Leafhopper Virus in Texas Glassy-Winged Sharpshooters*

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ABSTRACT- Abstract

USDA UNITED STATES DEPARTMENT OF

The glassy-winged sharpshooter Homalodisca vitripennis is an invasive pest and important vector of *Xylella fastidiosa*, a xylem-limiting bacteria that causes Pierce's Disease in grapes and other woody fruit and tree crops. The primary method of managing the spread of *Xylella* is controlling its insect vector populations. Methods such as chemical control are not target specific and lead to problems such as residue contamination, injury to nontarget organisms, and development of insecticide resistance.

Identifying microbial biological agents that can reduce *H. vitripennis* is the goal of one biological control strategy. In this study, we have identified Homalodisca coagulata virus-1, in populations of H. vitripennis collected in Texas. The virus is a novel virus that harbors pathogenic potential with regard to GWSS. DNA sequencing of the viral capsid protein gene was used to determine genetic variability between Florida HoCV-1 and Texas HoCV-TX strains. The genetic variability may be related to increased virulence of the Texas strain to leafhoppers.

Introduction

The glassy-winged sharpshooter, Homalodisca vitripennis (Hemiptera: Cicadellidae), is the major vector of *Xylella fastidiosa* Wells in the Southern USA (Adlerz 1980; Blua et al., 1999). The plant pathogenic bacterium, X. fastidiosa, has caused economic losses to several agricultural industries in North America and is associated with many plant diseases such as Pierce's disease, and oleander leaf scorch. Pierce's disease of grapevine has become a well recognized *Xylella*-related disease; the vector profile is well known and the epidemiology of the disease is well documented (Hopkins et al., 2002). The introduction of *H. vitripennis* into new areas is directly related to increased occurrence of Pierce's disease in vineyards (Perring et al., 2001). Therefore, the management of Pierce's disease depends heavily on the ability to control its vectors, especially *H. vitripennis*.

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CA	HoCV-1	AGAGACC
тх	HoCV-1	agaga <mark>cc</mark>
CA	HoCV-1	ACG <mark>TTC</mark> G ThrPheG
тх	HoCV-1	acg <mark>ttc</mark> g ThrPheG
CA	HoCV-1	AG <mark>TAT</mark> GG
	HoCV-1	GlnTyrG1 ag <mark>tat</mark> gg
		GlnTyrGl
CA	HoCV-1	TAACTTG AsnLeu
тх	HoCV-1	AsnLeu <mark>taacttg</mark> AsnLeu
CA	HoCV-1	CTGCAAT LeuGlnP
тх	HoCV-1	<mark>ctgcaat</mark> LeuGlnP
	W- (W- 1	GTCTCAC
	HoCV-1 HoCV-1	SerLeuTh gtotcac
17	1000-1	SerLeuTh
CA	HoCV-1	TGAT <mark>TT</mark> A
тх	HoCV-1	Aspleu <mark>tgactta</mark> Aspleu
CA	HoCV-1	GCC <mark>TACC</mark> AlaTyrL
тх	HoCV-1	<mark>gco<mark>t</mark>acc</mark> AlaTyrL
		<u></u>
	HoCV-1	GGGG <mark>TAC</mark> ArgGlyTh
ТX	HoCV-1	<mark>ggggg<mark>t</mark>ac ArgGlyTh</mark>
са	HoCV-1	
	HoCV-1	Thr Ly <mark>cac</mark> gaaa
		ThrLys

References

Adlerz, W. C. 1980. Ecological observations on two leafhoppers that transmit the Pierce's disease bacterium. Proc. Fla. State Hortic. Soc. 93:115-120. Blua, M. J., Phillips, P. A., and Redak, R. A. 1999. A new sharpshooter threatens both crops and ornamentals. Calif. Agric. 53(2):22-25. Hopkins, D. L., and Purcell, A. H. 2002. Xylella fastidiosa: Cause of Pierce's Disease of Grapevines and Other Emergent Diseases. Amer. Phytopath. Soc. 86(10):1056-1064. Perring, T. M., C. A. Farrar, and M. J. Blua. 2001. Glassy-winged sharpshooter host impacts Pierce's disease in Temecula Valley vineyards. Calif. Agric. 55: 13-18. Hunnicutt, L. E., Hunter, W. B., Cave, R. D., Powell, C. A., and Mozoruk, J. J. 2006. Genome sequence and molecular characterization of Homalodisca coagulata virus-1, a novel virus discovered in the glassy-winged sharpshooter (Hemiptera: Cicadellidae). Virology. 350(1): 67-78.

GACTCGCAACATCACAACAAATACACGACACCATGGAAAC<mark>TCATTC</mark>ACATGAG<mark>CCCAT</mark>AAACACCAACATAGA <u>agactegeaacateaacaaatacacgacaccat</u>ggaaacteatteacatgage A CAGAAGCGCGAAA<mark>T CACCCACTT CACAGAGGAT GACCGCGTACT CACCGACGCAGTGACAGAAATTACTT CATTACCCCT</mark>CT aggagaag<mark>ege</mark>gaaateacceaetteacagaggatgacegegtaeteacgaegeagtgacagaaattaetteattacceetet luLysArgGluIleThrHisPheThrGluAspAspArgValLeuThrAspAlaValThrGluIleThrSerLeuProLeuS GAA CATA GT GTAATAT C C T T T CTT CAAAGA C C GGAGAAAA T C G C TA CAGT GA C GT GGA C TA C G G C T CAAA <mark>7AspGlu</mark>ProArgGluHisSerValIleSerPheLeuGlnArgProGluLysIleAlaThrValThrTrpThrThrAlaGlnTh agacgag<mark>ccac</mark>gagaa<mark>catagtgtaatatcctttcttcaaagacc</mark>ggagaaaa<mark>tcgctacagtgacgtggactac</mark>gg<mark>ctcaaa</mark> **yAspGlu**Pro**ArgGlu**HisSerValIleSerPheLeuGln**Arg**Pro<mark>GluLys</mark>IleAlaThrValThrTrpThrThrAlaGlnTh FAT<mark>CCTTGCCAATTCCATCGTCTGTGTTG</mark>ACGACTATGTACAGAGAGAG<mark>C</mark>TGAGAGG<mark>CTTT</mark>GG<mark>CC</mark> ValSerLeuProIleProSerSerValLeuThrThrMetTyrArgGluLysLeuArgGlyPheGlyLeuLeuArgAlaAspIle gg<mark>tateettgeeaatteeategtetgtgte</mark>a<mark>aegaetatgtaeagagagaagetgagaggetttggeetgettegtge</mark>tteg<mark>tgeagaeatt</mark> uValSerLeuProIleProSerSerValLeu/hrThrMetTyrArg<mark>GluLys</mark>LeuArgGlyPheGlyLeuLeuAtgAlaAspIle T<mark>CAACTCACAGCCCTTCCAAGC</mark>TGGGAGATTGATTG<mark>C</mark>GACATACATT<mark>CCAGTTCCTGCCTATC</mark>TTTTACAAA nAlaGlvArgLeuIleAlaThrTvrIleProValProAlaTvrLeuLe tcaactcacageeettecaagetgggagattgattgegacatacattecagttectgeetatettt heAsnSerGlnProPheGlnAla<mark>GlyArgLeuIleAlaThrTyrIleProValProAlaTyrLeuLeu</mark>GlnArgThrArgMetA AAGACTGACCTCGTTACCTAACGTGATTATTGACATTAGTAAGCAGACTGAATGTAATATCACATTACCCTACGTAAGCTCGTT r<mark>ArgLeu</mark>ThrSerLeuProAsnValIleIle<mark>Asp</mark>IleSerLysGlnThr<mark>GluCys</mark>AsnIleThrLeuProTyrValSerSerP aagactgacctcgttacctaacgtgattattgacattagtaagcagactgaatgtaatatcacattaccctacgtaagctcgti rArgLeuThrSerLeuProAsnValIleIleAspIleSerLysGlnThrGluCysAsnIleThrLeuProTyrValSerSerPH ACAAGTGGCGGAGGAGATTGGGGCTTGTTCGACCTTTGGGTCTATAGTCCCCTCAGTAGTGCGTCTTCTCAGACAATCAACATC ThrSerGlyGlyGlyAspTrpGlyLeuPheAspLeuTrpValTyrSerProLeuSerSerAlaSerSerGlnThrIleAsnIle g<mark>c</mark>ggaggaga<mark>tt</mark>gggg<mark>cttgttcgacctttggg<mark>tc</mark>tatagt<mark>cccctcagt</mark>a</mark> IThrSer<mark>GlyGlyAsp</mark>Trp<mark>GlyLeuPheAspLeuTrpValTyr</mark>SerProLeuSerSerAlaSerSerGlnThrIleAsnIle 710 720 730 740 750 760 770 780 790 CTCGACAATGTACGCTTGGGTGCGCCCACGCAACAATCGTTAGTCACAGCGGAAAAGATGCTAAAAGCAAACGTACAGACACGGG LeuAspAsnValArgLeuGlyAlaProThrGlnGlnSerLeuValThrAlaGluLysMetLeuLysAlaAsnValGlnThrArgA e<mark>tcgacaatgtacgettggggtgege</mark>ta<mark>cgeaacaategtt</mark>ag<mark>teacage</mark>ggaaaaga<mark>tget</mark>aaaag<mark>etaaaegtacagaeae</mark>ggg euAspAsnValArgLeuGlyAlaPhoThrGlnGlnSerLeuValThrAlaGluLysMetLeuLysAlaAsnValGlnThrArgA rSerSer**Cys**GlySerIle\$erAlaArgAlaGlnGlyGlyLysGlnThrAlaGlySerGlyAspGlySerPheGlySerLeuLe a<mark>tetagttgtggetegatet</mark>tag<mark>egegegeeeaaggaggaaagea</mark>a<mark>acageeggetegggegatggateettegggatete</mark>teet nrSerSer**Cys**GlySerIleLewAlaArgAlaGlnGlyGlyLysGlnThrAlaGlySerGlyAspGlySerPheGlySerLeuLe 910 920 930 940 950 960 970 AAAGTGTCACTATGCAGGAGCGATCCGCAGGGACTATCTCCCGAGTTGGACATAGTATACGTGAGGGC ysSerValThrMetGlnGluArgSerAlaGlyThrIleSerArgValGlyHisSerIleArgGluGly laag<mark>tgtcactatgcaggagc</mark>aa<mark>tccgcagggactatctcccgagttggacatagtatacgtgagggc</mark> sLysCysHisTyrAlaGlyAlafleArgArgAspTyrLeuProSerTrpThrEndTyrThrEndGly

Results

HoCV-1 has been detected in GWSS populations collected in Texas.

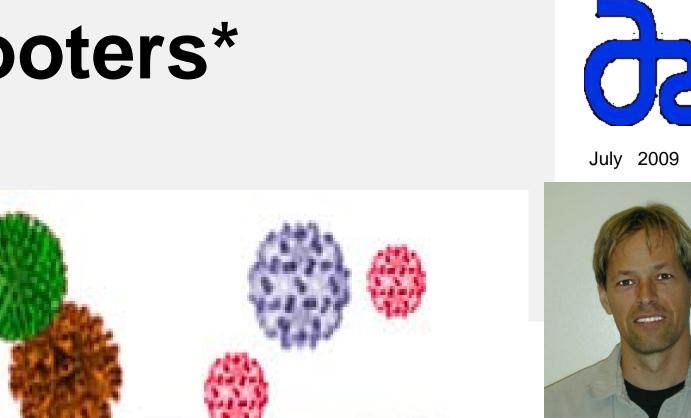
Sequence comparison of the Texas virus strain against the sequenced California strain (Hunnicutt et al., 2006) shows some variation. The percent similarity between the strains is **98.8%**. Supporting within species variation.

•Due to a Guanine insertion in the consensus strain at base pair 904 (possibly a deletion in the California strain), variation downstream in the amino acid chain was observed (Fig. 1).

Discussion

•The presence of variation between the Texas HoCV-1 sequence and the California HoCV-1 sequence showed amino acid changes, which may be the beginning of genetic selection in leafhoppers under Texas environmental conditions.

The Guanine insertion at base pair 904 caused variation in all downstream amino acid translation. This could lead to changes in protein folding and ultimately changes in protein function. Altered protein functions may cause an increase in virulence in the Texas HoCV-1 strain, making it a more ideal viral bio-control and pest management strategy.



Base pair 828, Cytosine in the California strain, is a Thymine in the consensus strain (Fig. 1). This changes the amino acid translation from Serine (polar side chain) into Leucine (nonpolar side chain).