Distribution of *Gloeotinia temulenta*, *Claviceps purpurea*, and *Anguina agrostis* among Grasses in the Willamette Valley of Oregon in 1988

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ABSTRACT

During the summer of 1988, a survey of was initiated to determine the distribution and severity of the grass seed diseases ergot, blind seed, and seed gall nematode in the Willamette Valley, Oregon. The grasses included were bentgrass (*Agrostis tenuis* Sibth. 'Highland'), Kentucky bluegrass (*Poa pratensis* L.), chewings fescue (*Festuca rubra* subsp. *commutata* Gaud.), tall fescue (*Festuca arundinaceae* Schreb.), annual ryegrass (*Lolium multiflorum* Lam.), perennial ryegrass (*L. perenne* L.), and orchardgrass (*Dactylis glomerata* L.). A total of 492 fields were examined. Ergot was detected in all grasses except orchardgrass. The percentages of fields infested with ergot were 52% in Kentucky bluegrass; 13% in bentgrass; and 1-3% in tall fescue, perennial ryegrass, and annual ryegrass. A survey of weed grasses indicated that ergot was widespread throughout the Willamette Valley and that tall fescue, annual ryegrass, and quackgrass (*Agropyron repens* (L.) Beauv.) were the most common weed grasses infested with ergot. Blind seed was detected in 26-30% of the tall fescue, annual ryegrass and perennial ryegrass fields; and in 3% of the Kentucky bluegrass fields. Blind seed was not found in fields of chewings fescue, bentgrass, or orchardgrass. Seed gall nematode was found only in 9% of the bentgrass fields.

Additional index words: **blind seed, ergot, seed gall nematode, seed production, orchardgrass, bluegrass, bentgrass, ryegrass, tall fescue, chewings fescue.**

INTRODUCTION

The fungi *Claviceps purpurea*, causal agent of ergot; *Gloeotinia temulenta*, causal agent of blind seed; and the nematode *Anguina agrostis*, commonly known as the seed gall nematode, are important pathogens of grasses grown for seed in the Willamette Valley of Oregon. The pathogens attack the flowers and colonize developing seeds. Seed yield losses result from seed abortion, reduction in seed size, or reduction in seed viability. Economic losses also result from added costs to remove sclerotia or galls during seed cleaning, or rejection of seed lots because of quarantines or marketing agreements.

Between 1941 and 1943, epidemics of blind seed occurred in ryegrass fields in the Willamette Valley. In 1943, one fourth of the ryegrass seed crop had less than 85% germination and could not be certified (Hardison, 1948). Disease control practices were introduced in 1944 and proved effective for controlling the disease (Hardison, 1957). Between 1941 and 1979 blind seed surveys were conducted in the Willamette Valley, based on ryegrass samples submitted to the Oregon State University Seed Testing Laboratory (Hardison, 1980). Only trace levels of disease were detected between 1960 and 1979. The current spatial distribution of blind seed in the Willamette Valley is not known. In addition, the levels of blind seed in other grasses, such as tall fescue or bluegrass, has not been established.

Ergot is believed to occur throughout the Willamette Valley (Hardison, 1980), but no systematic surveys have been conducted to determine the distribution of ergot among commercial seed production fields. In addition, the potential of weed grasses to harbor the fungus has been speculated for many years, but a survey of ergot sclerotia in wild grasses has not been documented.

The seed gall nematode was reported in Oregon in 1945 on chewings fescue. By 1952 the disease was recognized as a serious pathogen of bentgrass in the Willamette Valley (Courtney and Howell, 1952; Hardison, 1980). The present occurrence of the nematode among bentgrass fields in the Willamette Valley is not known.

The objectives of this study were to survey commercial seed production fields for blind seed, ergot, and seed gall nematode and to survey weed grasses in the valley for ergot.

MATERIALS AND METHODS

A computer data base containing a listing of grass seed production fields was obtained from the Oregon Seed Certification Service. Grasses included in the survey were Bentgrass (*Agrostis tenuis* Sibth. 'Highland') cv. 'Highland'; Kentucky bluegrass (*Poa pratensis* L.); chewings fescue (*Festuca rubra* subsp. *commutata* Gaud.) cv. 'Cascade' and 'Koket'; tall fescue (*Festuca arundinacea* Schreb.) cv. 'Bonanza', 'Falcon', 'Fawn', and 'Forager'; annual ryegrass (*Lolium multiflorum* Lam.);

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perennial ryegrass (*L. perenne* L.) cv. 'Linn' and 'Pennfine'; and orchardgrass (*Dactylis glomerata* L.) cv. 'Potomac' and 'Hallmark'. Lists of fields of selected cultivars for each of the grass species were generated from the data base. For Kentucky bluegrass all cultivars grown in the Willamette valley were included in the survey. Fields were selected at random using a computer-based random number generator. A copy of an aerial photograph was obtained for each field showing the field location. These maps were used by a survey crew to locate selected fields. A computer based listing was not available for annual ryegrass. These fields were found by driving to and searching for annual ryegrass fields in preselected areas within Benton and Linn counties, where much of the ryegrass is grown.

For each field, 400 seed heads were collected randomly while walking a diamond-shaped pattern through the field. Samples were placed in paper bags and dried 4 weeks prior to threshing. Seed samples were threshed using a Kamus/Westrup model LAH seed thresher and cleaned by hand screening. Prior to threshing, individual seed heads were examined for the presence of ergot sclerotia.

From each threshed and cleaned field sample, three 18 ml subsamples were taken for blind seed determination. A riffle sampler was used to take subsamples representative of the field sample. For blind seed determination, each subsample was mixed with an equal volume of water. After soaking one hour at 23-27 C the water was pipetted to centrifuge tubes and centrifuged at 5000 rpm for 12 minutes to concentrate any spores present in the subsample. All but 1-2 ml of the supernatant was removed. The pellet was resuspended and two 10-ul drops were transferred to a hemacytometer slide. The slide was examined for conidia of *G. temulenta* using a compound microscope at 250X magnification. The remaining suspension was placed in a 50 mm diameter observation dish and examined for the presence of nematodes using a dissecting microscope at 50 x magnification. Blind seed severity was determined by examining individual seeds in sets of 300 seeds.

During September and October, 1988, a survey of ergot in weed grasses was initiated. Eighty-two sites throughout the Willamette Valley were selected at random. A sampling site was defined as a 400 feet long by 10 feet wide section of each side of a straight north-south or east-west road. About 20 minutes were allocated to search each site for ergot infected grasses.

For statistical purposes data were summarized as proportions. Standard errors of proportions were calculated as outlined by Scheaffer et al. (Scheaffer et al., 1986).

A computer-based map of the Willamette Valley was constructed through the Oregon State University Cartographic Service. Field locations were plotted to within one section using a map overlay containing townships, ranges and sections.

RESULTS

Forty-two percent of bentgrass fields in the Willamette Valley were sampled. Ergot was detected in 13% of the fields (Table 1) and in all infested fields less than 1% of the seed heads contained ergot sclerotia. Blind seed was not detected. Seed gall nematode was found in 9% of the fields (Table 1) and these fields were located in areas of intensive bentgrass production (Fig. 1A).

Most cultivars of Kentucky bluegrass grown in the Willamette Valley were included in the survey and 31% of the fields were sampled. Ergot was detected in 52%

Table 1. Number and percent of total fields sampled and percent of fields with ergot, blind seed, or seed gall nematode in various grasses in the Willamette Valley in 1988 (± values are 95% confidence intervals).

Grass type	Number of fields sampled	Percent of registered fields[a]	Percent fields with		
			Ergot	Blind seed	Seed gall nematode
Bentgrass	45	42	13 ±8	0	9 ±7
Bluegrass	31	31	52 ±15	3 ±5	0
Chewings fescue	39	27	3 ±4	0	0
Tall fescue	122	25	1 ±1	30 ±7	0
Annual ryegrass	67	--[b]	2	30	0
Perennial ryegrass	88	25	2 ±2	26 ±6	0
Orchardgrass	100	49	0	0	0

[a]based on total registered fields for the varieties sampled
[b]based on a sample size of 67 fields, total fields not known

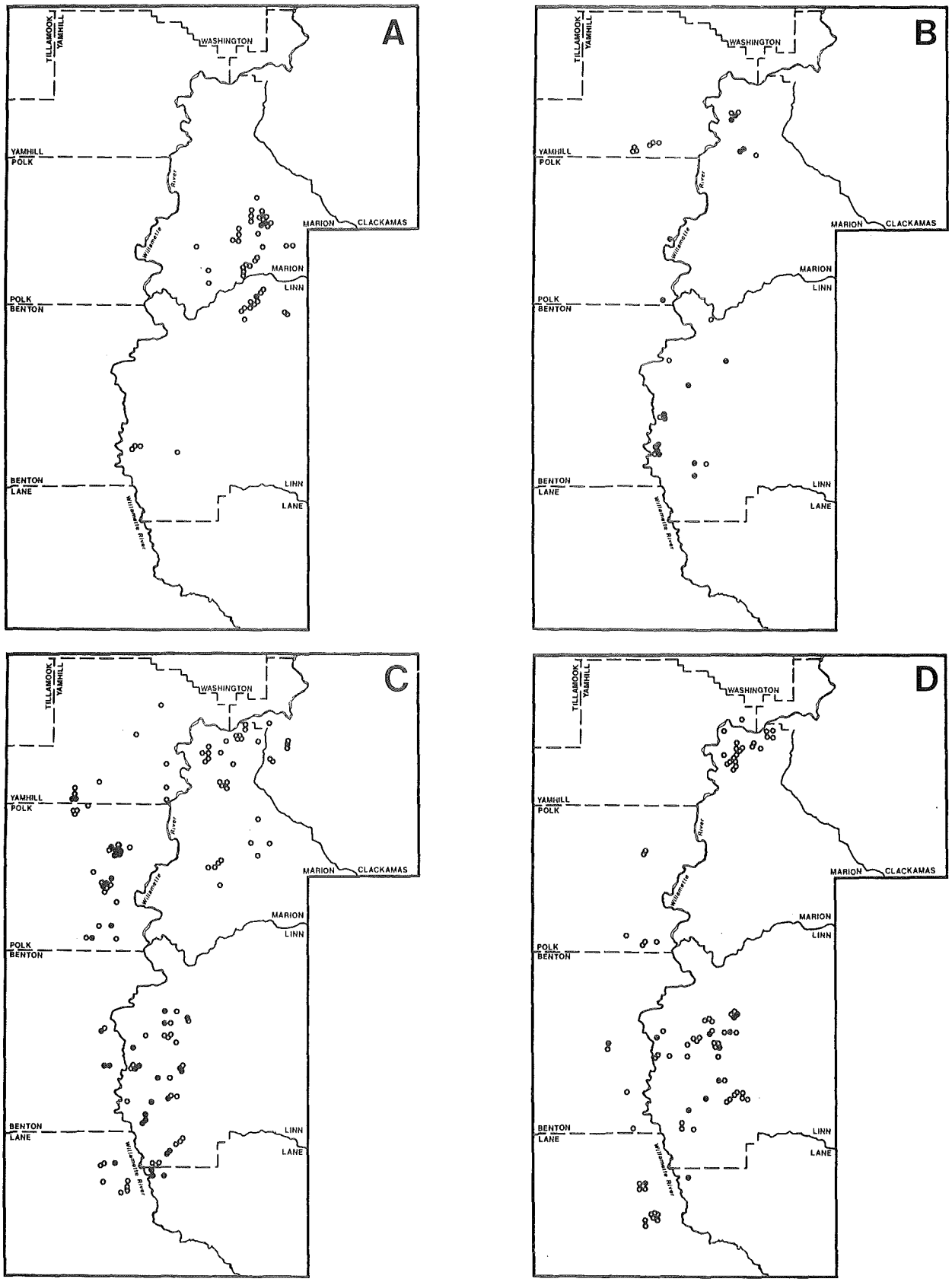

Figure 1. Distribution of A) *Anguina agrostis* among bentgrass, B) *Claviceps purpurea* among bluegrass, C) *Gloeotinia temulenta* among tall fescue, and D) *G. temulenta* among perennial ryegrass fields in the Willamette Valley of Oregon in 1988. Filled and open circles represent sites where the pathogen was found and not found, respectively.

of the fields. Severity of ergot was less than 3%. In 2% of the fields 25% of the heads contained at least one ergot sclerotium. Ergot was distributed throughout the Willamette Valley (Figure 1B). Blind seed was present in 3% of the fields and the severity was less than 0.1%. Seed gall nematode was not detected in Kentucky bluegrass.

Twenty-seven percent of chewings fescue fields were sampled. A low level of ergot was found in 2% of the fields. Blind seed was not detected in any of the fields sampled. Seed gall nematode was not detected.

Twenty-five percent of tall fescue fields were sampled. Ergot was detected in 1% of the fields (Table 1). Blind seed was detected in all varieties of tall fescue included in the survey and 30% of the combined total of the fields were infested. Blind seed was found in fields throughout most of the Willamette Valley except for Marion county, where blind seed was not detected (Fig. 1C). Only one infested field was found in Clackamas county. Seed gall nematode was not detected.

Sixty-seven annual ryegrass fields were included in the survey. A low level of ergot was observed in 2% of the fields. Blind seed was detected in 30% of the fields and several fields had levels of 0.3% blind seeds/sample, the highest levels detected in this survey. In the other fields, less than 0.1% of the seeds were infected. Seed gall nematode was not found.

Twenty-five percent of the perennial ryegrass fields (cv. 'Linn' and 'Pennfine') were sampled. Ergot was found in 2% of the fields and in those fields less than 0.1% of the heads contained at least one ergot sclerotium. Blind seed was detected in 26% of the fields although severities were less than 0.3% infected seeds. Blind seed incidence appeared generally distributed throughout western and central Willamette Valley (Fig. 1D). Blind seed was not detected in fields from the northeastern range of the valley (Marion county). Seed gall nematode was not observed in any of the perennial ryegrass samples.

Forty-nine percent of orchardgrass fields were sampled (Table 1). Ergot, blind seed, or seed gall nematode was not detected in any of the orchardgrass fields sampled.

In the survey of weed grasses, tall fescue and annual ryegrass were the most commonly encountered ergot infested grasses in the Willamette Valley (Table 2). Panicles of quackgrass and orchardgrass were also found to contain ergot. Mapping the distribution of ergot infested sites illustrated that the fungus was present throughout the Willamette Valley (Fig. 2).

Table 2. Number of sites and percent of total sites where ergot was found in the Willamette Valley of Oregon during 1988.

Grass type	Sites Ergot found (number)	Total sites (%)
Tall fescue	49	59
Annual ryegrass	29	35
Quackgrass	12	14
Orchardgrass	8	10
Perennial ryegrass	6	7
Kentucky bluegrass	1	1
Oatgrass	1	1

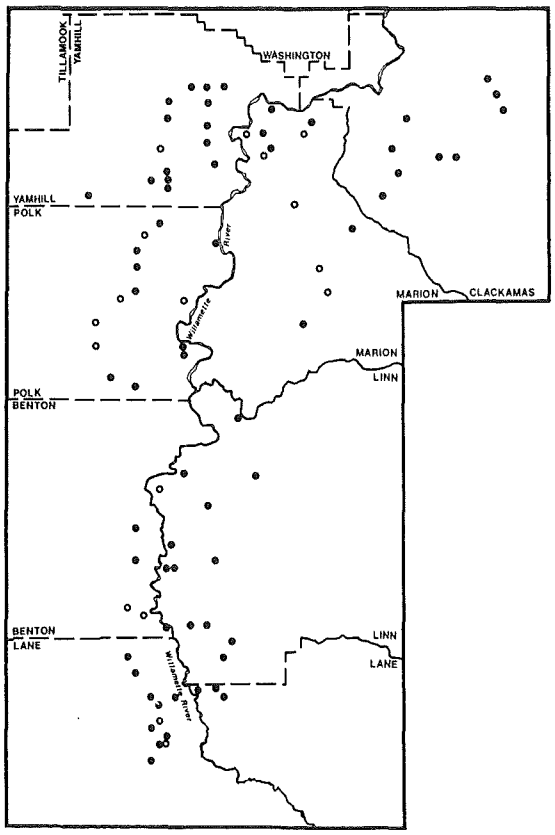

Figure 2. Distribution of *Claviceps purpurea* among weed grasses in the Willamette Valley of Oregon during 1988. Filled and open circles represent sites where *C. purpurea* was found and not found, respectively.

DISCUSSION

Ergot was observed throughout the Willamette Valley on most grasses grown for seed and on several weed grasses. Although ergot was not detected in commercial orchardgrass fields, ergot infected orchardgrass plants were found at eight out of 82 non-production sites in the Willamette Valley. It is not known if there is differential susceptibility among orchardgrass cultivars. It is also not known if more than one species of *Claviceps* are present in the Willamette Valley. More than one species of *Claviceps* has been reported on orchardgrass (Bove, 1970). Ergot was found in about 50% of the bluegrass fields and 13% of the bentgrass fields. The reason for higher ergot levels in bluegrass and bentgrass compared with the other grasses is not fully understood, but may be related to a time of flowering when more inoculum is present or when environmental conditions are more conducive to flower infection and disease spread.

Courtney and Howell (Courtney and Howell, 1952) reported that the seed gall nematode was a serious pathogen of bentgrass. In the present survey, *A. agrostis* was found in 9% of the bentgrass fields and these fields were located in the eastern-central part of the valley. However, the severity of nematode levels was not determined.

Previous surveys for blind seed in the Willamette Valley (Hardison, 1980) indicated that trace levels of disease were present between 1960 and 1979. In the present survey trace levels were also detected. However, low levels of disease were detected in about 30% of the fields of tall fescue and perennial and annual ryegrass. The large number of fescue and ryegrass fields infected suggest that under favorable environmental conditions for disease and in the absence of control measures, a general epidemic may be possible. However the timing of epidemic development is not well-defined. Disease levels are known to be influenced strongly by environmental conditions (Wilson et al., 1945). Higher disease levels would be expected if rainy, wet weather occurs during flowering. It is not quantitatively known how current disease levels are influenced by environmental conditions highly favorable for disease development. It is also not understood how changes in cultivars or production practices might influence disease levels.

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