REPORT TO THE OREGON PROCESSED VEGETABLE COMMISSION

TITLE: Survey of corn fields in the Willamette Valley for stalk rot

PROJECT LEADERS: Mary L. Powelson, Robin Ludy and Virginia Heffer
Botany and Plant Pathology
Oregon State University
Corvallis, OR 97331-2902

COOPERATORS: Bill Mansour and Dan McGrath

PROJECT FUNDING: $12,000

OBJECTIVES: 1) Determine the distribution and severity of stalk rot of sweet corn in the Willamette Valley; 2) Determine which *Fusarium* species are most commonly associated with stalk rot; and 3) Conduct a crop history survey.

INTRODUCTION

For the last few years, several sweet corn fields in the Willamette Valley have been identified with a significant stalk rot problem. The symptoms of stalk rot begin late in the season during silking; corn leaves begin to fire, or turn brown, at the base of the plant, and may continue to discolor up to the ear. The pith may be discolored and/or appear shredded. In severe cases, either ears fail to develop fully, reducing yield, or sporadic kernels appear dimpled, reducing kernel quality. In 1995, *Fusarium* spp. were isolated from symptomatic plants.

Fusarium species are known to be involved in stalk rots of corn in the United States. Most disease surveys and research have been done on field corn. In field corn, *F. moniliforme* causes Fusarium stalk and ear rot, and *F. graminearum* (*Gibberella zeae*) is the causal agent of Gibberella stalk rot. The predominant fungal species varies across the country and sometimes from year to year in the

same location. *F. moniliforme* tends to predominate in warm, dry regions and *F. graminearum* is more commonly predominant in cool, moist regions. *F. graminearum* is reported to be a more aggressive pathogen in field corn and causes greater losses than *F. moniliforme*. It is assumed that the disease organisms respond similarly in sweet corn. A study done at Pennsylvania State University indicated that stalk rot in sweet corn seed fields has been increasing in the past 20 years, with *F. moniliforme* and *F. oxysporum* most commonly associated with symptomatic plants.

A survey was conducted in the Willamette Valley in the summer of 1996 to determine the extent of the stalk rot problem in sweet corn plantings, and to determine *Fusarium* species commonly recovered from diseased plants.

MATERIALS AND METHODS

Forty-two fields between Woodburn and Walterville, near Springfield, were visited by our laboratory group during silking in August and September of 1996. Corn plants from 18 of these fields were sampled for disease and pathogen analysis. In addition, 10 fields were sampled by extension and processor representatives and submitted to us for analysis. Plants from four of the sampled fields were symptomless; plants from the other 24 fields showed varying degrees of symptoms from slight to severe.

Sampled plants were evaluated for the number of leaves showing firing and for the condition of the roots, interior pith, and ears. Roots were washed in tap water and in distilled water with Tergitol added to aid in the removal of soil particles. Roots were evaluated for size of the rootball, amount of fibrous roots and percentage of healthy roots. Stems were sliced longitudinally and the interior tissue was evaluated for pithiness and the extent of discoloration, brown to black or red. Ears, when present, were observed for dimpling and fungal growth.

Three to five plants were selected from each field sample for plating on agar media to determine fungal infection. Roots were cut into 1 mm segments at the demarcation between healthy and necrotic tissue. Stems were surface sterilized in 10% bleach for 5 min and rinsed in distilled water

for 1 min. Root segments and 1-2 mm long pieces of the crown and the 3rd node were placed on one plate each of Nash-Snyder, modified Komada's and potato dextrose agar (PDA) media. Nash-Snyder and modified Komada's are selective for *Fusarium*, whereas PDA is a general medium for the isolation of fungi. Plates were placed under fluorescent lights at room temperature to induce sporulation.

After 5 to 7 days, fungal colonies of different morphology were transferred onto carnation leaf agar (CLA) and PDA for identification. Cultures of *Fusarium* were identified to species based on the presence and morphology of macroconidia, microconidia, and chlamydospores on CLA, and on the color and growth characteristics on PDA.

Four fields representing different locations in the Willamette Valley were selected for nematode analysis. The corn plants selected had fired leaves and roots with black lesions. Root and soil samples were tested by the OSU Nematode Lab for presence and abundance of root lesion nematodes.

Crop history survey forms were sent in mid-November to field representatives or growers of the most severely affected fields.

RESULTS

Plants in the 42 fields visited ranged from healthy to very symptomatic. Twenty-nine percent of the fields had plants with leaves that were brown beyond the first leaf or suckers. The most severely affected fields were located around Stayton, Dayton, Coburg and Walterville (Fig 1).

A total of 109 plants were sampled from 28 fields. Evaluations of corn roots indicated that two-thirds of the plants had a root mass that was 25% or more rotted. Commonly, lower roots appeared black with many fibrous healthy roots originating from the stalk above the diseased roots. Leaf firing ranged from 1 to 8 leaves up the stem but rarely extended beyond the ear. A slight correlation ($r=0.58$, $P=0.0001$) existed between the number of leaves that were fired and the

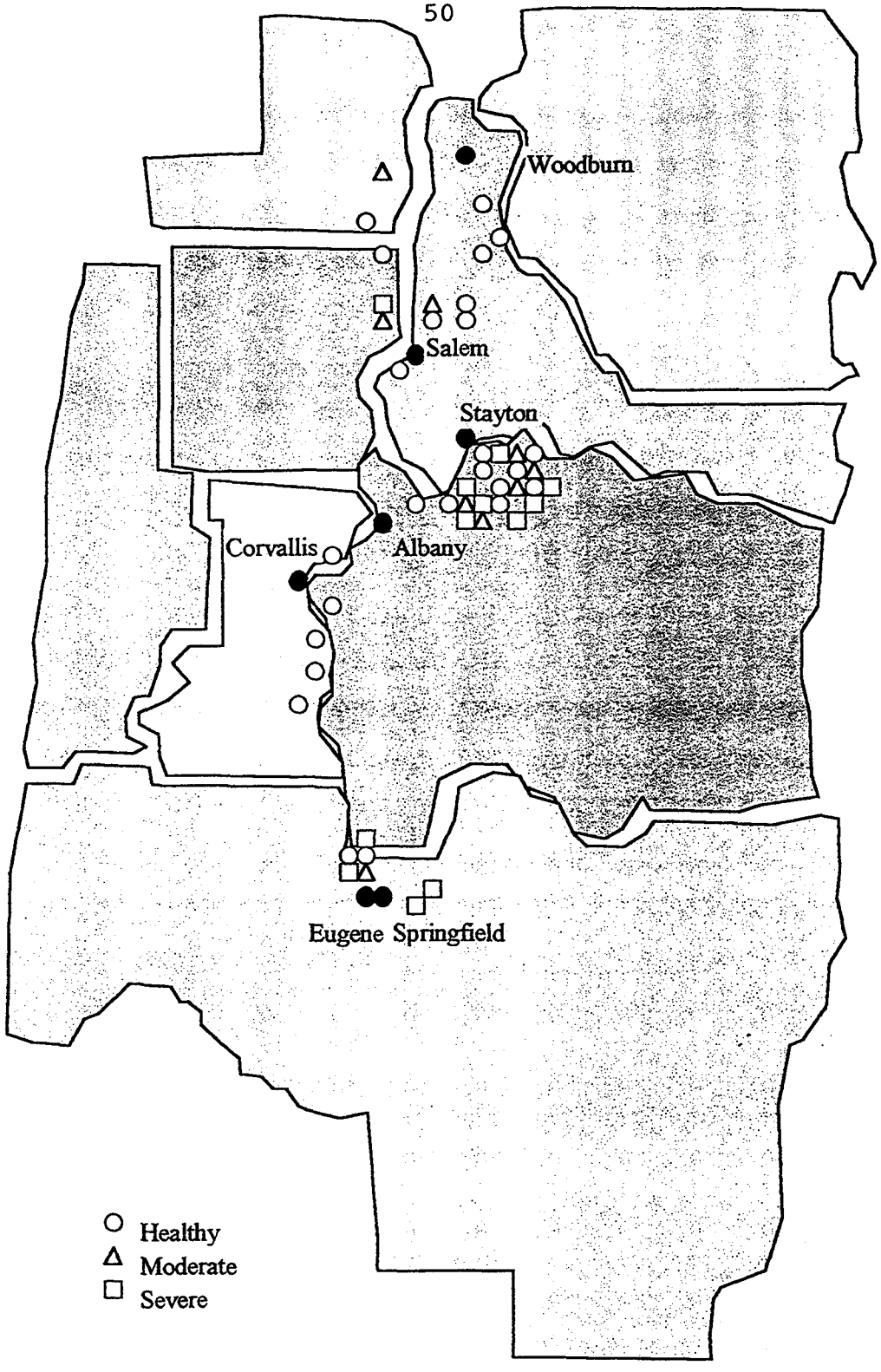

Fig 1. Severity of stalk rot symptoms in sweet corn fields visited in the Willamette Valley in 1996.

percent of root mass that was diseased. The interior of the crown tissue varied from no discoloration or slightly brown to red or black; severe discoloration was found in 25% of the sampled plants. Interior pith tissue was usually healthy and appeared shredded in only 7% of the plants. A few plants had longitudinal red or brown streaks in the pith. Most plant samples did not have ears mature enough to evaluate; samples from four fields, however, had ears that were shriveled or dimpled.

Fusarium colonies grew from all roots plated, and a total of 503 isolates were identified (Fig 2). The most commonly occurring species isolated from roots were *F. oxysporum* (66%) and *F. solani* (23%), followed by *F. culmorum* (3%), and *F. equiseti* (3%). *F. moniliforme* was rarely isolated from roots (less than 1%). All other species accounted for a total of 4% of the root isolations.

F. oxysporum also predominated in the plant above ground, occurring in 30% of crowns and 25% of nodes sampled (Fig 3). Other species isolated from crowns were *F. equiseti* (5%), *F. subglutinans* (4%), *F. culmorum* (4%), *F. avenaceum* (2%), *F. moniliforme* (2%), and *F. proliferatum* (2%). *F. subglutinans* was isolated from 10% of the nodes, followed by *F. proliferatum* (4%), *F. avenaceum* (3%), and *F. moniliforme* (2%). Fungi were not isolated from 54 % and 60% of the crowns and nodes sampled, respectively. The fusaria species found in stems and nodes were distributed throughout the valley and not clustered in any one location (Fig. 4).

Nematodes were not detectable in three of the four sampled fields. The fourth field had 6.5 *Pratylenchus* per gram of root tissue, which is not considered high enough to cause significant damage.

CONCLUSION

Examination of plants revealed symptoms indicative of several potential problems: rotted roots, rotted stalks, fired leaves and spider mite damage to leaves. There was only a slight correlation between rotted roots and rotted stalks on sampled plants; a number of plants showed root rot but not stalk rot symptoms and relatively few plants showed stalk rot without root rot. Similarly,

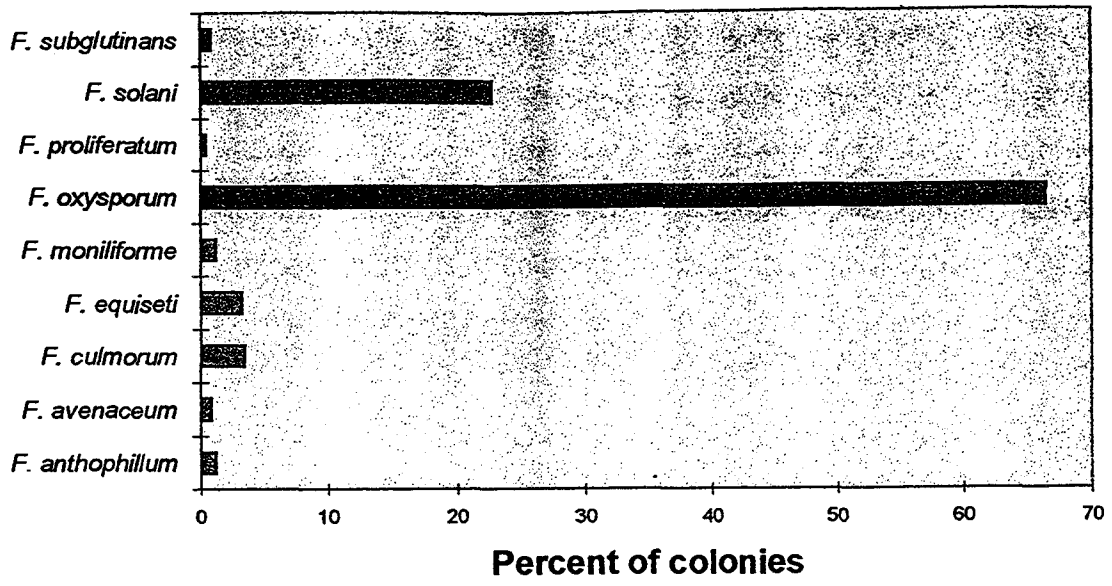

Fig 2. Percent recovery of colonies of fusarium species isolated from roots of sweet corn.

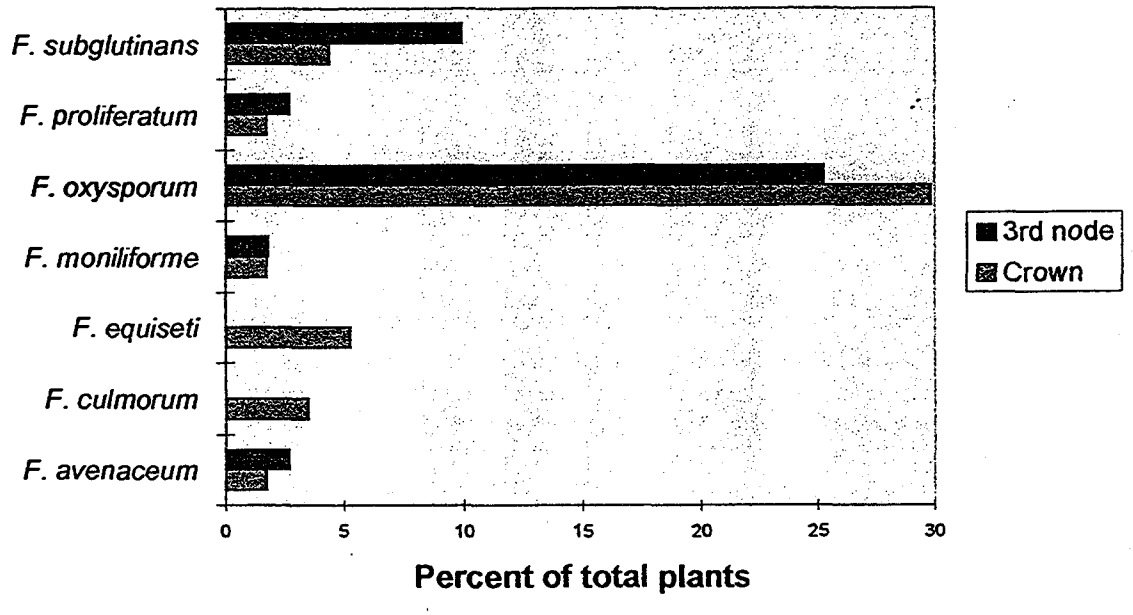

Fig 3. Percentage of sweet corn plants from which fusarium species were isolated.

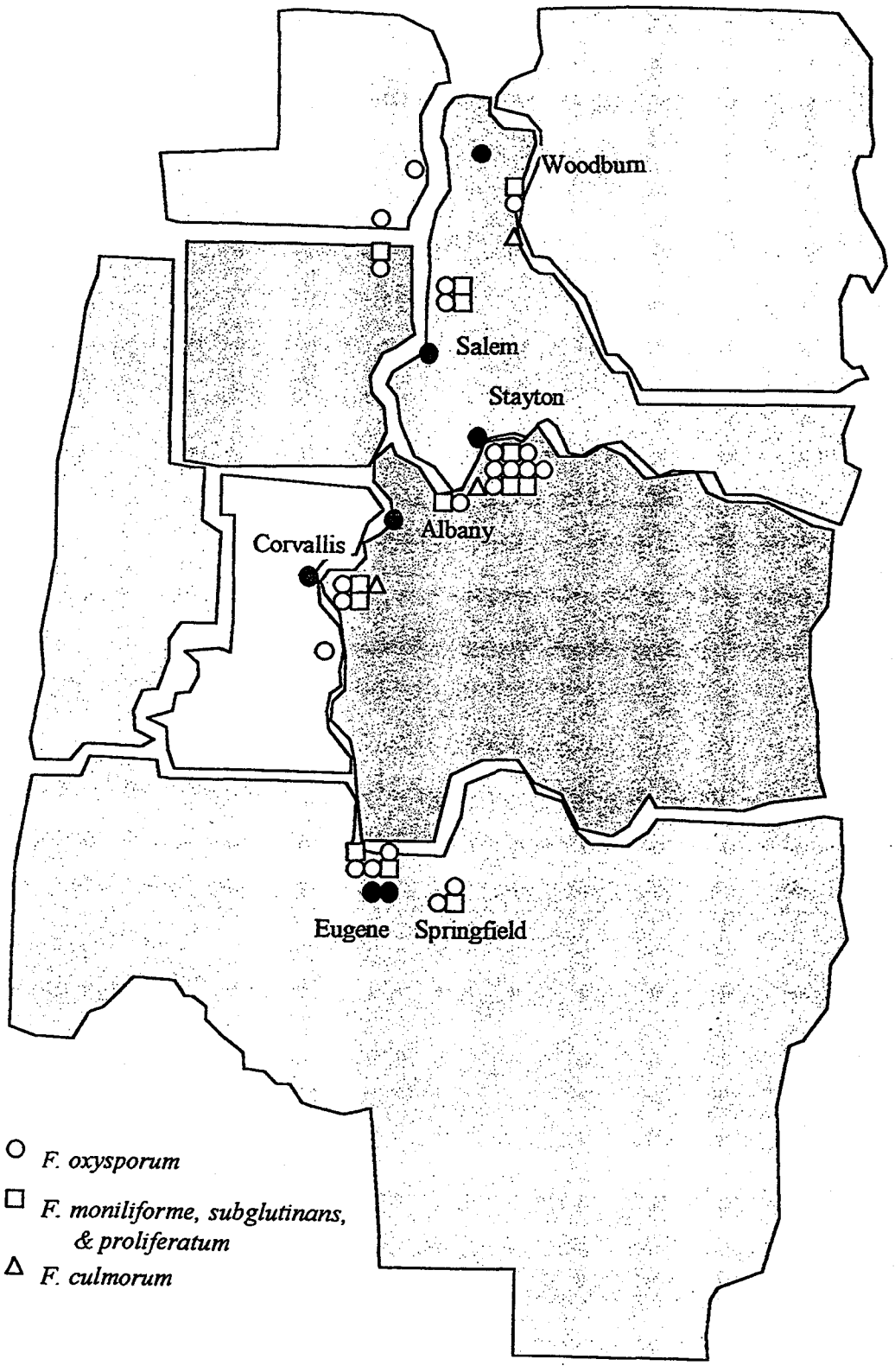

Fig 4. Distribution of fusarium species isolated from the crowns and nodes of sweet corn plants sampled.

spider mite damage, which appeared as mottling on the leaf, was sometimes but not always associated with stalk rot.

Culturing for pathogen analysis showed that species of *Fusarium* occurred with different frequency in the roots and the aboveground portions of the plants. *F. oxysporum* was the predominant organism in both roots and aboveground parts, but the percentage of this species was much higher in roots. Although *F. oxysporum* has often been isolated from corn stalks in areas throughout the US, its role in stalk rot is not fully understood. *F. solani* was the second most frequent organism in roots, but was found rarely in crowns and not at all in nodes. Research on field corn has shown that *F. oxysporum* and possibly *F. solani* can be pathogens of root rots. However, root rots are common and generally not considered to cause severe losses. Although root rot itself may not be a significant problem, it has been reported to predispose plants to stalk rot.

F. moniliforme has commonly been reported as a stalk rot pathogen. Because of the complex nature of the *Fusarium* genus, similar species have been grouped together at various times. In the past *F. subglutinans* and *proliferatum* were often grouped with the species *moniliforme*. We found these three species in 15% of nodes and 9% of crowns, but in less than 1% of roots. Studies have shown that *F. moniliforme* is not soil-borne, but that stalk infections may be the result of infected seed or of direct stalk penetration by spores from corn debris. This is consistent with our recovery of this species primarily from stems and only rarely from roots.

Fusarium culmorum was recovered at low levels from roots and crowns. *F. culmorum* is the predominant cause of corn stalk rot in Europe, and in the U.S. is known to be a pathogen of cereals and grasses. *F. avenaceum*, which was rarely recovered from roots, crowns, and nodes, is also a pathogen of cereals. *F. equiseti*, recovered at low levels from roots, crowns, and nodes, has not been reported as a pathogen on corn..

Pathogen analysis revealed that *Fusarium* species were isolated with approximately the same frequency from the healthy and diseased plants, appearing to indicate a lack of a causal disease agent. However, this is consistent with other surveys in the U.S. in which *Fusarium* species appear

to be opportunistic fungi that invade plant tissue but do not cause disease until the plant begins to senesce or comes under stress. Fusaria have commonly been found in low numbers in assymptomatic corn stalks early in the season, increasing in number and spreading systemically as the season progresses. Several plant stresses have been observed to predispose corn to stalk rot. These include early season water deficit, leaf injury from insect or mite feeding, root injury, and hail damage.

Our survey indicates a number of sweet corn fields in the Willamette Valley that are not at optimum health. As stalk rot is most likely a symptom of stresses occurring in the field, reported strategies for the control include planting resistant varieties, providing balanced fertilization with equal amounts of nitrogen and potassium, avoiding high plant populations, and avoiding drought stress.