Impact of Ergot on Kentucky Bluegrass Grown for Seed in Northeastern Oregon

Steve C. Alderman, Plant Pathologist, USDA-ARS National Forage Seed Production Research Center, Corvallis, OR 97331; and **Dale D. Coats,** Research Assistant, and **Fred J. Crowe,** Superintendent, Central Oregon Agricultural Experiment Station, Madras, OR 97741

ABSTRACT

Alderman, S. C., Coats, D. D., and Crowe, F. J. 1996. Impact of ergot on Kentucky bluegrass grown for seed in northeastern Oregon. Plant Dis. 80:853-855.

The impact of ergot on production of Kentucky bluegrass grown for seed in northeastern Oregon was determined. High levels of ergot occurred in only two of the six cultivars examined. In susceptible cultivars as many as 504 sclerotia per gram of seed were detected. This equated to 47% ergot by weight, or 25% infected seed. Ergot severity (percent sclerotia by weight) in Kentucky bluegrass seed in 1991 to 1994 was estimated at 0.20, 0.04, 0.07, and 1.15%, respectively, based on total seed production in northeastern Oregon. Percent seed replaced by sclerotia in 1991 to 1994 was 0.05, 0.01, 0.03, and 0.44%, respectively. A significant relationship between ergot severity and yield was not detected. However, a 9% reduction in marketable seed weight occurred when seed lots contaminated with ergot were recleaned to meet purity standards.

Kentucky bluegrass (*Poa pratensis* L.) is grown for seed on approximately 2,200 ha in northeastern Oregon. Annual production during 1992 to 1994 ranged from 1.7 to 2.4 million kg with a value of $2.2 to $3.1 million (22–25). Ergot, caused by *Claviceps purpurea* (Fr.:Fr.) Tul. is found on over 200 species of grasses (5,6). It is recognized as an important disease of bluegrass, although the impact of the disease on production of Kentucky bluegrass seed has not been established.

Surveys of ergot in Oregon indicated that ergot was common in Kentucky bluegrass (1) and in native grasses (21). In Oregon, 9 to 17% of seed-lot samples of Kentucky bluegrass seed were contaminated with ergot (1).

Ergot is characterized by an elongated, hard, purplish-black sclerotium that emerges from between the lemma and palea of infected florets (20). The sclerotium is the overwintering structure. Preceding the sclerotium is the conidial stage, in which viscous droplets, consisting of plant sap and conidia, ooze from infected ovaries (15,17). Ascospores released in the spring coincide with flowering in Kentucky bluegrass (2). Secondary spread can occur through movement of honeydew from infected to noninfected flowers, especially by insects (14,16).

Preharvest losses from ergot in cereal grains can occur through seed replacement by sclerotia, increased sterility of neighboring spikelets (13,19), and reduced kernel weight (8,12) due to diversion of host nutrients to the sclerotia at the expense of adjacent florets (4,11). In Kentucky bluegrass, loss of seed vigor was reported among seed from ergot-infected panicles (10). Postharvest losses can occur if seed does not meet purity requirements and requires recleaning. Each recleaning results in loss of additional seed, although published data on percent seed losses in Kentucky bluegrass are lacking.

The objective of this study was to estimate the severity of ergot among cultivars of Kentucky bluegrass grown for seed in northeastern Oregon and estimate yield loss from seed replacement and recleaning.

Corresponding author: Steve Alderman
E-mail: aldermas@ucs.orst.edu

Accepted for publication 30 April 1996.

Publication no. D-1996-0516-04R

MATERIALS AND METHODS

Precleaned (combine-run) samples (0.5 to 1.0 kg) of Kentucky bluegrass seed, representative of seed lots from each field assessed, were obtained from Blue Mountain Seed Co., Imbler, OR. Samples were cleaned with a combination of handscreens and air column to remove debris and lightweight material but retain ergot. All samples were subdivided with a riffle divider to provide unbiased subsamples. A 10-g subsample from each seed lot was examined under 5× magnification for ergot. Sclerotia were counted and weighed. Partial sclerotia or those broken in half were combined to approximate whole sclerotia.

To estimate the percent of sclerotia in a seed sample by count, the following equation was used: percent sclerotia = $(a/(a + (3{,}065 - (b/3.263 \times 10^{-4}))) \times 100$, where a = number of sclerotia per gram of seed sample, b = weight of sclerotia per gram of seed sample, 3,065 = average number of seed per gram, and 3.263×10^{-4} = weight of one Kentucky bluegrass seed (in grams).

The average seed number of Kentucky bluegrass per gram was obtained from data of the Association of Official Seed Analysts (3). The relationship $b/3.263 \times 10^{-4}$ was used to estimate the number of seed in a 10-g sample displaced by a given weight of sclerotia.

Cultivar name, field size, and yield (cleaned seed weight) data for each sample were obtained from Blue Mountain Seed Co. for the years 1991 through 1994. For each cultivar, the relationship between yield and ergot severity (number of sclerotia per gram of seed) was determined by means of regression analysis. Yield was adjusted by subtracting the proportion of weight due to ergot. The relationship between number of sclerotia per gram of seed and percent seed replaced by sclerotia was determined with second order polynomial regression.

To estimate percent loss of seed during recleaning, seed weights before and after recleaning for 19 fields from northeastern Oregon during 1991 to 1994 were obtained from the Oregon State University Seed Laboratory, which ran purity analyses on seed from the fields. Percent loss during recleaning was calculated with the following equation: 100 – [(seed weight after recleaning / seed weight before recleaning) × 100]. Percent reduction in ergot during recleaning was estimated from five fields with high levels of ergot. Ergot incidence, expressed as number of sclerotial pieces, was recorded during routine purity tests at the Oregon State University Seed Laboratory. Percent cleanout in ergot was calculated with the following equation: 100 – [(ergot number after cleaning / ergot number before cleaning) × 100].

RESULTS

In 1991 to 1994, 53 to 84% of fields examined in northeastern Oregon contained less than one sclerotium per gram of seed (Table 1). One sclerotium per gram of seed equated to 0.03% replaced seed (Fig. 1). Mean (± standard deviation) weight per sclerotium in 1991, 1992, 1993, and 1994 was 1.30 ± 1.13, 1.98 ± 1.74, 0.81 ± 0.29 and 1.32 ± 1.42 mg, respectively.

In 1991, 1992, 1993, and 1994, ergot was detected in 66, 38, 76, and 92% of the fields examined, respectively (Table 1). As the annual incidence of ergot (fields infected) increased, ergot severity (sclerotia per gram of seed) increased (Table 1). Ergot was more severe in 1994 than in 1991 to 1993.

High levels of ergot were detected in cvs. Chateau and Coventry (Table 2). Low levels of ergot were detected in cv. Abbey. Seed from a field of cv. Coventry in 1994 was estimated to contain 47% sclerotia by weight (25% sclerotia by seed number). This equated to 260 kg of sclerotia per ha and was the highest recorded severity during the 1991 to 1994 assessment period. No significant relationship between ergot severity (sclerotia per gram of seed) and yield was detected.

Production of Kentucky bluegrass seed between 1991 and 1994 ranged from 1.5 to 2.4 million kg (Table 3). Percent ergot in 1991 to 1993 was less than 0.20% but in 1994 reached 1.15%, or 19,155 kg of sclerotia. Percent seed replaced by *C. purpurea* in 1991 to 1993 ranged from 0.01 to 0.03 and reached 0.44% in 1994.

Mean ± standard deviation reduction in seed weight during recleaning was 9.1 ± 8.6%. Mean ± standard deviation percent cleanout of ergot was 22.6 ± 11.9%.

Table 1. Percentage of fields of Kentucky bluegrass among classes of ergot severity (sclerotia per gram of seed) and percentage of fields recleaned

		Fields in each class (%)				
		Sclerotia per gram of seed				
Year	No. of fields examined[a]	0	>0 to 0.9	1.0 to 19.9	>20	Fields recleaned (%)
1991	74	34	39	22	5	4
1992	56	62	22	16	0	4
1993	67	24	51	24	1	3
1994	51	8	45	35	12	8

[a] Results are based on Kentucky bluegrass fields grown for seed in northeastern Oregon.

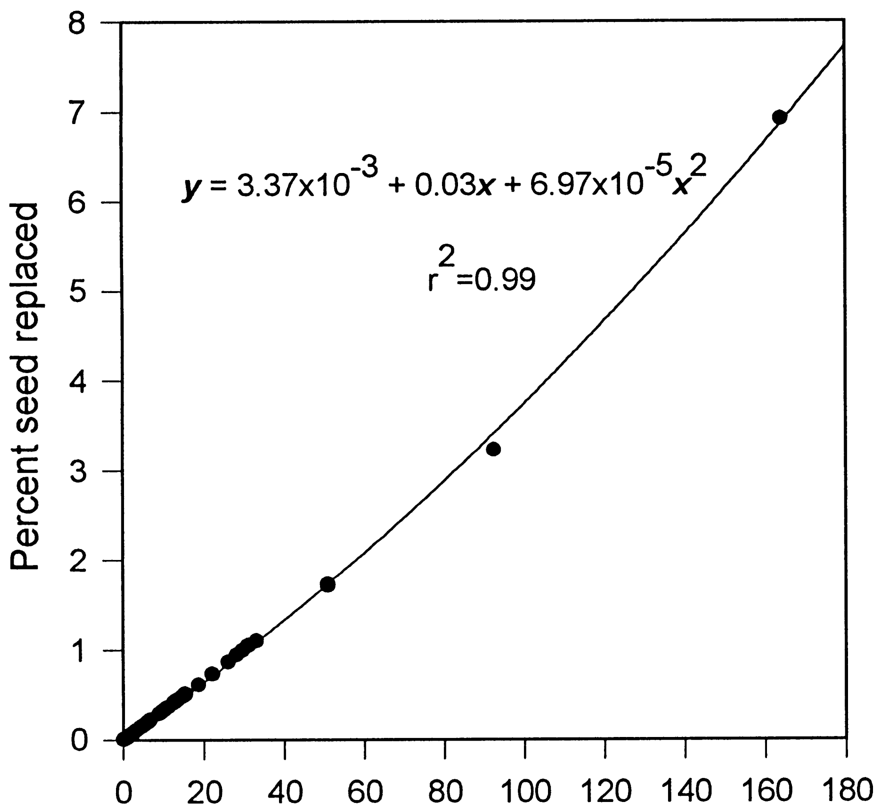

Fig. 1. Relationship between number of sclerotia of *Claviceps purpurea* per gram of Kentucky bluegrass seed, and percentage of seed replaced by sclerotia.

Table 2. Total fields examined, percent fields with ergot, and severity of ergot among six cultivars of Kentucky bluegrass grown for seed in northeastern Oregon in 1991 to 1994

			No. of sclerotia per gram of seed	
Cultivar	Total fields examined	Fields with ergot (%)	Range	Mean + SD[a]
Abbey	57	47	0.1 to 4.7	0.5 ± 0.4
Baron	65	68	0.1 to 14.8	2.7 ± 1.3
Chateau	12	100	1.0 to 92.4	10.4 ± 11.9
Coventry	15	80	0.3 to 504.0	54.3 ± 85.7
Merit	20	70	0.0 to 26.0	1.7 ± 2.3
Victa	18	72	0.1 to 12.7	2.3 ± 1.6

[a] Means and standard deviations based on yearly averages (1991 to 1994) from fields with ergot.

DISCUSSION

Yield (cleaned seed weight) in Kentucky bluegrass was highly variable among fields and among years and this could account for the lack of a significant relationship between ergot severity and yield. However, in studies of fungicidal control of ergot, in which significant differences in ergot severity were detected, corresponding differences in yield did not occur (9,18,26). Thus, the relationship between ergot severity and yield loss in Kentucky bluegrass has not been established.

Standards for pure seed allow up to 1% by weight inert matter. Since ergot is included as a component of inert matter, ergot levels greater than 1% would not meet purity standards. Lower levels of ergot could combine with debris normally present to affect purity. Seed that does not meet purity standards can be recleaned to reduce contaminants such as sclerotia. During 1991 to 1994, 3 to 8% of the fields with ergot were recleaned. Recleaning imposes the direct cost of handling the seed and the indirect cost of lost seed. Seed losses during recleaning, according to data from the Oregon State University Seed Laboratory, are about 9%, representing a significant reduction in yield. Thus, estimates of yield loss from ergot should include postharvest loss of seed during recleaning. Additional seed conditioning studies are needed to characterize seed loss during recleaning and to determine if increasing ergot levels result in increasing loss of seed.

Although ergot was present in most fields, high levels of ergot were found in only two cultivars, Chateau and Coventry, suggesting these are highly susceptible to ergot. Abbey was consistently low in ergot, suggesting this cultivar may carry some resistance. Resistance to ergot in Kentucky bluegrass has been reported (7).

The relationship between number of sclerotia per gram of seed and percent seed replaced was curvilinear, suggesting that ergot affects yield to a greater extent than

Table 3. Percent yield loss, based on scleotium weight or direct seed replacement, in northeastern Oregon due to ergot

Year	Production (kg) (×1,000)	Sclerotia (% by weight)	Sclerotia (% by count)
1991	2,350	0.20	0.05
1992	1,473	0.04	0.01
1993	2,005	0.07	0.03
1994	1,666	1.15	0.44

just direct seed replacement. The effect of ergot on reducing seed weight in rye was reported by Kossobutsky (13). Others (4,11) have reported the reallocation of photosynthates from healthy to infected seed. Chastain (10) reported reduced seed vigor of healthy Kentucky bluegrass seed in panicles infected by *C. purpurea*. Thus, loss due to ergot can include direct seed replacement, reduced seed set, reduced seed vigor, and loss through recleaning.

Additional costs of ergot contamination can occur through cost of disposal of seed screenings. Screenings contaminated with ergot can be burned, buried, or composted, but cannot be fed to animals because of toxic alkaloids present in the sclerotia. An estimated 19,000 kg of sclerotia produced in northeastern Oregon during 1994 alone represents a significant quantity of material to contend with.

The results from this study should not be extrapolated to production areas outside of northeastern Oregon. In the Pacific Northwest, Kentucky bluegrass is also grown for seed in central and north-central Oregon, eastern Washington, and northern Idaho. Losses due to ergot in these areas have not been documented and additional studies, including measurement of losses due to recleaning ergot-contaminated seed, are needed from these areas to further our understanding of the impact of ergot on Kentucky bluegrass seed production.

ACKNOWLEDGMENTS

We are indebted to Blue Mountain Seed Co. for providing seed samples and field data.

LITERATURE CITED

1. Alderman, S. C. 1991. Assessment of ergot and blind seed diseases of grasses in the Willamette Valley of Oregon. Plant Dis. 75:1038-1041.
2. Alderman, S. C. 1993. Aerobiology of *Claviceps purpurea* in Kentucky bluegrass. Plant Dis. 77:1045-1049.
3. Association of Official Seed Analysts. 1981. Rules for testing seed. J. Seed Technol. 6(2): 1-126.
4. Bacon, C. W., and Luttrell, E. S. 1982. Competition between ergots of *Claviceps purpurea* and rye seed for photosynthates. Phytopathology 72:1332-1336.
5. Bove, F. J. 1970. The Story of Ergot. S. Karger, Basal, Switzerland.
6. Brady, L. R. 1962. Phylogenetic distribution of parasitism by *Claviceps* species. Lloydia 25:1-36.
7. Brede, A. D., and Willard, W. E. 1993. Registration of 'Nustar' Kentucky bluegrass. Crop Sci. 33:1414-1415.
8. Brentzel, W. E. 1947. Studies on ergot of grains and grasses. N. D. Agric. Exp. Stn. Bull. 348.
9. Cagas, B. 1992. Seed yield and diseases in Kentucky bluegrass after fungicide application. J. Appl. Seed Prod. 10:11-14.
10. Chastain, T. G. 1992. Relationship of ergot to Kentucky bluegrass seed production quality. J. Appl. Seed Prod. 10:7-10.
11. Corbett, K., Dickerson, A. G., and Mantle, P. G. 1974. Metabolic studies on *Claviceps purpurea* during parasitic development on rye. J. Gen. Microbiol. 84:39-58.
12. Harper, F. R., and Seaman, W. L. 1980. Ergot of rye in Alberta: Estimation of yield and grade losses. Can. J. Plant Pathol. 2:222-226.
13. Kossobutzky, M. I. 1930. Ergot (*Claviceps purpurea* Tul.) in the Votyaks' Autonomous Region in the Years 1926-1928. [Pamphlet issued by Votyaks Regional Plant Prot. Stut. and Scient. Soc. for the Study of the Votyaks Region. Leningrad, 1929, 64 pp.] Rev. Appl. Mycol. 9:103-104.
14. Lemon, K. M. 1992. Dispersal of the ergot fungus *Claviceps purpurea* by the lauxanid fly *Minettia lupulina*. J. N. Y. Entomol. Soc. 100:182-184.
15. Luttrell, E. S. 1980. Host-parasite relationship and development of the ergot sclerotium in *Claviceps purpurea*. Can. J. Bot. 58:942-958.
16. Moreno, R., Pederson, V. D., and Schultz, J. T. 1971. Transmission of *Claviceps purpurea* (Fr.) conidia by the cabbage looper moth *Trichoplusia nu* (Hubner). Proc. N. D. Acad. Sci. 24:11-14.
17. Mower, R. L., and Hancock, J. G. 1975. Mechanism of honeydew formation by *Claviceps* species. Can. J. Bot. 53:2813-2825.
18. Schultz, T. R., Johnston, W. J., Golob, C. T., and Maguire, J. D. 1993. Control of ergot in Kentucky bluegrass using fungicides. Plant Dis. 77:685-687.
19. Seymour, E. K., and McFarland, F. T. 1921. Loss from rye ergot. Phytopathology 11:285-289.
20. Sprague, R. 1950. Diseases of Cereal Grasses in North America. The Ronald Press Co., New York.
21. Stur, E. T., Christensen, B. E., and Wong, E. 1943. Assay of Oregon ergot. J. Am. Pharma. Assoc. 32:241-244.
22. Young, W. C., III. 1991. Oregon grass and legume seed crop production statistics. Department of Crop and Soil Science, Oregon State University, Corvallis.
23. Young, W. C., III. 1992. Oregon grass and legume seed crop production statistics. Department of Crop and Soil Science, Oregon State University, Corvallis.
24. Young, W. C., III. 1993. Oregon grass and legume seed crop production statistics. Department of Crop and Soil Science, Oregon State University, Corvallis.
25. Young, W. C., III. 1994. Oregon grass and legume seed crop production statistics. Department of Crop and Soil Science, Oregon State University, Corvallis.
26. Zgorkiewicz, A. 1987. Chemical control of ergot (*Claviceps purpurea* Tul.) in meadowgrass (*Poa pratensis* L.). Pr. Nauk. IOR Poznan 24:179-195.