WERA 1017 2019 Annual Report – Washington State

Reporting period 9-30-18 to 8-31-19

Our overarching goal is to disseminate integrated pest management (IPM) knowledge and foster adoption of IPM practices by building upon established, successful extension projects and developing new and improved modalities for outreach and education, working across disciplines and geographic regions to achieve educational synergies and reduce duplication of effort while increasing knowledge and practice of IPM among agricultural and urban pest management practitioners.

Agronomic Crops

Objective 1: Increase grower skills at identifying and controlling mayweed chamomile, rattail fescue, Russian thistle, Italian ryegrass (75%)

- 1 podcast devoted to Italian Ryegrass, several news bulletins devoted to each weed, 2 new extension publications (rattail fescue and Italian ryegrass)
- Ultimate Weed Management Checklist published
- Increase grower knowledge of herbicide mechanisms of action (MOAs) and awareness of resistance (66%)
- 4 podcasts and an entirely new website devoted to resistance management

Objective 2: Increase knowledge of IPM tactics

- 12+ articles on IPM tactics including scouting, diagnostics, integrating new technologies, and non-chemical pest/weed controls
- Increase understanding of pollinator protection/methods (66%)
- 3 presentations were made to WA alfalfa growers, 1 to growers across the nation, and 1 to staff of the US EPA

Objective 3: Industry feedback to IPM Team about needs and willingness to adopt IPM strategies (50%)

- A survey of alfalfa seed growers was conducted in partnership with the WSU Social and Economic Sciences Research Center (SESRC) in Spring 2017 (end of previous project year); data were analyzed in early FY 2018 and a followup survey inFY 2019 will quantify changes in knowledge and behaviors.

Priority Area: Animal Agriculture

Objective 1: Increase knowledge of IPM tactics incorporating available and emerging chemical and non-chemical methodologies (80%)

- Presentations made at the Pacific Shellfish Growers annual meeting in September 2018.
- Decrease turbidity of sediment and water clarity resulting from control of burrowing shrimp (35%)
- Due to increased regulations on efficacious management tools, control of this pest remains difficult; research and extension continue.

Objective 2: Evolving IPM recommendations based on grower experience/feedback (66%)

- Two-way communication continues in an active partnership with growers on management of shrimp pests and eelgrass.

Priority Area: Communities

Objectives 1, 2 and 3: Among Hortsense users: 1) increase IPM knowledge (66%); 2) increase recognition of beneficial insect species and pollinators (75%); 3) increase recognition of invasive pests and their management (15%)

- Hortsense usage continues to grow and feedback indicates continued knowledge increases among users
- Release of new Beneficial Insect and Pollinator portal has fostered greater awareness of these species
- Invasive pests descriptions and photos are being added and have some user exposure; portal to be developed in FY2019

Priority Area: Specialty Crops

Summary of Objectives: Increase knowledge of IPM tactics including pest/beneficial ID, virus/vector ID, sampling, mating disruption, application methods, fungicide MOAs, and resistance managment; obtain industry feedback about needs and willingess to adopt IPM strategies (66%)

- Oral, written, and electronic outreach have increased knowledge of novel control methods for codling moth, pear psylla and stink bug in tree fruit.
- Identification and management of tipworm, aquatic weeds, and storage rot diseases of cranberry were discussed in a field day and newsletter
- Grassroots outreach on vegetable grafting took place in multiple western WA venues as well as to large-scale audiences at the NWREC field day (July 12, 2018) in Puyallup and American Society for Horticultural Science Conference (July 30-August 3, 2018) in WA DC
- Feb 27, 2019 Fungicide Resistance Management Workshop and March 6, 2019 Washington Advancements in Viticulture and Enology (WAVEx) events for grape growers reached capacity audiences of influential growers who are actively interested in this topic and promoting it among their fellow growers
- Formal surveys by WSU SESRC were conducted among wine grape, onion, and potato growers toward the end of FY17 and start of FY18; these results will be compared with followup surveys in FY19 to assess changes in knowledge and behavior

Priority Area: Pollinator Health

Objective 1: Increase understanding among beekeepers about varroa mite management and initiate sampling regimen (75%)

- Following extensive outreach in FY2017, Hopkins was able to work with beekeepers to monitor, chart, and predict status of the pest mite populations
- Outreach continues and sampling is increasing among beekeepers via training and peer-to-peer interaction on the topic

Objective 2: Increase knowledge among alfalfa seed producers about pollinator protection in an IPM context (66%)

- Presentations to Washington Alfalfa Seed Growers and Western Alfalfa Seed Growers Association and subsequent surveys indicate increases in both knowledge of and adoption of IPM tactics

Objective 3: WA's Managed Pollinator Protection Plan in alfalfa seed leads the way for MP3s in other states (100%)

- Numerous other states/crops have utilized our MP3 as a model: https://s3.wp.wsu.edu/uploads/sites/2168/2017/10/alfalfa-seedmp3.

Bonus Objective: Foss co-chairing a bumble bee census workshop in June 2019 to reach citizen scientists

Priority Area: Pesticide Applicators

Objective 1: Increase IPM knowledge on the part of urban pesticide applicators (64%)

- Urban pesticide applicator education including license recertification courses continued in FY18, with to-capacity classes conducted throughout the winter in a variety of western Washington locations
- Workshops in sustainable lawn and turf pest management were developed and attended

Objective 2: Develop IPM plans based on field assessments (50%)

- This objective got underway in FY18 and will continue through anticipated completion in FY19

TOTAL NUMBERS FOR PROJECT*:

1. 14 Peer Reviewed Publications
2. 7 Non Peer Reviewed Publications
3. 25 Presentations
4. >15,000 Total People Reached

*This does not include 14 newsletter articles, 12 websites maintained/expanded, 12 podcasts, 7 curricula, 13 events, and countless tweets and Facebook posts.

What opportunities for training and professional development has the project provided?

Graduate and undergraduate students receiving mentorship from our EIPM Team as they conducted IPM Extension outreach during this reporting period included (name, degree program, mentor):

• Jonathan O'Hearn, PhD, Walsh
• Adrian Marshal, PhD, Beers
• Adekunle Adasanya, PhD, Walsh
• Jacob Fischer, MS, Lyon
• Alexa McDaniel, PhD, Moyer
• Pinki Devi, PhD, Miles
• Abagail Attavar, PhD, Miles
• James Hepler, PhD, Beers

Moyer's "Viticulture Intern Boot Camp" (May 30, 2019) specifically targeted the next generation of grape growers, training them in IPM principles including pest and disease identification and designing of IPM programs.

Miles' "train the trainer" and K-12 curricula described in the Other Products section of this report provided training and mentorship for youth and adults.

Graduate students, postdoctoral researchers, and technical staff attended professional conferences and workshops in their field including those of the Entomological Society of America, American Phytopathological Society, and Weed Science Society of America.

How have the results been disseminated to communities of interest?
In addition to the publications, conference presentations, and other outreach materials cited in the Products and Other Products sections:

- Walsh hosted members and guests of the national Hop Research Council at WSU Prosser Irrigated Agriculture Research and Extension Center (IAREC) July 24-25, 2018 for presentations and a tour of the research hop yards, greenhouses, drying faclities, laboratory, brewing facilities and Clean Plant Center Northwest.
- Walsh held an alfalfa seed field day in June 2018 and will hold another June 18, 2019, in Touchet.
- Patten conducted a Cranberry Field Day in Long Beach, WA, at the Pacific Coast Cranberry Research Facility on August 1.
- Lyon's student (Fischer) has developed presentations on his work in controlling rush skeletonweed during fallow and is in the process of presenting them to a variety of target audiences interested in weed control in small grains.
- Beers WA-SIR and BMSB programs received print and broadcast media coverage.
- Waters hosts and/or participates in several onion, potato, and carrot field days annually.

What do you plan to do during the next reporting period to accomplish the goals?

- Walsh will work with alfalfa seed growers across the west to enhance pollinator protection in an IPM context.
- Lyon will focus on herbicide resistance and harvest weed seed control.
- Foss will contract with a programmer to create a portal for Invasive Species on the Hortsense website.
- Beers will expand her sterile insect reslease (WA-SIR) program and assess results in codling moth management as well as maintaining her BMSB location website.
- Moyer will continue her work in fungicide resistance management on multiple fronts including face-to-face conferences and field days, social media, and printed and electronic resources.
- O'Neal will produce a revision of IPM field guides for wine grapes and hops.
- Waters will focus on integrating disease (viral, bacterial, fungal) management with arthropod management, advancing varieties with improved pest resistance, and educating onion, potato, and carrot growers on pest management implications of their fertility programs.
- Miles will expand her work in vegetable grafting as a means for disease management, including additional train-the-trainer programs.
- Hopkins will conclude his varroa mite sampling and awareness training and assess beekeeper adoption of the process.
- Foss will produce two training videos on sustainable landscape practices and four training modules for ecoPRO Sustainable Landscape Professional certification.

Target Audience
Audiences reached during this period included:

- hop growers, researchers, merchants, and brewers interested in mite management and miticide resistance, management of downy and powdery mildews in a whole-farm IPM

context, efficacies of newer miticides and insecticides, and interactions between production activities (including irrigation and nutrient inputs) and pest management
- mint growers and end users seeking ways to monitor for mint root borer and integrate its treatment into their IPM program
- citizen scientists with an interest in identifying, monitoring, and protecting bumble bees
- growers of alfalfa produced for seed interested in balancing protection of native and managed pollinators with pest management
- regulatory agencies seeking understanding of native and managed pollinators and ways of protecting them
- growers of wheat and other small grains interested in traditional and novel weed control methodologies including weed seed control and use of tillage in an integrated weed management program
- grape growers and viticulture students seeking training on field scouting, identification of diseases, fungicide resistance management, and designing sustainable spray programs
- tree fruit (including pear, cherry, apple) growers seeking to improve control of pear psylla, codling moth, and brown marmorated stink bugs in their orchards by incorporating novel (including non-chemical) IPM tactics
- beekeepers concerned about Colony Collapse Disorder willing to monitor for and control varroa mites
- shellfish producers seeking ways to control burrowing shrimp, decrease sediment turbidity, and manage Japanese eelgrass in an integrated program
- cranberry growers concerned about the rise of tipworm populations and increasing incidence of storage rots
- growers of high-value vegetable row crops interested in incorporating grafting as a means of increasing pest resistance properties, as well as educators at all levels wishing to learn grafting techniques and teach them to others
- growers of onions, potatoes, and carrots seeking best management practices for newer pests and diseases in their crops
- homeowners and Master Gardeners wishing to expand their knowledge of IPM and learn about conservation and identification of beneficial arthropods
- professional pesticide applicators seeking current knowledge and certification in sustainable management of lawn, turf, and other landscape pests in urban environments
- K-12 students taking part in hands-on workshops
- undergraduate and graduate university students working with our team members to provide outreach education to the above audiences

PUBLICATIONS/PRESENTATIONS/WEBSITES

Barbour, J.D., D.G Alston, D.B Walsh, M. Pace, & L.M. Hanks. 2019. Mating Disruption for Managing Prionus californicus (Coleoptera: Cerambycidae) in Hop and Sweet Cherry. J. Econ Entomol. https://doi.org/10.1093/jee/toy430

Adesanya, A.W., E. Franco, D.B. Walsh, L.C. Lavine, M.D. Lavine, & F. Zhu. 2018. Phenotypic and Genotypic Plasticity of Acaricide Resistance in Populations of Tetranychus urticae (Acari: Tetranychidae) on Peppermint and Silage Corn in the Pacific Northwest. J. Econ. Entomol. https://doi.org/10.1093/jee/toy303

Wu M, Adesanya AW, Morales MA, Walsh D, Lavine L, Lavine M, Zhu F. 2018 Multiple acaricides resistance and underlying mechanisms in Tetranychus urticae on hops. J.Pest Sci. https://doi.org/10.1007/s10340-018-1050-5

O'Hearn, J., & D.B. Walsh. 2018. Pumpkin as an alternate host plant for laboratory colonies of grape mealybug (Pseudococcus maritimus). J. Econ. Entomol. https://doi.org/10.1093/jee/toy003

Walsh, D.B. 2019. Integrated Pest Management of Arthropods on Hops: 2018 Report. American Hop Convention, Monterey, CA. January.

O'Neal, S.D. and D.B. Walsh. 2018. Monitoring and Management of Mint Root Borer on Mint: 2018 Results and 2019 Proposal. Presented to Mint Industry Research Council, San Antonio, TX, January 22, 2019.

O'Neal, S.D., J. O'Hearn, and D. Walsh. 2018. Monitoring Mealybugs for Potential Imidacloprid Resistance and Buffalo Treehopper for Imidacloprid Susceptibility. Presented to Wine Research Advisory Committee, Prosser, WA, August 7, 2018.

O'Neal, S.D. and D. Walsh. 2018. Why are we having spider mite outbreaks in Washington vineyards? Presented to Wine Research Advisory Committee, Prosser, WA, August 7, 2018.

O'Neal, S.D. 2019. Integrated Pest Management, WSU Extension. Website maintained. http://ipm.wsu.edu

Walsh, D.B. 2019. Enhancing and Protecting Populations of Alfalfa Seed Predators. Western Alfalfa Seed Growers Association Convention. New Orleans, LA. January 28.

Walsh, D.B. 2019. Keeping the Buzz While Killing the Bugs. Environmental Protection Agency, Pesticide Division Meeting. Arlington, VA. February 7.

Booth, S.R., K. Patten, L. New. 2018. Response of estuarine benthic invertebrates to field applications of insecticide. Estuarine, Coastal and Shelf Science, Volume 218, 5 March 2019, Pages 86-94

Patten, K.D. 2018. Consequences of Zostera japonica management on estuarine fauna in Willapa Bay, Washington, USA. Journal of Experimental Marine Biology and Ecology.

Mallory-Smith, C., A.R. Kniss, D.J. Lyon, and R.S. Zemetra. 2018. Jointed goatgrass (Aegilops cylindrica): A review. Weed Sci. 66:562-573.

Lyon, D.J, M.E. Swanson, F.L. Young, and T. Coffey. 2018. Jointed goatgrass biomass and spikelet production increases in no-till winter wheat. Crop Forage Turfgrass Manage. doi:10.2134/cftm2018.04.0031.

Lyon, D.J., D.A. Ball, and A.G. Hulting. 2018. Rattail fescue: Biology and management in Pacific Northwest wheat cropping systems. (PNW613).

Hauvermale, A.L., K.N. Race, N.C. Lawrence, L. Koby, D.J. Lyon, and I.C. Burke. 2018. A mayweed chamomile growing degree day model for the Inland Pacific Northwest. (FS306E)

Foss, C.R. and D.G. James. 2018. Hortsense: Natural Enemies & Pollinators. New module. http://hortsense.cahnrs.wsu.edu/Search/SearchByNaturalEnemyAndPollinator.aspx

Walsh, D.B. 2019. Mealybugs, Leafrollers, and Grape Flea Beetles. Washington Winegrowers Convention and Trade Show. Feb. 6, 2019. Kennewick, WA.

Moyer, M.M. 2019. Fungicide Management. Washington Winegrowers Convention and Trade Show. Feb. 6, 2019, Kennewick, WA.

Lyon, Drew. 2018. Ultimate Weed Management Checklist. Washington State University Wheat & Small Grains. http://smallgrains.wsu.edu/ultimate-weed-management-checklist/ Published July 18, 2018.

Lyon, Drew. 2018. Italian Ryegrass Management in Eastern Washington. Washington State University Wheat & Small Grains. http://smallgrains.wsu.edu/italian-ryegrass-management-in-eastern-washington/ Published October 2, 2018.

Lyon, D.J., D.A. Ball, A.G. Hulting. 2018. RATTAIL FESCUE: BIOLOGY AND MANAGEMENT IN PACIFIC NORTHWEST WHEAT CROPPING SYSTEMS. Pacific Northwest Extension Publication 613. 12 pp. http://cru.cahe.wsu.edu/CEPublications/PNW613/PNW613.pdf

Bomberger, R. and D. Lyon. 2018. 2018 Growing Season Clinic Sample Diagnosis. Washington State University Wheat & Small Grains. http://smallgrains.wsu.edu/2018-growing-season-clinic-sample-diagnosis/ Published September 5, 2018.

Van Vleet, S. and D. Lyon. 2018. Effective Pre-emergence Management of Winter Annual Grasses. Washington State University Wheat & Small Grains. http://smallgrains.wsu.edu/effective-pre-emergence-management-of-winter-annualgrasses/ Published September 12, 2018.

Lyon, D., D. Appel, M. Thorne, H.C. Wetzel, J. Fischer, I. Burke, C. McFarland, R. Zuger. 2018. 2018 WSU Weed Control Report. Washington State University Extension. 60 pp. http://smallgrains.wsu.edu/wp-content/uploads/2019/01/Updated-2018-WSU-Weed-Control-Report.pdf

Lyon, D. 2019. Australia and Harvest Weed Seed Control. Washington State University Wheat & Small Grains http://smallgrains.wsu.edu/australia-and-harvest-weed-seed-control/ Published January 25, 2019.

Bomberger, R. and D. Lyon. How to get the most out of a plant problem diagnostic sample. Washington State University Wheat and Small Grains http://smallgrains.wsu.edu/how-to-get-the-most-out-of-a-plant-problem-diagnostic-sample/ Published February 28, 2019

Murray, T. and D. Lyon. 2019. No Shortcuts on Green Bridge Management for Soilborne Diseases. Washington State University Wheat & Small Grains. http://smallgrains.wsu.edu/no-shortcuts-on-green-bridge-management-for-soilbornediseases/ Published 3-27-2019.

Eigenbrode, S. and D. Lyon. 2019. Cereal Grass Aphid (Metopolophium festucae cerealium) in the Pacific Northwest. Washington State University Wheat & Small Grains. http://smallgrains.wsu.edu/cereal-grass-aphid-metopolophiumfestucae-cerealium-in-the-pacific-northwest/ Published 4-2-19.

Lyon, D. 2019. Herbicide Resistance Resources. Washington State University Wheat & Small Grains. http://smallgrains.wsu.edu/herbicide-resistance-resources/ Published 4-30-2019

Cooper, W. R., D. R. Horton, M. Wildung, A. Jensen, J. Thinakaran, D. Rendon, L. Nottingham, E. H. Beers, C. H. Wohleb, D. G. Hall, and L. L. Stelinski. 2019. Host and non-host "whistle stops" for psyllids: Molecular gut content analysis by high throughput sequencing reveals landscape-level movements of Psylloidea (Hemiptera). Environ. Entomol. (Forum) 48: https://doi.org/10.1093/ee/nvz038.

Gallinato, S. P., K. R. Gallardo Llanos, E. H. Beers, and A. J. Bixby-Brosi. 2019 Developing a management strategy for little cherry disease: The case of Washington State. Phytopath. https://doi.org/10.1094/PDIS-12-18-2235-SR

Beers, E. H., A. T. Marshall, J. Hepler, and J. M. Milnes. 2019. Prospects for integrated pest management of brown marmorated stink bug in Washington tree fruits. Outlooks Pest Manag. 30(1), 25-32. https://doi.org/10.1564/v30_feb_07

Schmidt-Jeffris, R. A., C. Duso and E. H. Beers. Insect pests of fruit: mites. Chap. 20. In X. Xu and M. T. Fountain (eds.), Integrated management of insect pests and diseases of tree fruit. Burleigh-Dodds

Nottingham, L., Orpet, R., Greenfield, B. M., Beers, E. H. 2019. Chemical Control of Pear Psylla in Pear, 2018 (C). Arthropod Management Tests. 44(1). https://doi.org/10.1093/amt/tsz043

Nottingham, L., Orpet, R., Greenfield, B. M., Beers, E. H. 2019. Chemical Control of Pear Psylla in Pear, 2018. Arthropod Management Tests. 44(1), https://doi.org/10.1093/amt/tsz026

Orpet, R., Nottingham, L., Greenfield, B. M., Beers, E. H. 2019. Chemical Control of Pear Psylla in Pear (B). Arthropod Management Tests. 44(1), https://doi.org/10.1093/amt/tsz032

DuPont, T., E. H. Beers, L. Nottingham, G. G. Grove, A. Amiri, C. Daniels, T. Schmidt, J. Kangiser, M. Klaus, L. Taylor, G. Steffen, and W. Jones. 2019. 2019 Crop protection guide for tree fruits in Washington. Bull. EB0419, Washington State University Cooperative Extension, Pullman, WA.

Beers, E. H., K. Athey, T. Northfield, J. Brunner and D. Crowder. 2019. These Are the Drones You're Looking For: WA-SIR Project Year 1 Update. In 93rd Annual Orchard Pest & Disease Management Conference, 9-11 January 2019, Portland Hilton, Portland, OR.

Northfield, T. D., E. H. Beers, Brunner, J. F., D. W. Crowder, and V. P. Jones. 2019. Adapting SIR from Eradication to IPM: Issues to Consider. In 93rd Annual Orchard Pest & Disease Management Conference, 9-11 January 2019, Portland Hilton, Portland, OR.

Marshall, A. T. and E. H. Beers. 2019. One Flew Over the Shade Net: Developing Stink Bug Exclusion Tactics. In 93rd Annual Orchard Pest & Disease Management Conference, 9-11 January 2019, Portland Hilton, Portland, OR.

Hepler, J. and E. H. Beers. 2019. Fickle Flaps of Fate: Building a Better Stink Bug Trap. In 93rd Annual Orchard Pest & Disease Management Conference, 9-11 January 2019, Portland Hilton, Portland, OR.

Nottingham, L., Beers, E. H., Pear IPM Planning Meeting, "Pear psylla research findings from 2018 and strategies for 2019," Cashmere, WA. December 14, 2018.

Beers, E. H., Marshall, A., Milnes, J., Hepler, J., Washington State Tree Fruit Association Annual Meeting, "Invasive Species: The New Normal," Yakima, WA. December 5, 2018.

Nottingham, L., Beers, E. H., Washington Horticultural Expo Hort Show, "Pear Pest Management Research," Yakima, WA. December 5, 2018.

Beers, E. H., Crowder, D. W., Northfield, T. D., Washington State Tree Fruit Association Annual Meeting, "WA-SIR: update on the sterile codling moth release project in Washington," Yakima, WA. December 5, 2018.

Milnes, J. M., Beers, E. H., Entomological Society of America National Meeting, "Biological control of the brown marmorated stink bug in Eastern Washington," Vancouver, BC. November 14, 2018.

Hepler, J., Marshall, A., Milnes, J., Beers, E. H., Entomological Society of America National Meeting, "BMSB in the shrubsteppe: Parasitoids, purshia, and proteins," Vancouver, BC. November 14, 2018.

Marshall, A., Beers, E. H., Entomological Society of America National Meeting, "Exploiting migration behavior as a novel control tactic for stink bugs," Vancouver, BC. November 14, 2018.

Beers, E. H., Schmidt-Jeffris, R., Entomological Society of America National Meeting, "Preserving the legacy: The workhorse phytoseiids in tree fruits," Vancouver, BC. November 14, 2018.

Nottingham, L., Beers, E. H., Wilbur-Ellis Fieldman's Meeting, "Pear psylla chemical trials from 2017 and 2018," Wenatchee, WA. November 7, 2018.

Nottingham, L., Beers, E. H., Bugs and Brews, "Pear psylla research findings from 2018 and strategies for 2019," WSUTFREC, Cashmere, WA. November 1, 2018.

Nottingham, L., Beers, E. H., Northwest Fieldman's Association, "Pear pest management strategies for 2019 in the Wenatchee Valley," Wenatchee, WA. October 16, 2018.

Nottingham, L., Beers, E. H., Science in our Valley Seminar Series, "Sticky Situations: Pest Management Research in Pears," Wenatchee, WA. October 3, 2018.

Miles, C., P. Kreider, A. Attavar, P. Devi, and J. King. 2018. Guide for Hosting a Vegetable Grafting Workshop. Washington State University Extension. http://vegetables.wsu.edu/Grafting_Training_Information_Packet.pdf

Waters, T.D. 2019. Lygus bugs: Impact and Implications for PNW Potatoes. Washington Oregon Potato Growers Conference, January 23-25, 2019, Kennewick, WA.

O'Neal, S.D., C.R. Foss, D. Lyon, E. Beers, D. Walsh, M. Moyer, T. Waters, K. Patten, B.K. Hopkins, C. Miles. 2018. 2018 Quarter 3 Newsletter. Integrated Pest Management, WSU Extension. October 2018. https://ipm.wsu.edu/newsletter/2018-quarter-3/

O'Neal, S.D., E. Beers, C. Miles, K. Patten, C.R. Foss, B.K. Hopkins, D. Lyon, T. Waters. 2019. 2018 Quarter 4 Newsletter. Integrated Pest Management, WSU Extension. January 2019. https://ipm.wsu.edu/newsletter/2018-quarter-4/

O'Neal, S.D., D. Lyon, D.B. Walsh, M. Moyer, T. Waters, K. Patten, E. Beers, C. Miles, C.R. Foss. 2019. 2019 Quarter 1 Newsletter. Integrated Pest Management, WSU Extension. April 2019. https://ipm.wsu.edu/newsletter/2019-quarter-1/

Moyer, M.M. (ed.) 2018. Viticulture and Enology Extension News. Washington State University Viticulture and Enology Program. Fall 2018. http://s3-us-west-2.amazonaws.com/sites.cahnrs.wsu.edu/wpcontent/uploads/sites/66/2010/07/13154918/2018-Fall-VEEN-FINAL.pdf

Moyer manages the WSU Viticulture Extension Facebook page: www.facebook.com/WSU_Vit_Enol_Ext (1167 likes, 1309 followers as of 6-3-2019).

Moyer manages the WSU Viticulture Extension Twitter feed @WSU_Vit_Ext which has 417 followers

Lyon produced numerous Timely Topics bulletins on the WSU Extension Wheat & Small Grains website throughout the project year. Examples included:

- Proposed Changes for Use-Restricted Herbicides (http://smallgrains.wsu.edu/proposedchanges-for-use-restricted-herbicides/, 9-20-2018)
- Grasshopper Damage in Winter Canola (http://smallgrains.wsu.edu/grasshopper-damage-in-winter-canola/ , 10-15-18)
- Weeds Are Coming: Do You Know What Invades Your Field? (http://smallgrains.wsu.edu/weeds-are-coming-do-you-knowwhat-invades-your-field/ , 2-5-2019)
- A Word of Caution About Two New Weed Control Technologies (http://smallgrains.wsu.edu/a-word-of-caution-about-twonew-weed-control-technologies/ 3-25-19)
- Stripe rust forecasts, updates, and related topics (http://smallgrains.wsu.edu/2019-first-stripe-rust-forecast-and-2018-fungicide-and-variety-yield-loss-tests/ 3-25-19; http://smallgrains.wsu.edu/stripe-rust-forecast-and-update-march-22-2019/ 3-27-18; http://smallgrains.wsu.edu/stripe-rust-update-april-18-2019/ 4-18-19; http://smallgrains.wsu.edu/stripe-rustremains-at-very-low-levels/ 4-22-19)
- Pollinator Residual Time to 25% (http://smallgrains.wsu.edu/epa-releases-residual-time-to-25-bee-mortality-rt25-datareducing-pesticide-hazards-for-bees/ 4-8-19)
- Time to Check Canola for Cabbage Seedpod Weevil (http://smallgrains.wsu.edu/time-to-check-canola-for-cabbageseedpod-weevil/ 5-15-19)

EDUCATIONAL AIDS / CURRICULA

Moyer's team hosted a "Viticulture Intern Boot Camp" on May 30, 2019, dedicated to field scouting and identification of diseases.

Foss led WSU's partnership with the Xerces Society, Idaho Department of Fish and Game, Washington Department of Fish and Wildlife, Oregon State University, and Oregon Department of Agriculture in conducting project training for the Pacific Northwest Bumble Bee Atlas at WSU's research and extension center in Puyallup, scheduled for June 15, 2019.

Patten conducted a cranberry field day 8-1-18 at the Pacific Coast Cranberry Research Foundation offices in Long Beach.

Miles and her team created a lesson for K-12 students titled "Measuring Sweetness of Fruit," in which STEM students developed and tested their hypothesis. regarding sweetness of fruit. Students learned the concept of refraction, use of a refractometer, and how to formulate and test a scientific concept.

Foss developed and held a 2-day training for landscape professionals Oct 24-25, 2018, in cooperation with the Washington State Nursery & Landscape Association. The training included presentations and hands-on activities demonstrated over 200 sustainable practices.

Hopkins and the WSU Honey Bees and Pollinators team partnered with Fungi Perfecti to develop an outreach curriculum explaining how fungi can improve honey bee and pollinator health.

Lyon and his team organized the popular Wheat Academy held Dec 11-12, 2018. A sellout group of 75 attended this in-depth course on production and pest management topics, about half of which directly related to IPM.

Miles' team converted their Guide for Hosting a Vegetable Grafting Workshop into a K-12 classroom lesson, "The Science Behind Vegetable Grafting," in cooperation with WA state educators and the Washington Science and Teacher Association.

AUDIO / VIDEO

Lyon produced numerous Wheat Beat podcasts throughout the project year. Those specific to Extension IPM Objectives and not reported previously included:

- Herbicide-Resistant Weeds, http://smallgrains.wsu.edu/wsu-wheat-beat-episode-34/ (8-6-18)
- Hessian Fly Resistance http://smallgrains.wsu.edu/wsu-wheat-beat-episode-35/ (8-13-18)
- Italian Ryegrass Control http://smallgrains.wsu.edu/wsu-wheat-beat-episode-36/ (8-20-18)
- Screening for Root Rot Resistance http://smallgrains.wsu.edu/wsu-wheat-beat-episode-37/ (8-27-18)
- All About Aphids http://smallgrains.wsu.edu/wsu-wheat-beat-episode-39/ (9-10-18)
- Herbicide Resistance & Jointed Goatgrass http://smallgrains.wsu.edu/wsu-wheat-beat-episode-42/ (10-8- 18)
- A Day In The Life of a Plant Diagnostician http://smallgrains.wsu.edu/wsu-wheat-beat-episode-44/ (11-5- 18)
- Australian Weed Seed Control http://smallgrains.wsu.edu/wsu-wheat-beat-episode-47/ (12-17-18)
- A Mixed Bag for Stripe Rust and Eyespot http://smallgrains.wsu.edu/wsu-wheat-beat-episode-48/ (2-4-19)
- A Beer Can Height: A Closer Look at Australian Harvest Weed Seed Control http://smallgrains.wsu.edu/wsu-wheat-beatepisode-
- 49/ (2-18-19)
- Australian Innovation in Weed Control http://smallgrains.wsu.edu/wsu-wheat-beat-episode-51/ (3-18-19)
- Breeding Herbicide-Resistant Wheat http://smallgrains.wsu.edu/wsu-wheat-beat-episode-54/ (4-29-19) DATABASES

Hopkins outreach in varroa mite (honey bee pest) monitoring has resulted in a database indicating population presence that will serve as a tool for developing management programs among beekeepers

Beers' team continued their work in brown marmorated stink bug (BMSB) identification and awareness among agricultural producers and citizen scientists, including an extensive spatial database of BMSB sightings

Foss' bumble bee atlas work planned for June 2019 will result in a spatial database of these bees.