**Project or Activity Designation and Number:** S-1068

**Project or Activity Title:** Integrated Pest Management of Pecan Arthropod Pests in the Southern U.S.

**Administrative Advisor(s):** Henry Fadamiro, Auburn University, Auburn, AL

**Period Covered:** March 2, 2020 – March 12, 2021

**Annual Meeting Dates:** March 12, 2021 (virtual meeting)

**Participants:**

Angelita Acebes-Doria, University of Georgia, aacebes@uga.edu

David Shapiro-Ilan, USDA, david.shapiro@usda.gov

Ted Cottrell, USDA, ted.cottrell@usda.gov

Joe Laforest, University of Georgia, laforest@uga.edu

Charles Graham, Noble Foundation, cjgraham@noble.org

Charles Rohla, Noble Foundation, ctrohla@noble.org

Andrew Sawyer, University of Georgia, agsawyer@uga.edu

Rebecca Melanson, Mississippi State University, rebecca.melanson@msstate.edu

Michael Polozola, Louisiana State University, mpolozola@agcenter.lsu.edu

Tiffany Johnson, New Mexico State University, shimsham@nmsu.edu

Phil Mulder, Oklahoma State University, phil.mulder@okstate.edu

**Project or Activity Leadership:** Chair – Angelita Acebes-Doria (UGA); vice-chair – vacant; secretary – Ted Cottrell (USDA).

**Brief Summary of minutes of annual meeting:**

The 2021 annual meeting of the S-1068 ‘Integrated Pest Management of Pecan Arthropod Pests in the Southern U.S.’ was held virtually on March 12, 2021.

Leadership for the project was addressed. Due to the vacant vice-chair position, the project participants agreed that T. Cottrell (USDA) will move into the Chair position for the next year, C. Graham (Noble Foundation) will become the vice-chair and Andrew Sawyer (Univ. of GA) will become the secretary.

The site for the 2022 meeting, if held in person, will be in Las Cruces, NM and will be held in conjunction with the Annual Meeting of the Western Pecan Growers Association, March 6-8, 2022.

Reports by participants were provided for the different project objectives in a round table format allowing all participants an opportunity to present research results and/or pecan-related issues. Time was allotted for participants to ask questions of presenters. Presented information is included in the “Accomplishments and Impacts” section.

A healthy discussion was had concerning the project re-write that is due during this calendar year. Potential objectives were discussed. The project leadership will produce a draft of the new project and provide to the project participants for comment and input leading to a final draft.

Dwindling numbers of entomology participants from the different states was discussed. It was considered that the project may broaden its focus to include other disciplines. The role of plant pathologists studying *Xylella* in pecan and the important role of insect vectors of this serious disease could be a natural fit for this project. No final conclusions for inclusion of pecan researchers/extension personnel from other scientific disciplines were made.

 **Accomplishments and Impacts:**

Research during the prior year saw several experiments against a wide range of serious pecan pests. These projects concerned: a sprayable pheromone for hickory shuckworm mating disruption (Cottrell, USDA); Grandevo biological insecticide for pecan aphids/pecan weevil (Shapiro-Ilan, USDA), establishing endophytic *Beauveria bassiana* and *Metarhizium brunneum* in pecan seedlings/trees for pest control (Shapiro-Ilan, USDA), using the *Cydia pomonella* granulosis virus against the hickory shuckworm (Shapiro-Ilan, USDA), survey, sampling and results of management trials for ambrosia beetles in GA (Acebes-Doria, UGA), current research on brown marmorated stink bug (Acebes-Doria, UGA), current research on pecan aphid control using commercially available products (Acebes-Doria, UGA), potential to use insecticidal netting on trunks to control pecan weevil (Acebes-Doria, UGA/Cottrell, USDA), impact of pecan hedging on arthropod pests of pecan (Acebes-Doria, UGA), progress developing web-based apps for pecan (Acebes-Doria, UGA), update on the status of the PecanIPMpipe (Laforest, UGA), Noble Foundation will retain pecan research activities with an emphasis on regenerative agriculture (Graham, Nobel Foundation), bud moth efficacy trials (Sawyer, UGA).

**Publications:**

Acebes-Doria, A. L., and P. L. Halliday. 2020. Insecticide Efficacy Against Pecan Aphids and Pecan Leaf Scorch Mites, 2018. Arthropod Management Tests 45: tsaa087.

Acebes-Doria, A., P. Halliday and A. Monterosa. 2021. Field Guide to Agriculturally Important Ambrosia Beetles in the Eastern US (Accepted). University of Georgia Cooperative Extension Service

Acebes-Doria, A., L. Wells, A. Sawyer, J. Brock and W. Hudson. 2020. Pecan Production Management Calendar. University of Georgia Cooperative Extension Service, Circular 1174.

Cottrell, T.E. 2020. Obscure scale: A stealthy pest of pecan. Pecan South. 52(12):24-30.

Cottrell, T.E., Aiken, M.J., Thoms, E.M., Phillips, T. 2020. Efficacy of sulfuryl fluoride against fourth-instar pecan weevil (Coleoptera: Curculionidae) in pecans for quarantine security. Journal of Economic Entomology. 113(3):1152-1157. <https://doi.org/10.1093/jee/toaa021>

Cottrell, T.E. 2020. Hickory shuckworm: an almost season-long pest of pecan. Pecan South. 53:12-20.

Cottrell, T.E., R.R. Balusu, E. Vinson, B. Wilkins, H.Y. Fadamiro and P.G. Tillman. 2020. Effect of trap color and residual attraction of a pheromone lure for monitoring stink bugs (Hemiptera: Pentatomidae). J. Entomol. Sci. 55: 437-447. https://doi.org/10.18474/079-8004-55.4.437

Cottrell, T.E.  2020.  Stink bugs all around.  Pecan South 53: 6-13.

Cottrell, T.E., M.J. Aikins, E.M. Thoms and T.W. Phillips.  2020.  In-shell fumigation to control larval pecan weevil.  The Pecan Grower 32: 66-72.

Cottrell, T.E. and B.W. Wood.  2021.  Gibberellic acid decreases *Melanocallis caryaefoliae* (Hemiptera: Aphididae) population density and chlorotic feeding injury to foliage in pecan orchards.  Pest Management Science 77:1512-1519.

Cottrell, T.E.  2021.  Overwintering insect pests of pecan.  Pean South 54: 24-26.

Fu, Y., Wang, W., Chen, C., Shan, S., Wei, X., Liu, Y., Shapiro-Ilan, D., Gu, X., Hu, B., Yoshiga, T., and Ruan, W. 2020. Chemotaxis behavior of *Steinernema carpocapsae* in response to *Galleria mellonella* (L.) larvae infected by con- or hetero-specific entomopathogenic nematodes. Biocontrol Science and Technology. In Press. Accepted 11-14-2020.

Gulzar, S., Usman, M., Wakil, W., Gulcu, B., Hazir, C., Karagoz, M., Hazir, S., Shapiro-Ilan, D. 2020. Environmental tolerance of entomopathogenic nematodes differs among nematodes arising from host cadavers versus aqueous suspension. Journal of Invertebrate Pathology. 175: 107452.

Haelewaters, D., Hiller, T., Kemp, E.A., van Wielink, P.S., Shapiro-Ilan, D.I., Aime, C.M., Nedved, O., Pfister, D.H., Cottrell, T.E. 2020. Mortality of native and invasive ladybirds co-infected by ectoparasitic and entomopathogenic fungi. PeerJ *PeerJ* ,:e10110 [https://doi.org/10.7717/peerj.10110](https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fdoi.org%2F10.7717%2Fpeerj.10110&data=04%7C01%7C%7C4062189587704677857608d8e8854619%7Ced5b36e701ee4ebc867ee03cfa0d4697%7C0%7C0%7C637515006397374660%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=hxXfES8t2BMM0vOWbVtkAfOzA5YP1x0GBHdIPk0TNp0%3D&reserved=0)

Hudson, W., A. Acebes-Doria, A. Sawyer and J. Brock. 2021. UGA Pecan Commercial Spray Guide (Bulletin 841): Version 2021. University of Georgia Cooperative Extension Service.

Kaplan, F., Perret-Gentil, A., Giurintano, J., Stevens, G., Erdogan, H., Schiller, K.C., Mirti, A., Sampson, E.M., Torres, C., Sun, J., Lewis, E., Shapiro-Ilan, D.I., 2020. Conspecific and heterospecific pheromones stimulate dispersal of entomopathogenic nematodes during quiescence. Scientific Reports. 10: 5738.

Kaplan, F., Shapiro-Ilan, D., Schiller, K.C. 2020. Dynamics of entomopathogenic nematode foraging and infectivity in microgravity. NPJ Microgravity6:20, [https://doi.org/10.1038/s41526-020-00110-y](https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fdoi.org%2F10.1038%2Fs41526-020-00110-y&data=04%7C01%7C%7C4062189587704677857608d8e8854619%7Ced5b36e701ee4ebc867ee03cfa0d4697%7C0%7C0%7C637515006397364706%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=VSk%2B3ATJO5s6bZz1orcv96LVwsbYPjpSIswonnJOGXc%3D&reserved=0)

Koppenhöfer, A.M., Shapiro-Ilan, D.I., Hiltpold, I. 2020. Entomopathogenic nematodes in sustainable food production. Frontiers in Sustainable Food Systems 4, 125. [https://doi.org/10.3389/fsufs.2020.00125](https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fdoi.org%2F10.3389%2Ffsufs.2020.00125&data=04%7C01%7C%7C4062189587704677857608d8e8854619%7Ced5b36e701ee4ebc867ee03cfa0d4697%7C0%7C0%7C637515006397374660%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=Eh8ebFx0lMdwHBZS1l8vQEVCCI25wVxYZoRcUBdfvi0%3D&reserved=0)

Koppenhöfer, A.M., Shapiro-Ilan, D.I., Hiltpold, I. 2020. Advances in the use of entomopathogenic nematodes (EPNs) as biopesticides in suppressing crop insect pests, Chapter 10, In: N. Birch and T. Glare (Eds.) Biopesticides for sustainable agriculture, Burleigh Dodds Science Publishing, Cambridge, UK, Pp. 1-38.

Ramakuwela*, T*., Hatting, J., Bock, C., Vega, F.E., Wells, L., Mbata, G.N., Shapiro-Ilan, D.I. 2019. Establishment of *Beauveria bassiana a*s a fungal endophyte in pecan (*Carya illinoinensis*)seedlings and its virulence against pecan insect pests. Biological Control 104, 104102. [https://doi.org/10.1016/j.biocontrol.2019.104102](https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fdoi.org%2F10.1016%2Fj.biocontrol.2019.104102&data=04%7C01%7C%7C4062189587704677857608d8e8854619%7Ced5b36e701ee4ebc867ee03cfa0d4697%7C0%7C0%7C637515006397364706%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=MJnbKZDKEDB646ADpkTSRZMiIUAJnKRphQWcQWzMzAQ%3D&reserved=0).

Sawyer A. and A. Acebes-Doria. 2020. Insect Pests of Nonbearing Pecan Trees. University of Georgia Cooperative Extension Service, Circular 1228.

Sawyer, A. and A. Acebes-Doria. 2020. Beneficial Insects in Pecan Trees. University of Georgia Cooperative Extension Service, Circular 1229.

Shapiro-Ilan, D.I., Kaplan, F., Oliveira-Hofman, C., Schliekelman, P., Alborn, H.T., Lewis, E.E., 2019. Conspecific pheromone extracts enhance entomopathogenic infectivity. Journal of Nematology. 51, e2019-82. DOI: 10.21307/jofnem-2019-082.

Shapiro-Ilan, D. I., Hazir, S., and Glazer, I.2020.Advances in use of entomopathogenic nematodes in IPM, In: Integrated management of insect pests: Current and future developments, M. Kogan and E. A. Heinrichs (Eds.), Burleigh Dodds Science Publishing, Cambridge, UK, Pp. 649 – 678.

Shapiro-Ilan, D.I., Oliveira-Hofman, C., and Kaplan, F. 2020. Specialized pheromones can boost the ability of beneficial nematodes to control pecan weevil and other pests. The Pecan Grower 23(5): 25-33.

Shapiro-Ilan, D.I., Ramakuwela, T., Bock, C., Hatting, J., Vega, F.E., Wells, L., and Mbata, G.N. 2020. Initial Studies on beneficial fungi that can live inside pecan trees and provide protection against insects and diseases. The Pecan Grower 23(5): 50-58.

Slusher, K.S., T. Cottrell and A.L. Acebes-Doria. Impacts of aphicides on pecan aphids and their parasitoids in pecan orchards. Insects. 2021 <https://doi.org/10.3390/insects12030241>

Slusher, K.S., W. Hudson and A.L. Acebes-Doria. Multi-site seasonal monitoring of pecan aphids and their parasitoids in commercial pecan orchards. 2021 The Pecan Grower (Submitted)

Monterrosa, A, B.R. Blaauw, A.L. Acebes-Doriaand S.V. Joseph. Influence of placement and age on ethanol bait attractiveness to ambrosia beetles (Coleoptera: Curculionidae). Journal of Economic Entomology (*In Review*)

Wakil, W., Abdullah, M.T., Al-Sadi, A.M., Shapiro-Ilan, D. 2020. Synergistic interactions between two invertebrate pathogens: an endophytic fungus and an externally applied bacterium. Frontiers in Microbiology. 11, 522368. [https://doi.org/10.3389/fmicb.2020.522368](https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fdoi.org%2F10.3389%2Ffmicb.2020.522368&data=04%7C01%7C%7C4062189587704677857608d8e8854619%7Ced5b36e701ee4ebc867ee03cfa0d4697%7C0%7C0%7C637515006397384616%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=5yN4pxD7WMmeNxYrwtvmHTYmwQ1YzQ8geCgXr6d68K0%3D&reserved=0).

Wu, S. Toews, M.D., Hofman, C.O., Behle, R.W., Simmons, A.M. Shapiro-Ilan, D.I. 2020. Environmental tolerance of entomopathogenic fungi: a new strain of *Cordyceps javanica* isolated from a whitefly epizootic versus commercial fungal strains. Insects. 11, 711; doi:10.3390/insects11100711.

Tillman, P.G., M. Toews, B. Blaauw, A. Sial, T. Cottrell, E. Talamas, D. Buntin, S. Joseph, R. Balusu, H. Fadamiro, S. Lahiri and D. Patel. 2020. Parasitism and predation of sentinel eggs of the invasive brown marmorated stink bug, *Halyomorpha halys* (Stal) (Hemiptera: Pentatomidae), in the southeastern U.S. Biol. Cont. 145: 104247. <https://doi.org/10.1016/j.biocontrol.2020.104247>

**Submitted by:** Dr. Ted E. Cottrell, Research Entomologist

**Date Submitted:** March 18, 2021