

Carolina Strongback: A Fusarium wilt and Root knot Nematode resistant *Citrullus amarus* rootstock for watermelon production

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Fusarium wilt is one of the most devastating diseases of watermelon



- Causal agent: *Fusarium oxysporum* f. sp. *niveum* (*Fon*)
- Pathogenic races of *Fon*: 0, 1, 2, and 3
- *Fon* race 1 resistance has been incorporated into many cultivars
- There are no edible cultivars with resistance to *Fon* races 2 or 3

Root knot nematode (RKN) (*Meloydogyne spp.*)

- RKN is the most destructive nematode of watermelon in the U.S.
- Cultivated watermelon (*Citrullus lanatus*) is susceptible to RKN.
- Commercial bottle gourd, pumpkin, and Interspecific hybrid rootstocks are susceptible to RKN

Reniform nematode (*Rotylenchulus reniformis*)

- Reniform nematode causes damage on numerous cucurbits
- Found in tropical & subtropical areas
- Rio Grande Valley in Texas and throughout the southeastern U.S.
- Can reduce fruit size and lower sucrose levels

Fusarium wilt and plant parasitic nematodes

- *Fusarium oxysporum* f. sp. *niveum* can remain viable in soil for more than 30 years.
- Most growing areas in the southeastern US have issues with southern root knot nematode.
- The loss of methyl bromide as an affordable soil fumigant has required a search for alternative control options.

Soilborne disease and pest control options:

- Chemicals
- Biological control
- Plant host resistance
- Grafting

WATERMELON

- *Citrullus lanatus*- Cultivated watermelon
 - Sweet (High Brix)
 - Mostly red flesh
 - Mostly large fruit
 - Often susceptible to pathogens and pests

Citrullus amarus- Citron melon

- Not sweet (often bitter)
- Mostly green or white
- Resistance to many pathogens and pests

ROOT KNOT NEMATODE

Meloidogyne incognita

ROOT STOCK ID	TYPE	REACTION
Macis	<i>Lagenaria</i>	Susceptible
FR Strong	<i>Lagenaria</i>	Susceptible
WMXP 3945	<i>Lagenaria</i>	Susceptible
Emphasis	<i>Lagenaria</i>	Susceptible
Geo Sprint	<i>Lagenaria</i>	Susceptible
Ojakkyo	<i>Citrullus amarus</i>	Least Susceptible
Shintosa Camel	Inter-specific Hybrid	Very Susceptible
WR-15006	Inter-specific Hybrid	Very Susceptible
Carnivor	Inter-specific Hybrid	Very Susceptible
WMXP 3943	Inter-specific Hybrid	Very Susceptible
Strong Tosa	Inter-specific Hybrid	Very Susceptible
Gladiator	Inter-specific Hybrid	Very Susceptible
Iron Cap	Inter-specific Hybrid	Very Susceptible

Goals for a new rootstock

- Reduction in rootstock costs.
- Easy and compatible grafting characteristics.
- Fusarium wilt resistance.
- Nematode resistance.
- High yields.



← **USVL246-FR²**

USVL252-FR²



Carolina Strongback



Carolina Strongback

Excellent grafting qualities:

- Uniform seedling growth
- Performs well under LED lights
- Thick hypocotyl
- 90-100% grafting “takes”
- Adapts well to newest grafting methods.



Carolina Strongback



Carolina Strongback

- *Citrullus amarus*
- Developed, PVP and Released, USDA-ARS & Clemson University
- High Levels of Tolerance to *Fusarium oxysporum* f. sp. *niveum* races 1 & 2
- High Levels of Tolerance to Root Knot & Reniform Nematode
- High Levels of Tolerance to Bacterial Fruit Blotch
- Produces an Abundance of Seed
- Open pollinated



YIELD

Rootstock	Fruit Number	Fruit Weight	Average Fruit Wt.	% Fruit Count				
<u>Treatment</u>	<u>per Plot</u>	<u>lb/Plot</u>	<u>lb/Plot</u>	<u>Under 9 Lb</u>	<u>60 Count</u>	<u>45 Count</u>	<u>36 Count</u>	<u>30 Count</u>
Non-Grafted	21.00 a	301.00 a	14.33 a	9.52 a	42.86 b	23.81 b	19.05 b	4.76 b
Carnivor	21.00 a	273.15 b	11.09 b	4.76 b	57.14 b	33.33 a	0.00 c	4.76 b
Strong Tosa	22.00 a	291.71 ab	13.26 a	4.55 b	22.73 c	8.09 c	59.09 a	3.57 b
Macis	14.00 b	137.30 c	9.81 b	4.61 b	70.94 a	24.45 b	0.00 c	0.00 b
Emphasis	15.00 b	151.41 c	10.09 b	3.98 b	68.21 a	23.82 b	3.99 c	0.00 b
Carolina Strongback	23.00 a	380.30 a	16.53 a	0.00 c	26.09 c	34.78 a	17.39 b	21.74 a

INTERNAL FRUIT QUALITY

Treatment	Cut Length (cm)	Cut Width (cm)	Total Soluble Solids (Heart)	pH (Heart)	Heart Firmness			Locule Firmness		
Non-grafted	26.88	22.75	11.53	5.96	3.32	2.27	2.62	1.82	1.53	1.69
Carnivor	25.31	21.36	11.39	5.76	4.72	4.91	4.58	2.08	2.20	2.17
Strong Tosa	24.08	20.83	10.87	5.81	4.44	4.30	4.19	1.90	1.93	2.01
Emphasis	25.72	22.00	11.32	5.91	5.61	4.52	4.94	3.49	3.85	3.90
Macis	24.42	20.15	10.57	5.57	6.02	6.08	6.66	2.77	2.28	2.63
Carolina Strongback	25.20	21.63	11.77	5.89	4.24	4.53	4.93	2.95	1.94	2.92



Carnivor and Carolina Strongback in nematode infested field



**Triploid grafted to
Carnivor Rootstock**



**Triploid grafted to
Carolina Strongback Rootstock**

Carolina Strongback: Cucumber (*Cucumis sativus*)

- Preliminary study (2020) on use of Carolina Strongback for greenhouse cucumber production is promising.
- Yields were much heavier for grafted verses non-grafted (more than 2-fold)
- Fruit produced ten days earlier on rootstocks and produced longer.



Carolina Strongback: Issues

- Seven to ten day lag in fruit set compared to non-grafted

Possible causes:

- Too vigorous vine growth
- Needs more cold soil tolerance

Carolina Strongback: Issues

- Does not work with Cantaloupe (*Cucumis melo*)
 - Graft incompatibility?
 - Genetic?
 - Physical issues?

Carolina Strongback: Cantaloupe failure



Future Citroides Rootstocks

- Six (USVL246-FR2 x USVL114) RILs.
 - High tolerance to *Fon* race 1 & 2
 - High level of resistance to Root Knot nematode
- RILS performed well in grafting study.
- Made reciprocal F₁ hybrids with Carolina Strongback.
- Field testing this season in South Carolina.



Thank you!

- USDA Project 6080-22000-025-00
- NIFA-SCRI 6080-21000-018-08 (CucCAP)
- NIFA-SCRI 6080-22000-028-22 (Grafting)



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