WASHINGTON TURFGRASS SEED COMMISSION
PROGRESS REPORT FOR 2020 PROJECTS

Project No.:______________________________

Title: Integrated Disease Management of Ergot in Kentucky Bluegrass

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Cooperators: Jory Iverson, Mike Hawman, David Prior

Reporting Period: July 2020-November 2020

Accomplishments:

Our first objective was to screen novel fungicide chemistries for ergot control during anthesis. Ergot incidence and severity was low in field plots at both locations and a significant effect of fungicide treatment was not detected in either trial, but a few trends were observed at both locations. Our second objective was to validate and a crowdsourced Ergot Alert Network that will enlist grass seed stakeholders in participatory research, disease monitoring, and predictive model development. During the 2020 season, 149 data points were collected and analyzed and ergot ascospores were detected during all sampling events. Overall, 93.3% of the data points agreed between rotating-arm spore samplers and the standard Burkard spore samplers. Rotating-arm spore samplers were also deployed near Paterson, WA, Echo, OR, and La Grande, OR as a preliminary test of the new system in commercial seed production fields. Field-testing in the 2019 and 2020 production seasons indicate that the rotating-arm spore samplers can perform as well as the Burkard spore samplers for detecting airborne ergot ascospores. Overall grower feedback was positive, and helpful suggestions were received that will be used towards developing improved rotating-arm samplers in the future. Additional traps will be offered to growers for the 2021 field season to help expand the monitoring network. This research contributes towards the development of comprehensive integrated disease management strategies for ergot in grass seed crops of Oregon and the Pacific Northwest.

Results:

Objective 1: Screen novel fungicide chemistries for ergot control during anthesis. Ergot incidence and severity was low in field plots at both locations and a significant effect of fungicide treatment was not detected in either trial ($P > 0.05$), but a few trends were observed at both locations. Plots treated with QuiltXcel or Miravis Neo exhibited the lowest incidence and severity of ergot at both locations, while plots treated with Aproach alone exhibited the highest ergot incidence and severity.

Objective 2: Validate and establish a crowdsourced Ergot Alert Network that will enlist grass seed stakeholders in participatory research, disease monitoring, and predictive model development. A total of 149 sampling events were performed during the first year of validation (Table 1). Ergot spores were detected in all 149 (100%) of the sampling events (Table 2) and results from the rotating-arm samplers were consistent with results from the Burkard spore sampler for 93.3% of the data points. The most false negatives were observed for the 3ft rotating-arm sampler (5 false negatives), followed by the 4ft rotating-arm sampler (3 false negatives) and the 2ft rotating-arm sampler (2 false negatives) (Table 2). Rotating-arm samplers set at collection heights of 2ft, 3ft, and 4ft were compared with the Burkard spore sampler, which collects at a height of 2ft. There were no statistical difference among collection heights and Burkard sampler ($P = 0.73$) (Table 3), indicating that rotating-arm samplers performed equally at different collection heights and were comparable to the Burkard spore sampler. It was noted that as the season progressed, operation of the rotating-arm samplers at 2ft heights were compromised by the canopy, so it will be recommended that the rotating-arm samplers are placed just above the expected canopy height at anthesis. Different sampling periods (3d, 4d, and 7d) were tested and compared with the standard Burkard spore sampler. Unlike 2021, there was no significant difference among sampling period ($P = 0.32$) (Table 4). For practical purposes, growers would be able to place a rotating-arm sampler in or next to their field for as little as three days or up to a week at a time, depending on crop phenology, logistics, or expected disease pressure.

Publications:

Kaur, N., Cating, R.A., Rondon, S.I., Scott, J.C., Alderman, S.C., Walenta, D.L., Frost, K.E., Hamm, P.B, and Dung, J.K.S.. 2019. Dispersal potential of ergot spores by insects foraging in perennial ryegrass fields in the Columbia Basin of Oregon and Washington. Crop, Forage, and Turfgrass Management. doi:10.2134/cftm2019.04.0020.

Cheng, Q., Dung, J.K.S., and Frost, K.E. 2019. Evaluation of fungicides for control of ergot on Kentucky bluegrass in Oregon, 2018. Plant Disease Management Reports 13:T001. doi: 10.1094/PDMR13.

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Instructions:

1. Record information for active and pending projects.
2. All current research to which principal investigator(s) and other senior personnel have committed a portion of their time must be listed whether or not salary for the person(s) involved is included in the budgets of the various projects.
3. Provide analogous information for all proposed research which is being considered by, or which will be submitted in the near future to, other possible sponsors.

Name (List PI#1 first)	Supporting Agency and Project #	Total $ Amount	Effective and Expiration Dates	% of Time Committed	Title of Project
	Current (Dung):				
Dung	California Garlic and Onion Research Advisory Board	$7,700	March 2020- February 2021	1%	Genetic diversity and pathogenicity of *Fusarium proliferatum* causing clove rot on garlic
Dung	Oregon Agricultural Research Foundation	$15,000	March 2020 – February 2022	1%	Development of a field-deployable assay for detecting ergot spores in grass seed production systems
Dung, Frost, Cheng, Walenta	Oregon Seed Council	$10,000	July 2020 - June 2021	1%	Crowd-Sourcing Disease Detection Networks for Enhanced IPM in Grass Seed Crops
Dung, Frost, Cheng, Walenta,	Washington Turfgrass Seed Commission	$26,000	July 2020- June 2021	1%	Integrated Disease Management of Ergot in Kentucky Bluegrass
C. Sullivan, J. Dung	Oregon Mint Commission	$14,959 (Dung: $2,820)	April 2019 – December 2021	0.5%	Evaluating the Efficacy of Cover Crops to Control Verticillium Wilt, Reduce Mint-Pathogenic Nematodes, and Improve Soil

Dung, Chang, Mahmud, Mahaffee, Jacobs, Greenway, Savory, du Toit, Sidhu, Stoll	USDA-NIFA SCRI	$2,999,364 (Dung: $655,067)	September 2020-August 2024	5%	A Systems Approach for Managing Bacterial Blight of Carrot (this proposal)
M. Lange, K. Vining, J. Dung	Mint Industry Research Council	$37,660 (Dung: $9,000)	July 2019 - June 2021	0.5%	Verticillium Control Through Natural Antifungal Terpenoids
Dung, Sagili	Oregon Agricultural Research Foundation	$12,483	March 2019 – February 2021	1%	Can Honey Bees Serve as Vectors of Bacterial Blight in Carrot Seed Crops of Central Oregon?
Dung	Mint Industry Research Council	$32,614	July 2019 – June 2020	1%	Identifying Economic Action Thresholds to Inform Verticillium Wilt Management Decisions
H. Pappu, J. Dung, C. Cramer, B. Nault, M. Havey	USDA-NIFA-SCRI	$3,291,766 (Dung: $449,946)	September 2018 – September 2022	2.0%	Managing Stakeholder-Prioritized Pests and Diseases Threatening the US *Allium* Industry
L. Trippe J. Dung	Mint Industry Research Council	$11,862 (Dung: $1,962)	July 2019 - June 2020	0.5%	Identifying Novel Solutions that Inhibit the Dispersal and Infectivity of Soil-borne (INSIDIOuS) Pathogens of Mint
Dung	California Fresh Carrot Advisory Board	$9,439	March 2020 – February 2021	1%	Evaluation of Bacteriophages for Bacterial Blight Control in Carrots
Dung, Frost	Eastern Oregon Kentucky Bluegrass Workgroup	$7,500	July 2020-June 2021	0.5%	Integrated Disease Management of Ergot in Kentucky Bluegrass
Dung, Spring, Sullivan	Eastern Oregon Kentucky Bluegrass Workgroup	$8,900	July 2020-June 2021	0.5%	Revisiting Plant Growth Regulator Rates Under Different Soil Moisture Conditions

Dung	Mint Industry Research Council	$5,066	July 2020 – June 2021	0.5%	Evaluation of Boost Biomes Biocontrol Formulations for Verticillium Wilt Suppression in Peppermint
	Pending (Dung):				
Dung, Frost,	Washington Turfgrass Seed Commission	$26,000	July 2021 – June 2022	1%	Controlling Ergot in Kentucky Bluegrass (*this proposal*)
L. Trippe J. Dung	Mint Industry Research Council	$15,244 (Dung: $11,753)	July 2021 - June 2022	0.5%	Identifying Novel Solutions that Inhibit the Dispersal and Infectivity of Soil-borne (INSIDIOuS) Pathogens of Mint
Dung	Mint Industry Research Council	$32,860	July 2021 – June 2022	1%	Identifying Economic Action Thresholds to Inform Verticillium Wilt Management Decisions
	Current (Frost):				
Charkowski, et al.	USDA-NIFA-SCRI	$2.5M	10/1/17 – 9/30/22	4%	Integrating next-generation technologies for blackleg and soft rot management in potato
Rosen, et al.	USDA-SCRI	$8.1M	9/1/18 – 8/31/22	4%	Enhancing soil health in U.S. potato production systems
Frost, Huseth, Anderson, Groves, Cooper	USDA-ARS State Partnership Program	$60,000	7/1/18-6/30/21	1%	Potato cultivar sensitivity to feeding of three Lygus species
Frost	Northwest Potato Research Consortium	$23,990	7/1/20 – 6/30/21	1%	Using next generation sequencing to characterize the total microbial community in soils associated with seed potato

Frost	Northwest Potato Research Consortium	$37,150	7/1/20 – 6/30/21	1%	Data mining for crop rotations that predict the occurrence of mefanoxam-resistant Pythium species
Karasev, Pavek, Frost	Northwest Potato Research Consortium	$25,808	7/1/20 – 6/30/21	1%	Monitoring PVY strains in the Othello and Hermiston trials
Cooper, Horton, Crowder, Frost	Northwest Potato Research Consortium	$44,174	7/1/20 – 6/30/21	1%	Molecular and landscape approaches to understanding beet leafhopper and potato purple top disease in the Columbia Basin
Woodhall, Frost, Tanaka	Northwest Potato Research Consortium	$30,000	7/1/20 – 6/30/21	1%	Developing collaborative modern diagnostic approaches for potato pest and pathogen detection and characterization for the Pacific Northwest
Frost	Oregon Potato Commission	$21,00	7/1/20 – 6/30/21	1%	Potato pathology seed lot trials and Extension program
Zasada, Gleason, MacGuidwin,	USDA-ARS State Partnership Program	$55,393	7/1/20 – 6/30/21	1%	Nematode community assessment as part of defining soil health
Mollov, Hammerschmidt, Rosenzweig, Kinkle, Frost	USDA-ARS State Partnership Program	$125,000	7/1/20 – 6/30/21	1%	Developing potato common scab management strategies based on *Streptomyces* spp. diversity from suppressive and non-suppressive sites
Karasev et al.	USDA-SCRI	$5.7M	9/1/20 – 8/31/24	1%	Development of sustainable system-based management strategies for vector-borne, tuber necrotic viruses in potato
Lukas, et al.	USDA-NNF	$246,000	1/1/2021-12/30/2024	1%	Growing opportunities: engaging graduate students in agricultural science through novel experiential learning approaches
	Pending (Frost):				

Frost	Northwest Potato Research Consortium	$35,00	7/1/21 – 6/30/21		Development of an assay to screen for fungicide resistant *Fusarium* species in potato field soil
Frost	Northwest Potato Research Consortium	$15,000	7/1/21 – 6/30/21		Predicting the occurrence of mefanoxam-resistant *Pythium ultimum* based on potato cropping rotations
Wheeler, et al.	Northwest Potato Research Consortium	$70,484	7/1/21 – 6/30/21		Comparison of potato yields, soil health, and pathogen loads in virgin and non-virgin soils.
Wheeler, et al.	Northwest Potato Research Consortium	$47,326	7/1/21 – 6/30/21		How much *Verticillium dahliae* is needed to cause disease and yield losses in the most popular potato varieties in the Columbia Basin?
Woodhall, Frost, Tanaka	Northwest Potato Research Consortium	$30,000	7/1/21 – 6/30/21	1%	Developing collaborative modern diagnostic approaches for potato pest and pathogen detection and characterization for the Pacific Northwest

APPENDIX.

Table 1. Ergot incidence and severity in Kentucky bluegrass cultivar 'Shamrock' following treatments with fungicides during anthesis[1]

	COAREC				**HAREC**				**Combined**			
	Incidence (%)		**Severity**		**Incidence (%)**		**Severity**		**Incidence (%)**		**Severity**	
Nontreated	6.3	± 2.6	8.8	± 3.9	11.0	± 3.8	5.5	± 1.9	8.6	± 4.0	7.1	± 3.3
Abound (15.5 oz.)	3.8	± 1.7	3.8	± 1.7	13.5	± 5.7	8.8	± 5.0	8.6	± 6.5	6.3	± 4.4
Aproach (6 oz.) + Propimax (4 oz.)	4.5	± 2.4	6.8	± 4.4	10.0	± 2.8	7.3	± 2.2	7.3	± 3.8	7.0	± 3.3
Aproach (9 oz.)	7.3	± 2.6	9.3	± 3.9	16.5	± 6.8	10.5	± 3.9	12	± 6.9	9.9	± 3.7
Aproach (9 oz.) + Propimax (4 oz.)	4.0	± 0.8	5.5	± 1.3	10.5	± 5.0	5.8	± 2.1	7.3	± 4.8	5.6	± 1.6
Miravis (3.8 oz.)	5.0	± 6.7	7.8	± 12.2	11.0	± 6.2	6.8	± 3.9	8.0	± 6.8	7.3	± 8.4
Miravis Neo (13.7 oz.)	3.3	± 3.4	3.3	± 3.4	8.0	± 4.9	4.0	± 2.4	5.6	± 4.7	3.6	± 2.8
QuiltXcel (14 oz.)	2.8	± 1.7	3.0	± 2.2	8.5	± 4.4	4.8	± 3.1	5.6	± 4.4	3.9	± 2.6
Tilt (8 oz.)	5.3	± 2.5	6.3	± 3.7	11.5	± 4.4	6.3	± 2.6	8.4	± 4.7	6.3	± 3.0
Trivapro (13.7 oz.)	5.3	± 3.6	6.8	± 4.0	9.0	± 6.6	4.8	± 3.6	7.1	± 5.3	5.8	± 3.7
***P*-value**	**0.64**		**0.29**		**0.56**		**0.30**		**0.55**		**0.06**	

[1] Ergot incidence and severity were determined based on the number of infected panicles and number of sclerotia per 50 (HAREC) or 100 (COAREC) panicles.

Table 2. Number of days on which ergot spores were detected or not detected using different rotating-arm sampling periods and heights and compared with a Burkard spore sampler.

Sampling Period	Sampling Height	Detected	Not Detected	False Negatives[1]
3 days	**Rotating-Arm (2ft)**	9	0	0
	Rotating-Arm (3ft)	9	0	0
	Rotating-Arm (4ft)	9	0	0
	Burkard (2ft)	9	0	0
4 days	**Rotating-Arm (2ft)**	17	0	2
	Rotating-Arm (3ft)	15	0	5
	Rotating-Arm (4ft)	15	0	3
	Burkard (2ft)	21	0	0
7 days	**Rotating-Arm (2ft)**	8	0	0
	Rotating-Arm (3ft)	9	0	0
	Rotating-Arm (4ft)	9	0	0
	Burkard (2ft)	9	0	0

[1] False negatives were defined as days on which ergot spores were not detected by a sampler but were detected by at least one other sampler during the same sampling period.

Table 3. Effect of different rotating-arm sampling heights (2ft, 3ft, and 4ft) on ergot spore collection and compared with a Burkard spore sampler.

Sampling Height	Mean Cycle Threshold Value[1]
Rotating-Arm (4ft) (*n*= 36)	26.20
Rotating-Arm (3ft) (*n*= 38)	25.50
Rotating-Arm (2ft) (*n*= 36)	25.39
Burkard (2ft) (*n*= 39)	25.34
***P*-value**	**0.73**

[1] A smaller cycle threshold value indicates that more spores were collected. Treatments followed by the same letters are not significantly different from each other using Tukey's test.

Table 4. Effects of different rotating-arm sampling periods (3d, 4d, and 7d) on ergot spore collection.

Sampling Period (number of samples)	Mean Cycle Threshold Value[1]
3d (*n*= 36)	23.41
4d (*n*= 78)	28.81
7d (*n*= 35)	24.61
***P*-value**	**0.32**

[1] A smaller cycle threshold value indicates that more spores were collected. Treatments followed by the same letters are not significantly different from each other using Tukey's test.