Field evaluation of commercial tomato cultivars against *Ageratum yellow vein virus* in Guam

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Introduction

In 2007, a disease with leaf curl, yellowing and stunting symptoms was reducing yield of tomatoes by 10% in northern Guam. Samples were sent to Agdia diagnostic company. Their genetic sequencing produced 89-90% matches to both *Papaya leaf curl virus* and *Malvastrum leaf curl virus*. In the spring of 2011, some farms were experiencing a total loss of their tomato crops, apparently to the same problem. This prompted two additional samples to be sent to Agdia. Forward and reverse sequences of the samples had a 93% identity to *Ageratum yellow vein virus* (AYVV).

In an effort to identify the virus species with greater precision, additional samples were collected and processed at the U.S. Vegetable Laboratory. Due to the high level of sequence diversity found, it is likely that Guam has a unique strain of AYVV. Crop health screening for a panel of viruses showed only positive in the Begomovirus Group PCR test, but negative to many other common tomato virus in enzyme-linked immunsorbent assay (ELISA).

It was decided that identifying AYVV resistant varieties among commercial tomato cultivars suitable for Guam was necessary to control AYVV.

Materials & Methods

During Guam's wet-season, August 2014, farm trials were begun to compare 17 commercial tomato varieties for virus resistance and production suitability against the control variety **'Season Red'** (**Table 1**). Varieties were grape, cherry, elongate, globe, plum, roma, oval, or round, and either determinate or indeterminate.

A Tomato Virus Severity Scale (**Figure 1**) was created and used to visually evaluated the tomato varieties for AYVV (**Figures 2, 3,** and **4**). Three times throughout the wet-season trial, fields were visually evaluated for AYVV, approximately one, two, and three months after transplant. Following the third virus severity evaluation, samples were collected from each field trial and pooled for Real-time PCR analysis at the USDA-ARS Vegetable Laboratory.

At the conclusion of the wet-season field trial, producers surveyed the participating farm trials and identified their top variety choices in each field.

Tomato varieties were compared against the control and analyzed using a cumulative logit model. Virus severity was a natural ordinal response variable. Variety ID vs. Control was an explanatory where each variety was compared against the control variety. Plot ID was added into the model as a blocking factor to improve the model's fit.

Table 1: List of varieties used for field evaluation.

Field ID	Variety	Fruit type
1	Olivia	Grape
2	Baxter's Bush	Cherry
3	Carmine	Cherry
4	Coralino	Cherry
5	Felicity	Globe
6	Rubia	Elongate
7	Affinity	Grape
8	Ensalada	Plum
9	Ornela	Grape
10	Sassy	Roma
11	Shanty	Oval
12	Tylon	Oval
13	**Season Red**	**Cherry**
14	Tovi Star	Globe
15	Tycoon	Globe
16	Heatwave II	Roma/Round
17	Matty	Oval
18	Tribute	Globe

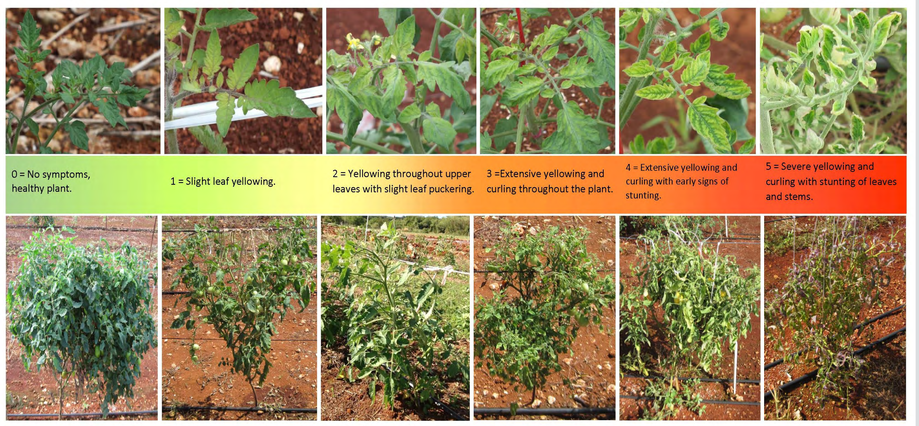

Figure 1: AYVV Tomato Virus Severity Scale.

Figure 2: An AYVV infected tomato plant (scale 4), compared to a healthy tomato plant (scale 0).

Figure 3: Tomato plant with severe AYVV symptoms, identified as scale 5.

Figure 4: A close-up of a tomato leaf with AYVV symptoms, identified as scale 5.

Results & Discussions

Partial analysis of the third set of field data, identified 12 varieties with virus resistance superior to **'Season Red'** and five with inferior resistance (**Table 2**). Based on Real-time PCR of pooled samples, AYVV was detected in one superior variety and four of the inferior ones. When symptomless tomatoes were tested, only one of the 18 varieties were positive for AYVV.

The top varieties from each field were selected and ranked by producers, which include 'Olivia', 'Carmine', 'Affinity', 'Ornela', and 'Felicity' (**Table 3**).

Table 3: Producers variety ranking.

Rank	Field 1	Field 2	Field 3	Field 4
1st	9	1	7	5
2nd	5, 7, 3	5	5	3, 1
3rd	1, 12, 17, 2	3, 14, 9, 7	3, 16, 1	14

These varieties were recommended for production on Guam based on their strong virus resistance, high yield and low levels of cracked and unmarketable fruits. **Figure 5** illustrates the fruit types of the selected varieties, either grape, cherry, globe, or oval fruit.

Table 2: Ranking of varieties, from resistant to susceptible, based on visual evaluation in comparison to **Season Red**, with corresponding Real-time PCR detection of AYVV.

Field ID	Visual Evaluation[1,2]	Real-time PCR (Ct)
3	7.315E+08	0
9	7.189E+08	0
12	7.189E+08	0
7	85.753	0
1	32.777	20.41*
4	10.364	0
5	8.613	0
14	5.393	29.51*
11	3.559	0
15	3.216	0
10	2.234	0
17	1.049	0
13	**Control**	**18.38***
16	0.745	0
6	0.368	19.52*
18	0.250	29.86*
8	0.123	26.56*
2	0.067	19.95*

[1]Change in Odds Ratio when switching from control to variety #

[2]Values in orange are not reliable since there was an uneven spread of sick and healthy crops due to the fact that no virus was detected.

*Samples confirmed to have AYVV based on Real-time PCR analysis.

Figure 5: Varieties selected by producers for suitability on Guam during wet-season, compared to **'Season Red'**.

In a separate replicated trial planted on October 2014, plants again exhibited AYVV symptoms; however, Real-time PCR analysis showed low frequencies of the virus This may indicate the presence of another virus affecting tomato production.

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Reference

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