

## Recent Occurrence and Potential Development of Blind Seed Disease in Oregon.

S. C. Alderman<sup>1</sup>

### ABSTRACT

Blind seed disease was detected in 6-8% of the 1186 (1995) and 2314 (1997) seed samples of tall fescue (*Festuca arundinacea* Schreb.) examined, although less than one percent of samples contained more than one percent of infected seeds. In 1995, blind seed occurred in less than 1% of 2207 perennial ryegrass (*Lolium perenne* L.) samples tested and in no samples did blind seed exceed 1% infected seed. Among four fields of tall fescue evaluated from 1994-1997, blind seed severity varied among years, with no evidence for an increase with respect to time. However, blind seed severity, based on conidial number from a seed washing procedure, increased with increasing rainfall during May. The relationship between conidial numbers washed from seed and the percentage of infected seed was defined by a linear function.

*Additional index words:* seed testing, seed quality, *Gloeotinia temulenta*

### INTRODUCTION

Blind seed, caused by *Gloeotinia temulenta* (Prill & Delacr.) M. Wilson, M. Noble, & E. Gray is an important floral disease of tall fescue (*Festuca arundinacea* Schreb.) and perennial ryegrass (*Lolium perenne* L.) which results in poor germination of infected seed. The fungus attacks only the ovary or developing seed, replacing the endosperm with fungal mycelia (Wilson, Noble and Gray, 1945).

Blind seed was a serious disease of ryegrass in Oregon during the 1940s and it was not until later in that decade that field burning was found to control the disease. Blind seed disease decreased sharply by 1950 as the practice of post-harvest field burning became established. Disease severity increased about 1957 when alternatives to field burning were introduced, but the disease was reduced to trace levels by 1961 when burning was again emphasized (Hardison, 1963). Disease surveys by Hardison (1980) indicated that blind seed occurred at trace levels from 1961-1979. Surveys by Alderman (1991) indicated that between 1986 and 1989 blind seed was present in 5-10% of tall fescue and 2-3% of perennial ryegrass samples, but at trace (<1% infected seed) levels.

In 1991, a law was enacted by the state of Oregon that mandated an incremental reduction in post-harvest burning of grass seed fields to a maximum of 16000 ha after 1997. The area burned declined from about 80,000 ha in 1987 to about 28,000 in 1993 (Young, Quebbeman, Silberstein and Chilcote, 1994). The finding of several fields of tall fescue with a high level (20% infected seed) of blind seed in 1995 (Alderman, 1996) renewed interest in this disease and promoted an effort to determine the extent and potential development of blind seed disease in Oregon.

The objectives of this study were to i) evaluate the occurrence of blind seed through comprehensive surveys of seed samples; ii) monitor fields with blind seed over a four year period to determine the rate of disease increase; and iii) project the potential development of blind seed in terms of current (non-burning) management practices and environmental conditions.

### MATERIALS AND METHODS

During 1995 and 1997, samples of tall fescue seed sent to the Oregon State University (OSU) Seed Laboratory for germination and purity testing during July-January, were subsampled for blind seed testing. During 1995, samples of perennial ryegrass seed were also subsampled. As previously described (Alderman, 1991), 5 g seed samples were soaked in tap water for 15 minutes followed by removal and examination under 200X magnification of the effluent for conidia of *G. temulenta*. A hemacytometer was used to quantify conidial numbers.

To determine the relationship between numbers of *G. temulenta* conidia and percent infected seed, samples for blind seed testing were split into two 5 g fractions. In one fraction blind seed spores were determined from the seed wash procedure. In the other, seeds were chosen at random and placed individually in each of four replicate 96-well plates. Two hundred  $\mu$ l water were added to each well. After two hours at room temperature, the plates were examined for a pinkish deposit at the bottom of the wells, characteristic of blind seed infection (Alderman, 1996). Conidia of *G. temulenta* were confirmed by microscopic examination of the well water at 200X magnification. Since conidial formation is associated with blind seed infection, the presence of conidia was used to determine percent infected seed. The relationship between numbers of conidia found in a seed wash and percent infected seed was evaluated using regression analysis.

Seed samples which had tested positive for blind seed were traced back through the OSU Seed Lab database and OSU Seed Certification databases to obtain cultivar identity and field location. Four fields of tall fescue (cv. Fawn) so identified were in continuous production from 1994-1997. Spore count data from the fields were analyzed by regression analysis to determine if disease severity increased with respect to time. Data were also subject to one way ANOVA to determine if differences between any years were significant. The relationship between spore counts and rainfall during May (the month during which tall fescue cv. Fawn flowers in Oregon) was defined through regression analysis. Rainfall data were obtained from archived records of the Oregon Climate Service, (<http://ocs.orst.edu>).

<sup>1</sup> USDA-ARS National Forage Seed Production Research Center, Corvallis, OR, 97331, USA. Accepted for publication 9 October 1998.

**RESULTS**

Blind seed levels in tall fescue were similar in 1995 and 1997 (Table 1). The percentage of infected seeds within a seed lot ranged from trace (<0.1%) to about 3%. Less than 1% of the samples had greater than 0.5% of seeds infected. During 1995 and 1997, blind seed was found in 32 and 47 cultivars of tall fescue, respectively. During 1995, blind seed was detected in only 36 out of 2207 perennial ryegrass samples examined and no samples exceeded 1% infected seed. A linear relationship was found between the number of blind seed conidia in a 5 g seed sample and the percentage of infected seeds (Figure 1).

established infection classes ranging from none to heavy, based on a relationship between infected seed percentage and the number of conidia recovered from a water suspension after soaking cleaned seed in an equal volume of water. A similar approach was used in this study, although seed weight rather than seed volume was used. A linear relationship between conidial number and the percentage of infected seeds provided a convenient conversion between spore counts and infected seeds.

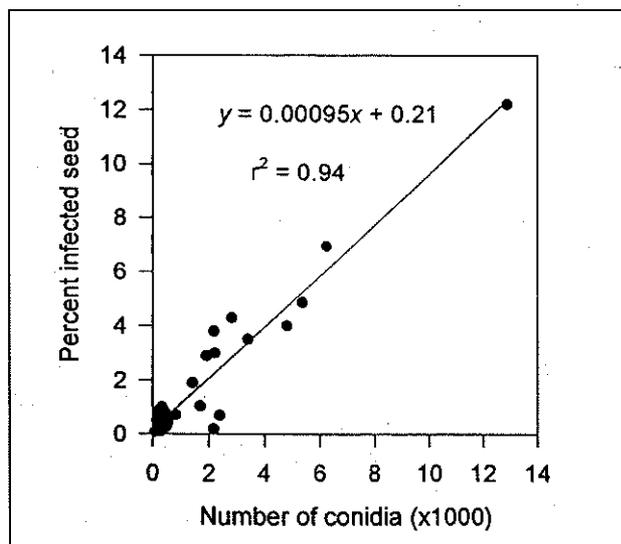
The association between wet weather and blind seed development is well established (Gorman, 1940; Lithgow and

**Table 1. Number of tall fescue seed samples examined and percentage of samples found with trace, <0.5, <1.0 or >1.0% infected seeds during 1995 and 1997.**

| Year | Number of samples examined | Percentage of samples in each infection class |          |         |                 |
|------|----------------------------|---|----------|---------|-----------------|
|      |                            | <0.1  | 0.1-0.49 | 0.5-0.9 | >1 <sup>1</sup> |
| 1995 | 1186                       | 5.5   | 1.7      | 0.3     | 0.03            |
| 1997 | 2314                       | 4.0   | 1.4      | 0.7     | 0.04            |

<sup>1</sup> percentage of infected seeds

Blind seed severity among four fields of tall fescue did not differ significantly and there was no increase in disease severity with respect to year sampled. However, conidial counts did increase with increasing rainfall during May (Figure 2).

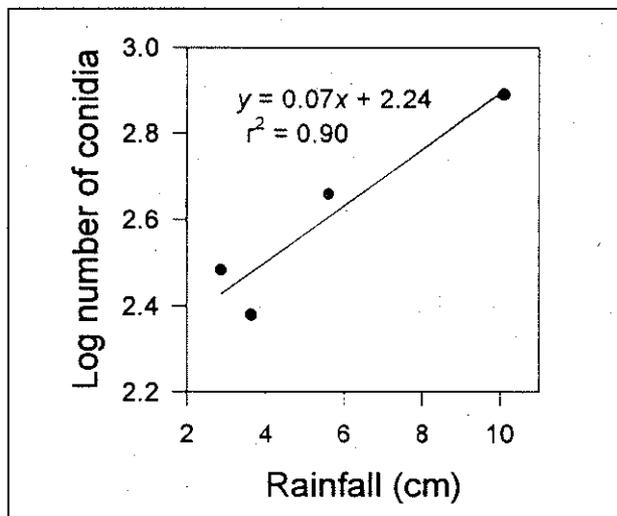


**Figure 1. Relationship between number of conidia of *G. temulenta* washed from a 5 g seed sample and the percentage of infected seeds.**

In the Willamette Valley (Corvallis, OR) average rainfall (1961-1990) decreased from 17.3 cm in January to 1.4 cm in July. Average rainfall during May, when many grasses flower, was 5.0 cm. Rainfall during May from 1994 to 1998 was variable, ranging from 0-11 cm (Figure 3), with few consecutive years of high rainfall in May.

**DISCUSSION**

Assessment of blind seed, as the percentage of infected seeds, is laborious if individual seeds are examined. Hardison (1957)



**Figure 2. Relationship between total rainfall during May and number of conidia of *G. temulenta* washed from 5 g seed samples. Each point represents the mean spore count from 4 fields of tall fescue.**

Cottier, 1953; Chestnutt, 1958; Grant 1985; DeFilippi *et al.* 1996). Early maturing cultivars such as Fawn tall fescue flower during mid-May when prolonged periods of rainfall can occur. However, in the Willamette Valley, rainfall during May is variable, ranging from about 0 to 11 cm; few consecutive years of relatively high rainfall occur. Blind seed would likely be more severe under consecutive years of wet weather.

In the Willamette Valley, environmental conditions by early June are typically warmer and drier, with less frequent rainfall than in May, creating conditions that are less favorable for blind seed development. Temperature and rainfall average 12.6° C and 5.0 cm, respectively for May and 16.1° C and 3.1cm, respectively for June. Days with rain average 12 for May and 7 for June. Although less favorable than in May, environmental conditions in June support a low level of blind

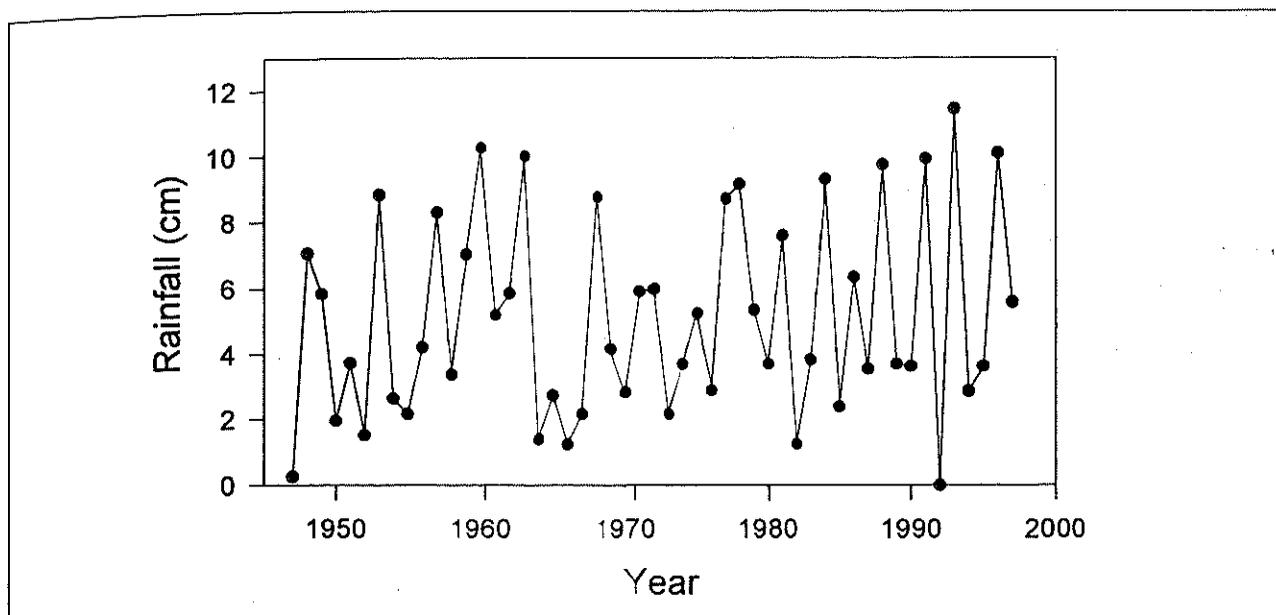


Figure 3. Total rainfall during May at Corvallis, OR during 1947-1997.

seed occurrence. A low level of blind seed (< 1% infected seeds) occurred in 47 cultivars of tall fescue in 1997, many of which were later maturing cultivars.

Fewer seeds infected with *G. temulenta* were found in perennial ryegrass than in tall fescue, and no samples of perennial ryegrass were found with greater than 1% infected seed. The greater occurrence of blind seed in tall fescue is due primarily to its occurrence in cultivar Fawn. Of 151 samples of tall fescue in which blind seed was detected in 1997, 55 of the samples were cultivar Fawn.

An occurrence of a high level of blind seed in Oregon in 1995 (Alderman, 1996) was likely due to a combination of an early maturing cultivar (Fawn) and management practices. Practices believed to have supported blind seed included long stand age (>5 years); lack of field burning; late harvest, which results in heavier seed but greater seed shatter; partial in-field cleaning during combining, which leaves lightweight, infected seed in the field as an inoculum source. Even under environmental conditions slightly or moderately favorable for blind seed, the greater the number of infected seeds returned to a field during harvest, the greater the potential inoculum from infected seeds and subsequent disease development.

Blind seed epidemics will be unlikely in the Willamette Valley of Oregon unless there are significant increases in rainfall and changes in grass seed production practices that permit greater inoculum increase. Efficient removal of seed from fields, along with short (<5 year) rotations, good seed bed formation, use of clean seed of high germination capacity (Hardison, 1963) and optimal fertilizer use (Hampton and Scott, 1980; DeFilippi *et al.*, 1996) are practices that discourage the development of blind seed and are used by most growers in the Willamette Valley. In addition, the use of later maturing cultivars which flower at a time of lower rainfall promotes seed production under less favorable conditions for blind seed disease development. Despite the historical precedent for blind seed development in Oregon, recent data suggests blind seed is not likely to increase significantly in Oregon.

## ACKNOWLEDGEMENTS

I thank Don Pfeiffer and Nanci Adair for technical assistance.

## REFERENCES

1. Alderman, S.C. 1991. Assessment of ergot and blind seed diseases of grasses in the Willamette Valley of Oregon. *Plant Disease* 75:1038-1041.
2. Alderman, S.C. 1996. Occurrence of *Gloeotinia temulenta* on tall fescue in Oregon. *Plant Disease* 80:105.
3. Chestnutt, D.M.B. 1958. Susceptibility of perennial ryegrass to blind seed disease (*Gloeotinia temulenta*). *Journal of the British Grassland Society* 13:295-298.
4. DeFilippi, J.M., Hampton, J.G., Rolston, M.P., and Rowarth, J.S. 1996. Effect of nitrogen and irrigation on blind seed disease in perennial ryegrass (*Lolium perenne* L.) cv. Grasslands Nui. *Journal of Applied Seed Production* 14:81-83.
5. Gorman, L.W. 1940. Blind seed disease investigations. *New Zealand Journal of Science and Technology* 22:79A-83A.
6. Grant, A.S. 1985. A seed development study of the effects of different soil moisture regimes on three perennial ryegrass cultivars (*Lolium perenne* L.). *Proceedings of the New Zealand Grassland Association* 46:241.
7. Hampton, J.G. and Scott, D.J. 1980. Blind seed disease of ryegrass in New Zealand. 1. Occurrence and evidence for the use of nitrogen as a control measure. *New Zealand Journal of Agricultural Research* 23:143-147.
8. Hardison, J.R. 1957. Record of blind seed disease control in Oregon. *Plant Disease Reporter* 41:34-41.
9. Hardison, J.R. 1963. Control of *Gloeotinia temulenta* in seed fields of *Lolium perenne* by cultural methods. *Phytopathology* 53:460-464.
10. Hardison, J.R. 1980. Role of fire for disease control in grass seed production. *Plant Disease* 64:641-645

11. Lithgow, A.V. and Cottier, K. 1953. Pre-harvest examination of ryegrass seed for blind seed disease. *New Zealand Journal of Agriculture* 87:405-406.
12. Wilson, M., Noble, M., and Gray, E.G. 1945. The blind seed disease of rye-grass and its causal fungus. *Transactions of the Royal Society of Edinburgh* 61:327-340.
13. Young, W.C., Quebbeman, B.M., Silberstein, T.B. and Chilcote, D.O. 1994. An evaluation of equipment used by Willamette Valley grass seed growers as a substitute for open-field burning. *Oregon State University Department of Crop and Soil Science Ext/CrS* 99. 20pp.