USING INFORMATION TECHNOLOGY TO ADVANCE INTEGRATED ERGOT DISEASE MANAGEMENT IN PERENNIAL GRASS SEED CROPPING SYSTEMS

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Introduction

Ergot is an important fungal disease of perennial ryegrass and Kentucky bluegrass in the Pacific Northwest (PNW). The ergot fungus can infect only unfertilized flowers of grasses, so timing of fungicide application(s) at the beginning and/or during the early stages of the flowering period are critical for successful ergot control in grass seed production fields. Fungicides can prevent infection but cannot cure the disease once the fungus has germinated and colonized the ovary of the flower. Growers are challenged with applying fungicides at the optimum time due to weather conditions, overall workload, and the variation in crop maturity and time of flowering for different cultivars. Multiple fungicide applications are often required to protect flowers during extended flowering stages.

In years when very few or no ergot spores are detected, growers could reduce the number of fungicide applications or even avoid fungicide application completely, thus saving approximately $14 to $35/acre/application. These treatment costs are based on 2014–2015 custom application rate estimates (application + product cost) for products registered for ergot control in grasses grown for seed. Please refer to the *2015 PNW Disease Management Handbook* (http://pnwhandbooks.org/plantdisease) for details.

Growers and consultants can more effectively manage disease problems with readily accessible information regarding potential for disease development. Information and communication technology continues to evolve, giving university Extension personnel the opportunity to utilize new platforms for the delivery of time-sensitive information and deployment of new decision-aid tools. The Ergot Team's objective for the *Ergot Alert Newsletter* was to develop an electronic alert system that would provide the PNW grass seed industry with timely and region-specific information regarding ergot spore production and crop development progress, in addition to providing ergot management recommendations for Kentucky bluegrass and perennial ryegrass seed crops.

Materials and Methods

In 2015, seven Burkard spore traps were deployed in three grass seed production regions east of the Cascade Mountain Range: Columbia Basin (Oregon and Washington), Grande Ronde Valley (northeast Oregon), and central Oregon (Table 1). Spore traps were used to collect continuous air samples from mid-April through late June in each area. Personnel collected the spore trap samples and performed trap maintenance on a weekly basis. Weather data were collected with data loggers within the field and/or obtained from AgriMet and AgWeatherNet weather stations located near the spore traps.

The weekly samples were examined at the USDA-ARS National Forage Seed Production Research Center in Corvallis, OR, using microscopic methods to detect and quantify ergot spores collected from each trap. Weekly spore trap counts were available within approximately 7–10 days.

The spore trap results were compared to weekly crop development observations made at each trap location to determine potential risk of ergot infection based on local inoculum pressure. Observations and results were compiled weekly/biweekly.

Table 1. Burkard spore trap monitoring site descriptions.

Site	County	Grass species	Cultivar	Planting date
PRG-1	Umatilla, OR	Perennial ryegrass	Multiple (cultivar trial)	Aug. 29, 2014
PRG-2	Umatilla, OR	Perennial ryegrass	Pavilion	Sep. 20, 2013
KBG-1	Benton, WA	Kentucky bluegrass	Arrowhead	Sep. 2, 2014
KBG-2	Benton, WA	Kentucky bluegrass	Arrowhead	Sep. 3, 2014
KBG-3	Union, OR	Kentucky bluegrass	Wildhorse	May 5, 2010
KBG-4	Union, OR	Kentucky bluegrass	Baron	April/May 2014
KBG-5	Jefferson, OR	Kentucky bluegrass	Multiple (cultivar trial)	Aug. 11, 2014

Ergot Alert Newsletters were distributed on a weekly/biweekly basis between May 13, 2015 and July 2, 2015. Information contained in the newsletters was intended to assist growers in field monitoring efforts to determine optimum timing for fungicide application(s), if needed. Due to differences in ergot spore production and rate of crop development, newsletters were tailored to each region. The regional newsletters were e-mailed directly to stakeholder distribution lists for each of the three production regions.

In total, the newsletters were sent to 61 recipients in central Oregon, 310 recipients in the Columbia Basin, and 65 recipients in the Grande Ronde Valley of northeastern Oregon. Newsletters were also posted online at OSU-HAREC, OSU-COARC, and OSU Extension-Union County websites.

An OSU Institutional Review Board-certified survey tool was developed to assess impact and perceived importance of the *Ergot Alert Newsletter*. The survey tool consisted of two components, including: (1) a preharvest survey tool to determine current ergot management practices and informational needs for improved ergot management, and (2) a postharvest survey tool to determine whether the newsletter improved stakeholder knowledge about ergot disease and management practices. The survey tool was designed as a paper-based survey, and an electronic version (Qualtrics) was made available online and via e-mail. The paper-based preharvest survey was deployed in May 2015 at the annual Hermiston Grass Seed Field day, followed by launch of the online version on May 27, 2015. The survey closed on September 4, 2015. The online postharvest survey was launched on September 4, 2015 and closed January 14, 2016.

Results and Discussion

Preharvest survey

The preharvest survey was completed by 22 respondents representing mostly crop consultants/field scouts (55%) and growers (45%), with a portion of the group also involved in seed cleaning (18%). Most respondents were from the Columbia Basin (50%) and central Oregon (40%).

Ergot was viewed as a moderately to highly important disease (3.6 on a scale of 1 to 5) for grass seed crops, with many comments indicating that significant yield loss can occur before harvest and that ergot makes harvest difficult and causes additional seed loss during cleaning operations. Others mentioned concerns for seed quality and disposal of ergot-infected pellets made from screening materials. Many respondents who indicated that ergot was not important were from the northern Columbia Basin of Washington, where ergot is not as much of a problem in dryland production systems.

Current ergot management practices in grass seed cropping systems rely on fungicide application (95% of respondents) to grass seed crops (Figure 1). Other common practices include crop rotation (57%), control of weed/volunteer grasses in rotational crops (48%), and propane flaming (43%). These results indicate that many growers are already implementing various cultural control practices in an effort to reduce ergot inoculum sources.

Fungicide use for ergot control ranged from one to four applications (median two applications) per growing season. The survey did not collect data related to fungicide use for other disease management needs. Information most often used by growers/consultants to

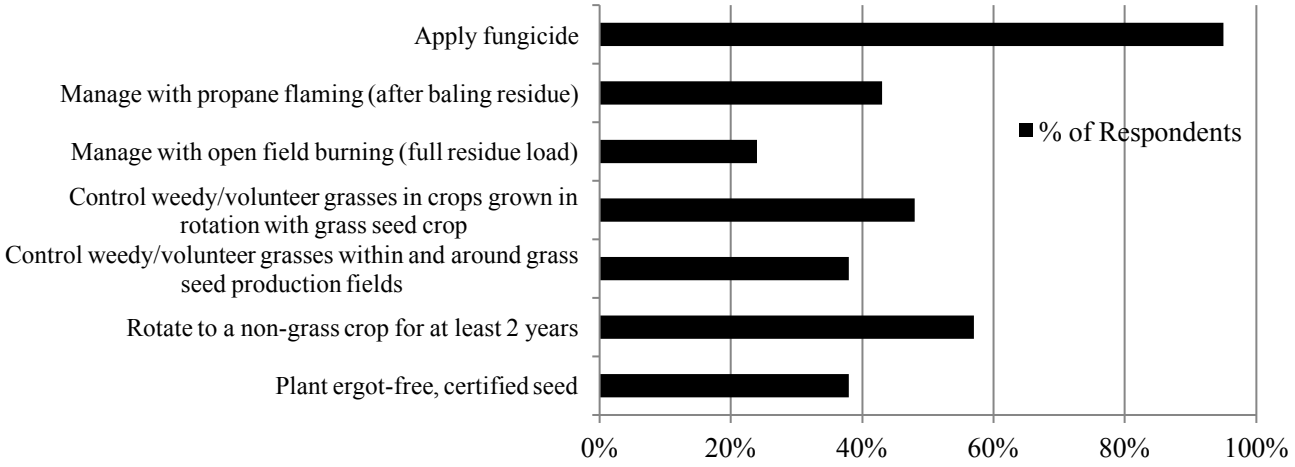

Figure 1. Tactics currently used to manage the fungal disease ergot, 2015 preharvest survey.

make fungicide application decisions focused on the history of ergot presence in production fields (92%), observations when scouting fields (62%), and time of flowering initiation (62%). Fewer than half of the respondents utilized information related to length of the flowering period, stand age, or proximity to other seed production fields with previous/current ergot infection.

Fungicide application programs for ergot control were initiated by 60% of respondents at early crop growth stages, ranging from stem elongation (Feekes 5) to the boot stage (Feekes 10), which are well in advance of the susceptible flowering stage (Feekes 10.5). These responses suggest that opportunities still exist to help some growers optimize timing of early fungicide applications for ergot control.

All respondents indicated it would be helpful to receive notifications about ergot spore presence in their region at certain times during the growing season, particularly before and/or during flowering. An overwhelming 95% of respondents expressed interest in receiving the *Ergot Alert Newsletter.* The majority of respondents (86%) indicated willingness to adopt new IPM management practices by basing future fungicide application decisions on prediction models and/or knowledge of ergot spore presence/absence in the air.

Postharvest Survey

The postharvest survey was completed by 21 respondents representing primarily growers (62%) and crop consultants/field scouts (33%), with a portion of the group also involved in seed cleaning (19%). Most respondents were from the Columbia Basin (48%) and central Oregon (33%). Ergot was considered to be moderately difficult to manage in 2015 (2.4 on a scale of 1–5). Pre- and postharvest yield losses for both species were mostly in the 1 to 10% range; however, some respondents reported pre- and postharvest yield losses up to 11 to 25% in Kentucky bluegrass and up to 26 to 50% in perennial ryegrass (Figure 2). The difficulties associated with the fungal disease ergot were many, but timing fungicide application with flowering was considered to be most difficult (86% of respondents), followed by making multiple applications during flowering (Figure 3).

Overall, the *Ergot Alert Newsletter* was rated moderately to highly useful (3.6 on a scale of 1–5), and 90% of respondents reported an improvement in their knowledge of ergot disease. Many respondents indicated they would use multiple tactics in the future to manage ergot, including:

- Use the *Ergot Alert Newsletter* information and field scouting to determine start of flowering in each species and variety.
- Use different fungicide modes of action and improved application timing.
- Continue to use multiple tactics, such as nutrient management, fungicide application, and harvest aids.
- Follow recommendations provided by agronomists and other research professionals.
- Improve weed management around field perimeters.
- Improve flowering stage monitoring and timing of fungicide application.
- Produce varieties with short flowering stages.

The *Ergot Alert Newsletter* also helped 52% of respondents make fungicide application decisions in 2015, resulting in better ergot control (20% of respondents) and reduced fungicide applications (13% of respondents). Comments regarding newsletter usefulness indicated that it was difficult to determine whether or not ergot control was improved due to field-to-field variability in ergot infection and/or the lack of

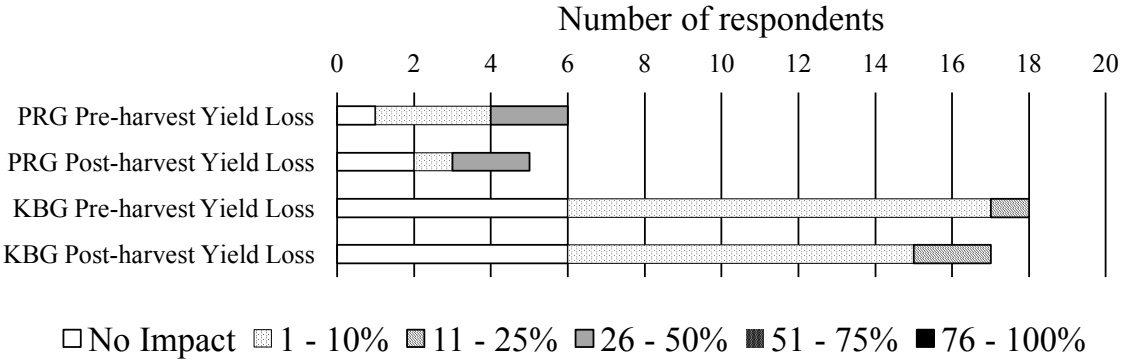

Figure 2. Yield losses of perennial ryegrass (PRG) and Kentucky bluegrass (KBG) in the field (preharvest) and after seed cleaning operations (postharvest), as reported by growers, fieldmen, and seed cleaners, 2015 postharvest survey.

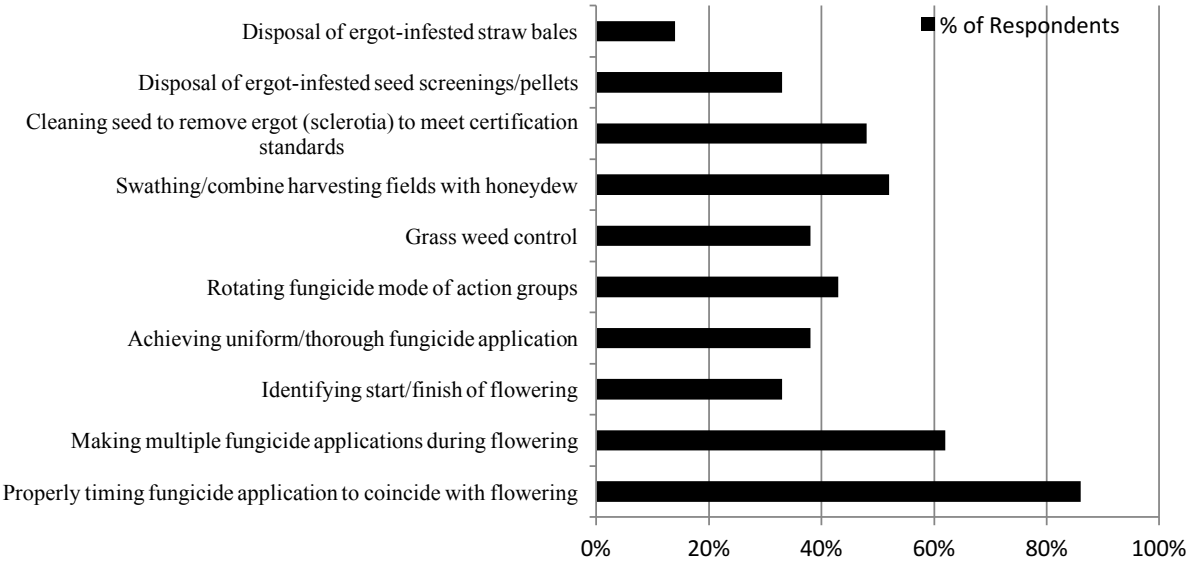

Figure 3. Difficulties associated with the fungal disease ergot, 2015 postharvest survey.

ergot pressure. However, some respondents indicated the newsletter did confirm proper application timing when fungicides were used.

In the future, 86% of respondents were willing to base fungicide application decisions on predictive models and knowledge of airborne ergot spore activity, but very few respondents were willing to use either as a stand-alone decision-making tool. Overall, 100% of respondents would use the tools to help make fungicide application decisions.

Newsletter distribution prior to critical stages of crop development was preferred by most respondents (71%). However, 19% of respondents preferred weekly distribution.

Conclusions

Improvements to the newsletter in 2016 and beyond will be incorporated as the technology is developed and adapted into the regional alert system. The DNA-based ergot spore detection protocol and predictive models for perennial ryegrass and Kentucky bluegrass are under development and will need validation prior to full deployment for ergot management (Dung et al., 2013). The new tools will facilitate monitoring in more locations and more frequent/timely notifications. Currently, the alert system is limited to seven monitoring locations due to the time- and labor-intensive process of mechanical spore trapping and visual quantification of ergot spores using microscopic methods. Ultimately, the Ergot Team's goal is to provide frequent ergot alert notifications that are compatible across various information/communication technology platforms (including smartphone technology) to aid field monitoring efforts and achieve optimum timing of fungicide application(s).

References

Dung, J.K.S., S.C. Alderman, D.L. Walenta, and P.B. Hamm. 2015. Environmental factors influencing airborne ergot ascospore concentrations in perennial ryegrass fields in the Columbia Basin of Oregon. In A. Hulting, N. Anderson, D. Walenta, and M. Flowers (eds.). *2013 Seed Production Research Report.* Oregon State University, Ext/CrS 150.

Acknowledgments

This project was funded in part by the USDA National Institute of Food and Agriculture through the Western Integrated Pest Management Center. The Ergot Team greatly appreciates the funding and/or in-kind support provided by the following: Oregon Seed Council, Washington Turfgrass Seed Commission, Oregon Department of Agriculture Alternatives for Field Burning Research Financial Assistance Program, Columbia Basin Grass Seed Growers Association, Union County Grass Seed Growers Association, Central Oregon Seeds, Inc., CHS, Inc., Columbia River Seeds, DLF International Seeds, Jacklin Seed, NextGen Turf Research, Pennington Seed, Inc., Pickseed, Pure Seed, Riverview Seeds, Blue Mt. Seeds, Inc., Brett Rudd, and Wade Bingaman. We also appreciate the technical support from staff members at HAREC, COARC, and OSU Extension-Union County.