

November, 2011

PROCEEDINGS OF THE 11TH ANNUAL SCRI ZEBRA CHIP REPORTING SESSION



F. Workneh, A. Rashed, and C.M. Rush Editors

**PROCEEDINGS OF THE 11th ANNUAL
2011 ZEBRA CHIP REPORTING SESSION**

F. Workneh. A. Rashed and C. M. Rush Editors

San Antonio, TX

November 6-9, 2011

PREFACE

Zebra chip of potato (ZC) was first documented from potato fields around Saltillo, Mexico in 1994, and in 2000 it was identified in South Texas. In the USA, the disease initially was considered a regional problem in South Texas, but by 2006 ZC had been identified from all potato production areas in Texas, and also in Arizona, California, Colorado, Kansas, Nebraska, Nevada, and New Mexico. Outside of the USA, ZC has been reported from Guatemala, Honduras, Mexico and New Zealand. Early studies of ZC were hampered by lack of knowledge concerning disease etiology, but in 2007, the potato psyllid, *Bactericera cockerelli*, was definitively associated with ZC and in 2008 two independent studies reported the association of *Candidatus Liberibacter* spp. with ZC. It now has been repeatedly demonstrated that transmission of *Candidatus Liberibacter solanacearum* by the potato psyllid results in diagnostic symptoms of ZC, while infestations by potato psyllids without *Candidatus Liberibacter solanacearum* do not cause ZC. However, questions still exist concerning the effect of pathogen and vector variability on disease severity.

Soon after ZC was first identified in South Texas, representatives from *Frito Lay*, approximately four farmers and two plant pathologists met to discuss how to deal with the new disease. Grower sponsored research projects were initiated the next year, and the same small group met again, after the 2001 harvest, and in an informal setting presented their findings and observations. This meeting constituted the first ZC reporting session. After the disease was identified in potato production regions outside of Texas, the National Potato Council and the US Potato Board recognized the potential danger of this new disease and begin to support additional research. In 2007, the Texas Legislature appropriated \$ 2 million to support research on ZC and in 2009; a multistate, multidisciplinary group of scientists were awarded \$6.9 million, from the Federal Specialty Crop Research Initiative (SCRI) Program, to study all aspects of ZC.

From November 6-9, 2011, 117 scientists, farmers, and personnel from agri-industry and potato processing companies, representing four countries, attended the 11th Annual Zebra Chip Reporting Session. Each year, the goal of the meeting is to provide a forum to facilitate collaboration and multidisciplinary research on all aspect of ZC. Those who attend present research results on a wide variety of topics including pathogen detection, vector/pathogen diversity, epidemiology, pest management, breeding for resistance, economics, and disease risk assessment and forecasting. The high quality of information presented in an informal setting to a multidisciplinary group with common interests always makes for an enjoyable, professionally rewarding experience. This volume serves as a record of information presented at our most recent meeting and represents the first published Proceedings of the ZC Reporting Session. It is hoped that the information presented in this Proceedings will be useful to all those interested in ZC.

Charlie Rush
ZC SCRI Program Director

ACKNOWLEDGEMENTS

The publication of this Proceedings and the research reported herein was made possible through a Federal grant from the USDA-NIFA-SCRI Program, Grant #2009-51181-20176.

The organizers of this meeting would like to express their gratitude to Ms. Patty Garrett for facilitating local arrangements for this meeting. We also would like to acknowledge Bayer Crop Science and Frito Lay for covering expenses for the Welcome Reception. Finally, we appreciate the assistance of Jerri Hamar, and the efforts of Kay Ledbetter and Donnie Parrack in recording interviews with all speakers and Advisory Board members for posting on the SCRI ZC Website.

ADVISORY BOARD

Mike Schwarz
Bayer Crop Science

Neil Gudmestad
North Dakota State University

James Supak
Texas A&M University – College Station

Charlie Rush
Texas AgriLife - Amarillo

John Trumble
University of California – Riverside

Jon Gilley
R.D. Offutt

John Nordgaard
Black Gold Potato

Brian Murray
Texas Department of Agriculture

Gerhard Bester
Frito Lay

Mark Lynch
Premium Source Ag

Jack Wallace
J.W. Farms

Andrew Jensen
Washington State Potato Commission

Jason Walther
Walther Farms

John Wallace
CSS Farms

Bruce Barrett
Barrett Farms

Edwin Civerolo
USDA-ARS, Parlier, CA

David Ragsdale
Texas A&M University – College Station

Kiran Shetty
Syngenta

SESSION MODERATORS

Epidemiology / Survey
Charlie Rush – Session I

Host / Pathogen Interaction
Arash Rashed – Session II

Pathogen / Vector Management #1
Jerry Michels – Session III

Pathogen Detection
Neil Gudmested – Session IV

Insect Biology / Monitoring
Don Henne – Session V

Pathogen / Vector Management #2
John Trumble – Session VI

Resistance / Germplasm Identification
Joseph Munyaneza – Session VII

Molecular Biology and Physiology
Blake Bextine – Session VIII

Zebra Chip Impact on Potato Production
Fekede Workneh – Session IX

TABLE OF CONTENTS

Preface	i
Acknowledgements.....	ii
Table of Contents	iv

Epidemiology / Survey

A New Threat in the Columbia Basin of Oregon and Washington: Zebra Chip P.B. Hamm, S.I. Rondon, J.M. Crosslin, and J.E. Munyaneza.....	1
Zebra Chip Found In Idaho P. Nolte, N. Olsen, E. Wenninger, and M. Thornton	6
Exploratory Assessments of Weather Variables in Relation to Psyllid/ZC Prevalence F. Workneh, J.A. Goolsby, D.C. Henne, A. Rashed, L. Paetzold, P.B. Hamm, S. Rondon, and C.M. Rush	7
Regional Monitoring of Potato Psyllid Populations and the Associated Pathogen, <i>Ca. Liberibacter Psyllauros</i> J.A. Goolsby, J.J. Adamczyk, J.M. Crosslin, N.N. Troxclair, J.R. Anciso, G.G. Bester, J.D. Bradshaw, E.D. Bynum, L.A. Carpio, D.C. Henne, A. Joshi, J.E. Munyaneza, P. Porter, P.E. Sloderbeck, J.R. Supak, C.M. Rush, F.J. Willett, B.J. Zechmann, and B.A. Zens.....	12
Liberibacter Testing of 2011 Psyllids and Research Update J.M. Crosslin, J.A. Goolsby, and J.E. Munyaneza.....	17

Host / Pathogen Interaction

Relationship between Time of Infestation, Disease Development, and Tuber Yield A. Rashed, F. Workneh, J. Gray, L. Paetzold, and C.M. Rush	22
Zebra Chip Disease Severity and ' <i>Candidatus Liberibacter Solanacearum</i> ' Titer Load of the Potato Hosts Inoculated Throughout the Field Season A. Rashed, F. Workneh, L. Paetzold, J. Gray, C. Wallis, and C.M. Rush.....	27
Multilocus Sequencing Typing Markers for Genotyping and Population Genetic Analyses of ' <i>Candidatus Liberibacter Solanacearum</i> ' H. Lin, J. Glynn, Md S. Islam, A. Wen, and N.C. Gudmestad.....	32
Effects of Zebra Chip and Potato Psyllid on Potato Seed Quality J.E. Munyaneza, J.L. Buchman, B.E. Heilman, V.G. Sengoda, and D.C. Henne.....	37

Pathogen / Vector Management #1

Potato Psyllid and Zebra Chip Disease Management in South Texas D.C. Henne, J.A. Goolsby, T.E. Mirkov, and J.E. Munyaneza.....	41
---	----

Impact of Imidacloprid on the Feeding Behaviors of the Potato Psyllid C.D. Butler, G.P. Walker, and J.T. Trumble	46
Evaluation of Control Strategies for Determining When to Apply Insecticides for Management of Potato Psyllid Infestations and Zebra Chip Incidence E.D. Bynum, C.M. Rush, and J. Guenther	51
Evaluating Current Chemical Control Strategies for Potato Psyllid in Relation to Zebra Chip Disease G.J. Michels, Jr., J.B. Bible, E.N. Jones, R.A. Lange, and J. Brazille	56
Behavioral Responses by Potato Psyllids to Agro-Chemicals S. Prager, K. Vaughn, N. Henderson, X. Martini, M. Lewis, and C. Nansen	61

Pathogen Detection

The Effects of Zebra Chip Disease Development and Bacterial Titer on Tuber Biochemical Properties in Relation to the Time of Infection A. Rashed, C.M. Wallis, A. Simmons, L. Paetzold, F. Workneh, and C.M. Rush	65
Using Hyperspectral Imaging in ZC Research C. Nansen, S.M. Prager, B. Qi, X. Martini, M. Lewis, and K. Vaughn.....	70
Development of PCR Assay Using SSR Primers for Detection and Genotyping of ' <i>Candidatus</i> <i>Liberibacter solanacearum</i> ' A. Wen, H. Lin, and N.C. Gudmestad	74
LAMP PCR Lights the Way for a Simple, Fast Method for Detection of Lso in Infected Potatoes and Psyllids A. Ravindran, J. Levy, E. Pierson, and D.C. Gross	79

Insect Biology / Monitoring

Development of a Sequential Binomial Sampling Plan for Psyllids in Potatoes C.D. Butler and J.T. Trumble	84
Sampling of Potato Psyllids S. Seibert, S. Prager, B. Qi, X. Martini, K. Vaughn, M. Lewis, C. Merritt, J. Gustafson, L. Davis, and C. Nansen	89
Using Biotyping to Establish Temporal and Spatial Relationships between Potato Psyllid Populations Colonizing Potatoes in Texas A. Ochoa, G. Schuster, B. Bextine, S. Nelson, and J.E. Munyaneza	92
Impacts of Psyllid Symbiont Communities on Their Hosts B.R. Bextine, H. Daymon, A. Nalian, and W. Hunter	97
Separating Biotypes and Populations of Potato Psyllids (<i>Bactericera cockerelli</i>) Using Melt Temperature Analysis and Inter-Simple Sequence Repeats R.I. Chapman and B.R. Bextine.....	102

Investigating Effects of “ <i>Candidatus Liberibacter Solanacearum</i> ” Infection on Psyllid Populations C. Tamborindeguy and P. Nachappa.....	107
--	-----

Pathogen / Vector Management #2

Efforts to Identify the Sex Pheromone of the Potato Psyllid C. Guédot, D.R. Horton, P.J. Landolt, J.E. Munyaneza, and J. Millar	112
Management of Zebra Chip of Potato with Chemistries Targeting the Plant or Pathogen R.D. French-Monar, A.F. Patton III, and C.R. Dabney.....	117
Repellency of Essential Oils against the Potato Psyllid, <i>Bactericera Cockerelli</i> (Sulc): An Alternative for Control? J. Diaz-Montano and J.T. Trumble.....	122
Effects of Potato Planting Dates on Psyllid Populations and Zebra Chip Incidence in Texas J. Trevino, G. Schuster, S.D. Nelson, A.P. Ochoa, and J. Munyaneza	127

Resistance / Germplasm Identification

Behavioral Responses of Adult Potato Psyllid and Transmission of <i>Candidatus Liberibacter psyllaourous</i> in Tri-Species Potato Germplasm R.G. Novy, C.D. Butler, B. Gonzalez, K.L. Manjunath, R.F. Lee, and J.T. Trumble	131
Further Studies on Host-Plant Tolerance to Zebra Chip J.C. Miller, Jr., D.C. Scheuring, J. Koym, D. Henne, J. Jifon, J.C. Levy, C. Tamborindeguy, and E.A. Pierson	134
Evaluating Cultivar Response to and Monitoring of Psyllid Populations in Nebraska R.M. Harveson and J.D. Bradshaw.....	137
Update on Potato Variety Screening Trial for Zebra Chip under Controlled Field Cage Conditions J.E. Munyaneza, J.L. Buchman, B.E. Heilman, V.G. Sengoda, G. Bester, R. Hoopes, C. Miller, R. Novy, and P. Van Hest.....	141
New Materials and Resistant Varieties in IPM Trials J.T. Trumble, R. Novy, C.D. Butler, C.M. Miller, G. Kund, J. Diaz-Montano, and W. Carson.....	144
Translocation and Quantification of ‘ <i>Candidatus Liberibacter solanacearum</i> ’ in Potato and Tomato J. Levy, A. Ravindran, D. Gross, and C. Tamborindeguy, and E. Pierson	149

Molecular Biology and Physiology

Enrichment and Characterization of “ <i>Candidatus Liberibacter Solanacearum</i> ” in Tomato Host J. Chen.....	154
---	-----

Zebra Chip Symptoms are Associated with Increased Phenolic, Pathogenesis-Related Protein, and Amino Acid Levels C.M. Wallis and J. Chen	159
A Comparison of Phage-Like Regions in ' <i>Candidatus</i> Liberibacter Solanacearum' and ' <i>Candidatus</i> Liberibacter Asiaticus' C.P. Johnson, Y.P. Duan, A. Wen, and N.C. Gudmestad	163
Zebra Chip Impact on Potato Production	
Zebra Chip Economics J. Guenther, G. Greenway, and J. Goolsby	168
Tomato Potato Psyllid and Liberibacter in New Zealand - Impacts and Research Programme Overview S.C. Ogden	173
The Impact of <i>Ca.</i> Liberibacter Infected Seed Tubers on Potato Production in New Zealand N. Berry, S. Thompson, N. Taylor, P. Wright, F. Shah, M. Walker, S. Beard, N. Jorgensen, R. Butler, S. Thompson, I. Scott, and A.R. Pitman	178
A Summary of Research Work on Potato Zebra Chip in the Central Part of Mexico O.A. Rubio-Covarrubias, M.A. Cadena-Hinojosa, and I.H. Almeyda-Leon	183



Attendees of the
2011 SCRI Zebra Chip Annual
Reporting Session
November 6-9, 2011

2011 SCRI ZC ANNUAL REPORTING SESSION

NOVEMBER
6-9, 2011

