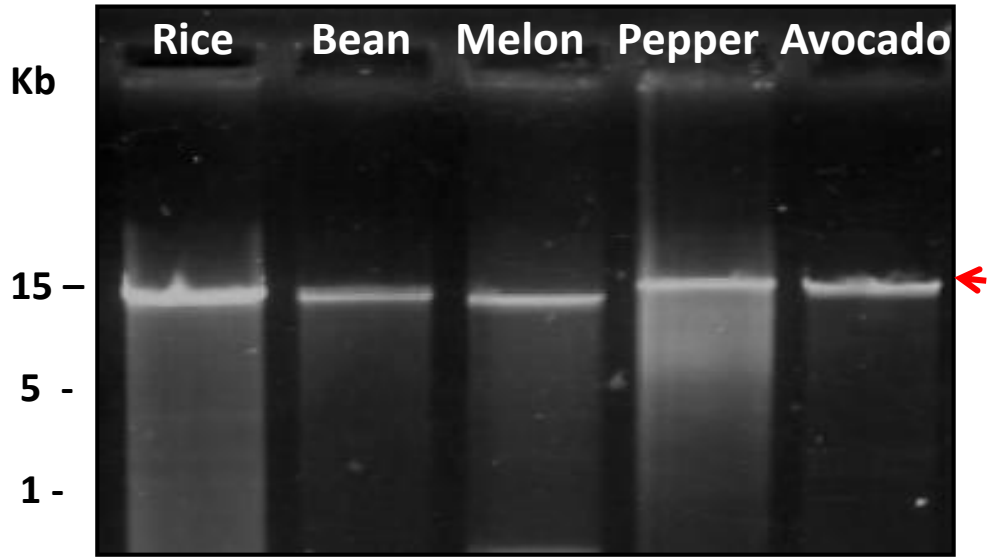
Endornaviridae

14-17 kb linear ssRNA



Plants, fungi, oomycetes





Major crops infected by endornaviruses

Capsicum annuum ***(Solanaceae)***	**Pepper (bell)**	
Phaseolus vulgaris ***(Fabaceae)***	**Common bean**	
Cucumis melo ***(Cucurbitaceae)***	**Melon/Cantaloupe**	
Oryza sativa ***(Poaceae)***	**Rice**	
Persea americana ***(Lauraceae)***	**Avocado**	

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Capsicum annuum horticultural types, and other *Capsicum* species are infected with bell pepper endornavirus (BPEV)

Capsicum annuum

C. annuum

C. annuum

C. annuum

Capsicum baccatum

Capsicum frutescens

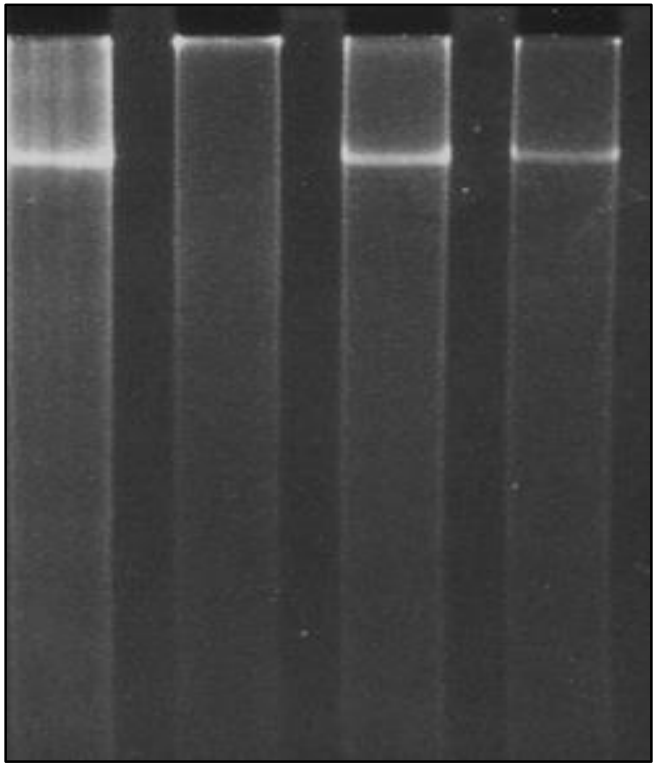
Capsicum chinense

Identification of a BPEV-free bell pepper

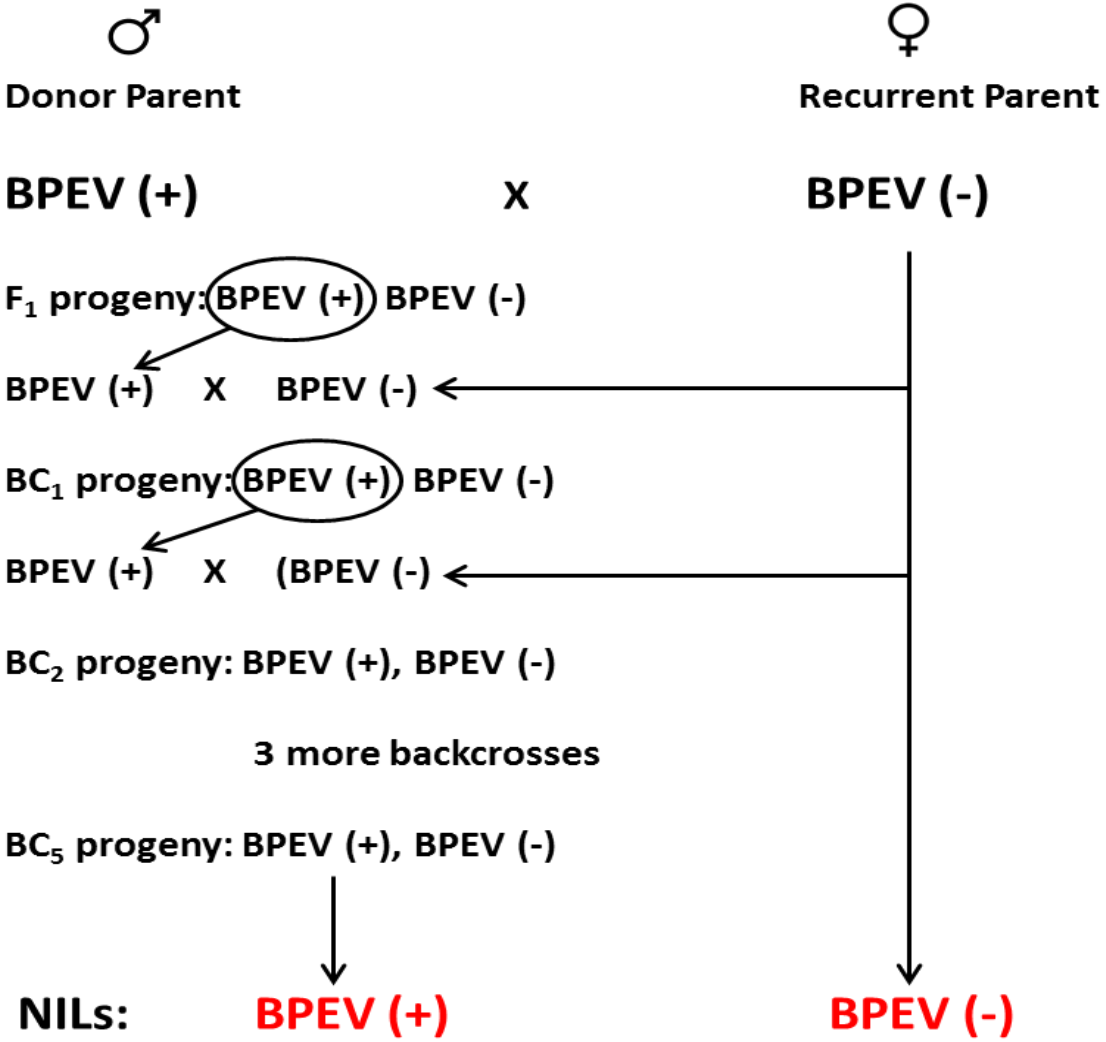
Obtained after testing over 100 individual plants of bell pepper cv Marengo

Okada et al., 2013. J Gen Virol

BPEV+ BPEV- BPEV+ BPEV+



Development of two Marengo bell pepper near-isogenic lines (NILs)



Escalante & Valverde, unpublished

Near-isogenic lines of Marengo bell pepper

BPEV +

BPEV -

BPEV +

BPEV -

Escalante & Valverde, unpublished

Near-isogenic lines of Marengo bell pepper

BPEV+ BPEV- BPEV+ BPEV-

Escalante & Valverde, unpublished

Near-isogenic lines inoculated with tomato spotted wilt virus and potato virus Y

BPEV +

BPEV -

Tomato spotted wilt virus

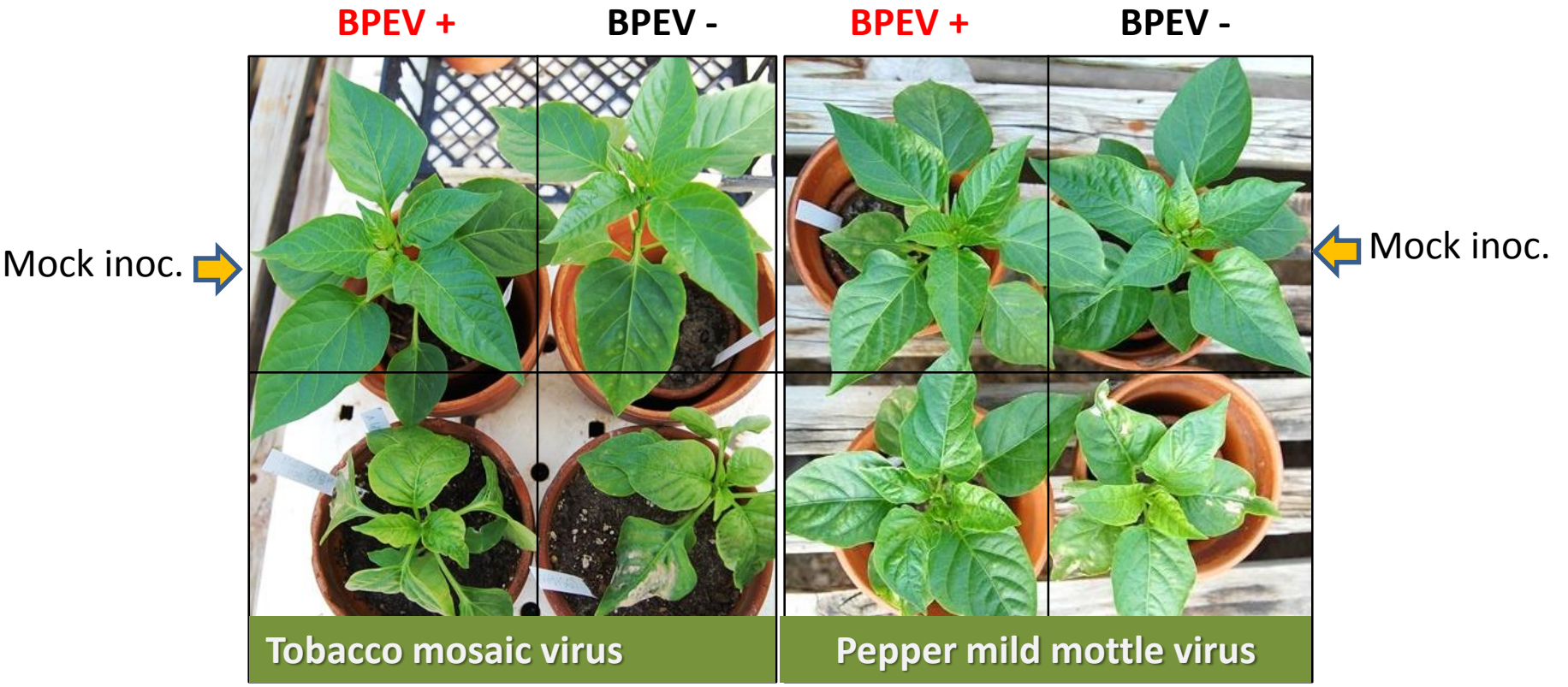
BPEV +

BPEV -

Potato virus Y

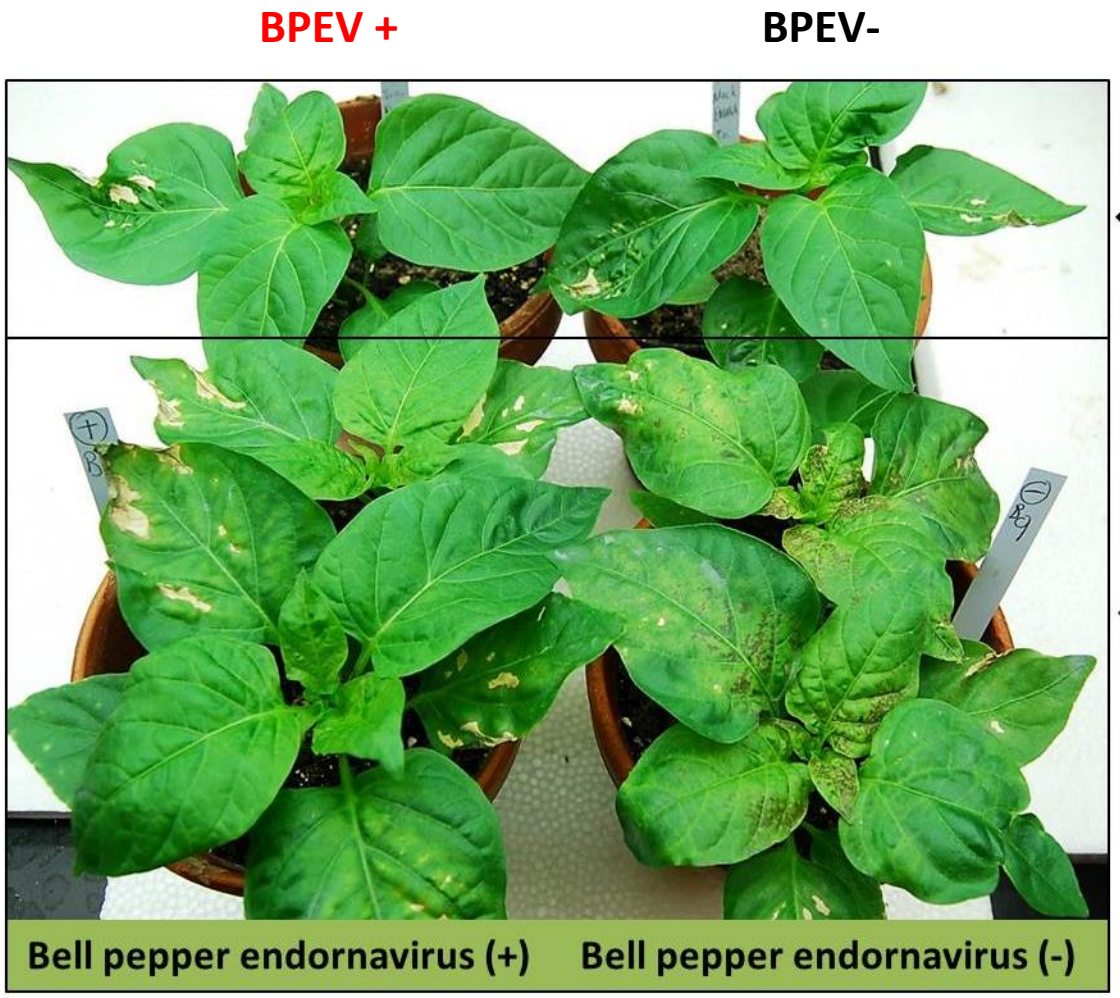
Escalante & Valverde, unpublished

Near-isogenic lines inoculated with tobacco mosaic virus and pepper mild mottle virus



Escalante & Valverde, unpublished

Near-isogenic lines inoculated with tobacco mild green mosaic virus



Escalante & Valverde, unpublished

Near-isogenic lines inoculated with tobacco mild green mosaic virus

BPEV +

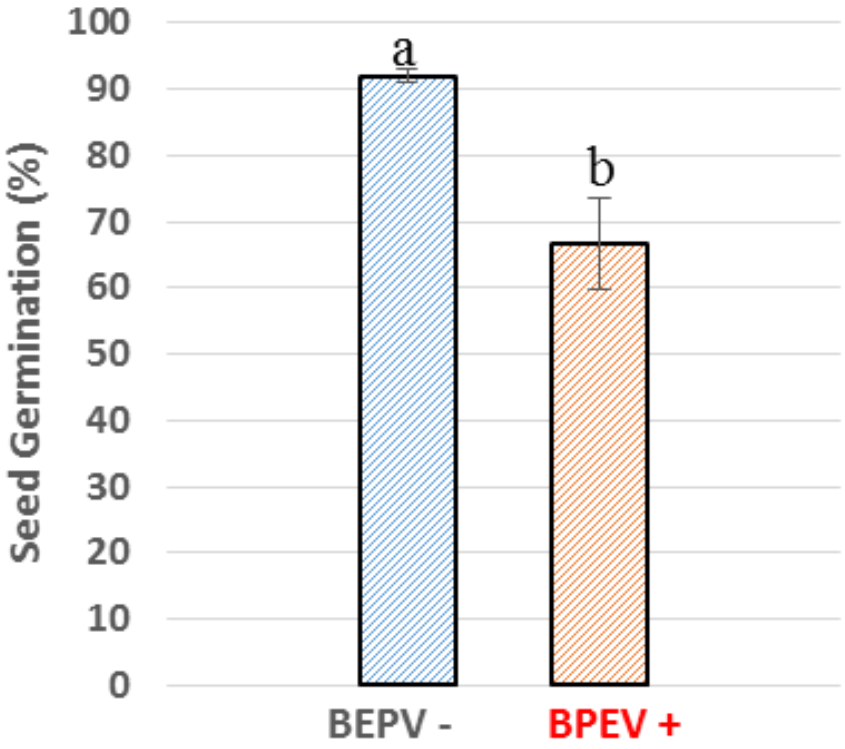
BPEV-

Escalante & Valverde, unpublished

Plastic pots containing bell pepper near-isogenic lines placed in a gravel plot

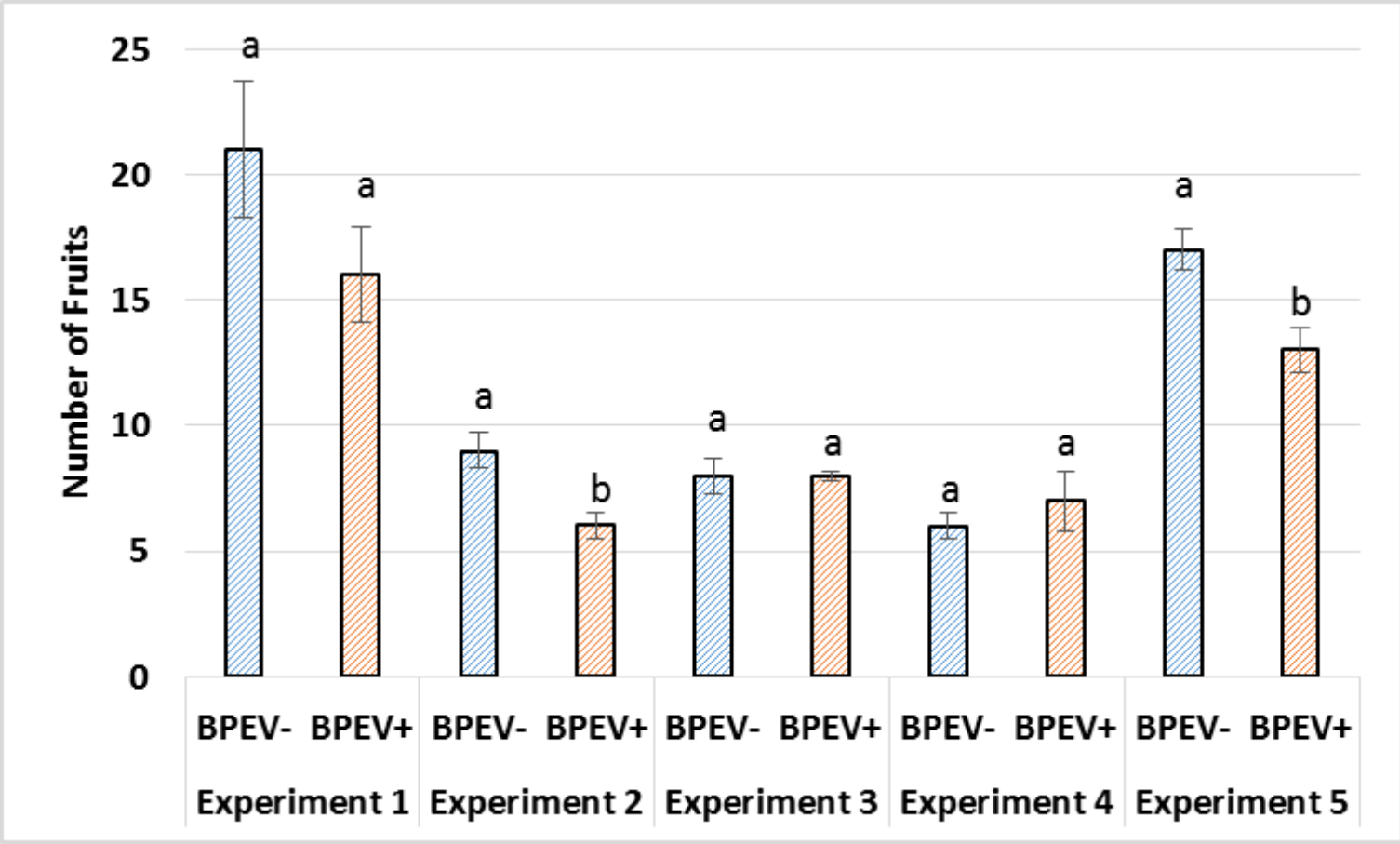
Escalante & Valverde, unpublished

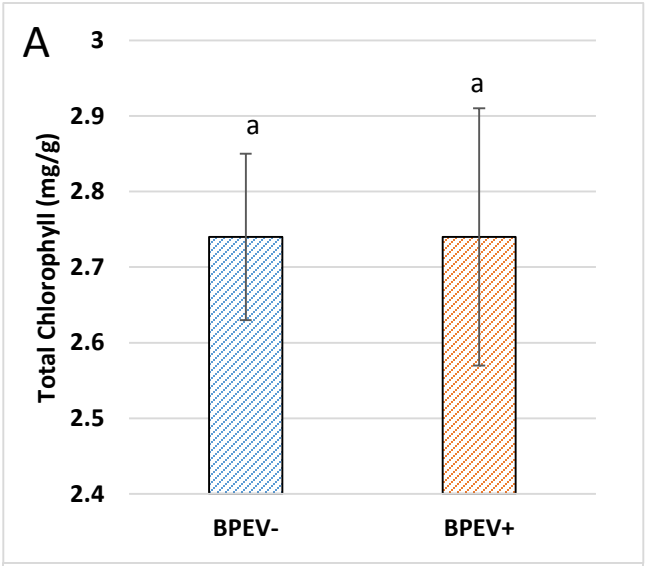
Seed germination

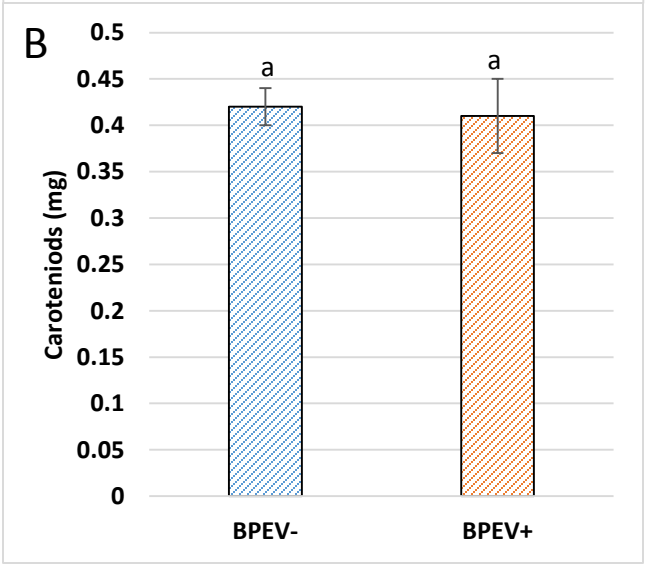


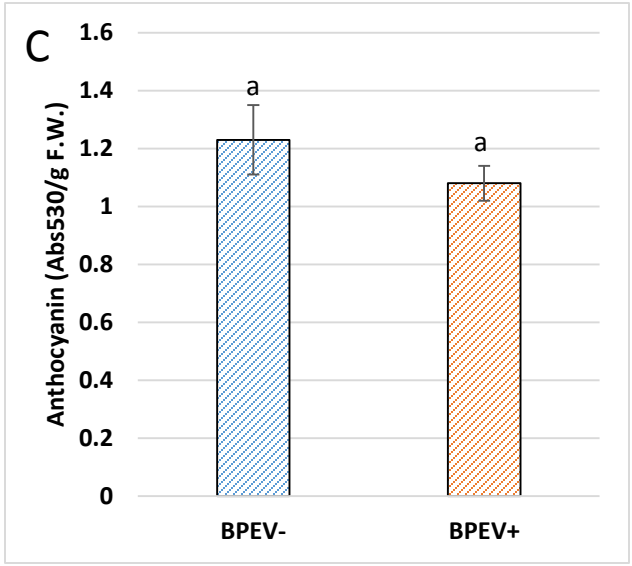
Escalante & Valverde, unpublished

Number of fruits





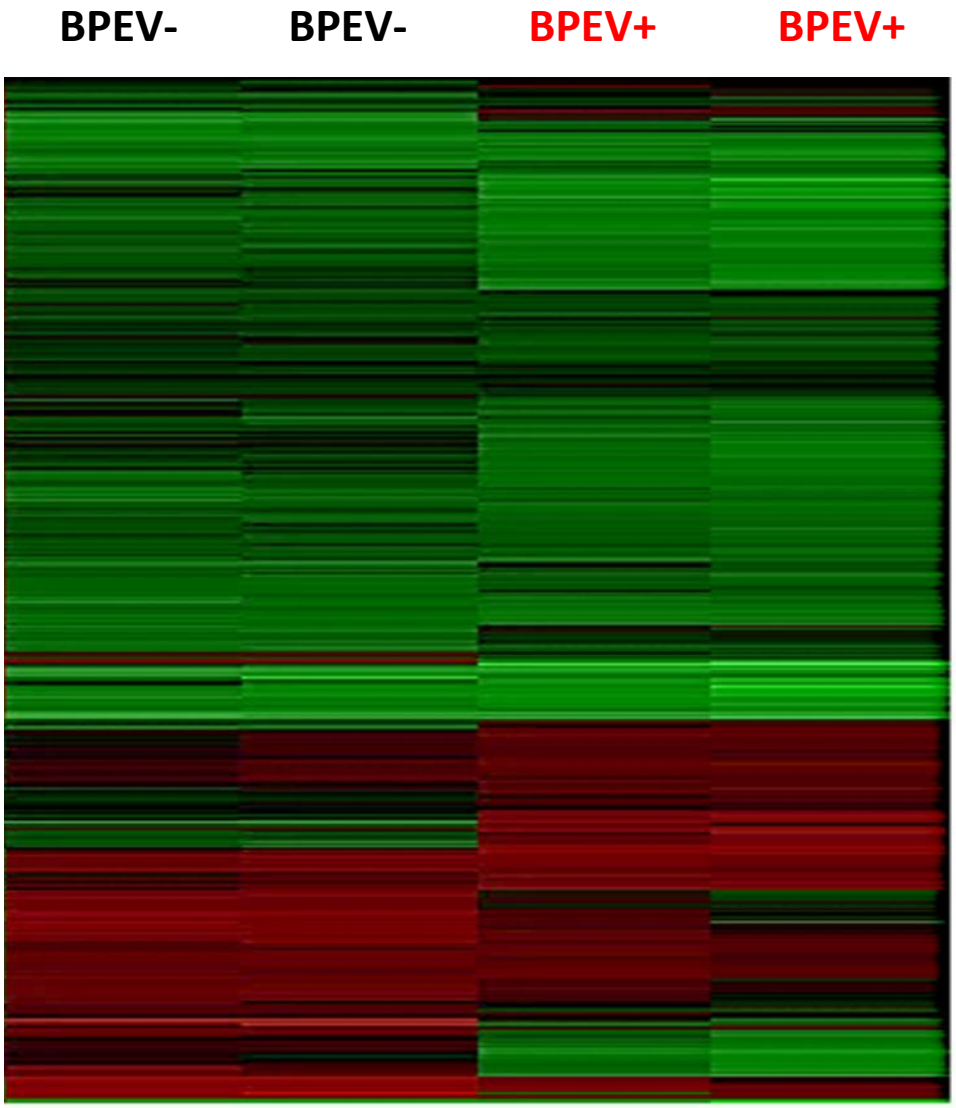




Chlorophyll (A) **Carotenoid** (B) and **Anthocyanin** (C) content

Escalante & Valverde, unpublished

Heat map of the transcriptome of the two bell pepper NILs



Escalante et al., unpublished

Summary

There is no evidence that BPEV affect the plant phenotype

We found an association of BPEV with lower fruit yield and seed germination

BPEV is associated with inhibition of a systemic necrosis caused by TMGMV

We are currently, conducting bioinformatics analyses of RNAseq data on the two bell pepper near-isogenic lines

Plant endornaviruses: questions

Beneficial?

Detrimental?

Do they play an active role when the host is exposed to abiotic/abiotic stresses?

Why bell pepper and melon breeders without knowing of the presence of endornaviruses in those two crops appear to have selected only endornavirus-infected lines?

Future and ongoing endornavirus research

Develop a novel method for inoculation of endornaviruses

Generate near-isogenic lines of endornavirus-free and endornavirus-infected plants

Continue differential gene expression studies and validate and test selected genes

Interaction studies of endornaviruses with biotic (pathogens, herbivores) and abiotic agents (temperature, water, salt, etc.)

Investigate mechanisms of gene silencing/suppressor of gene silencing associated with endornavirus infections

Collaborators on bell pepper endornavirus research

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CSIC, Malaga Spain

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