NURSERY DISEASE NOTES **USDA FOREST SERVICE**

NORTHERN REGION
FOREST HEALTH PROTECTION

No. 142 **February 2001**

OUTBREAK OF *SIROCOCCUS STROBILINUS* ON 2-0 PONDEROSA AND LODGEPOLE PINE SEEDLINGS- USDA FOREST SERVICE NURSERY COEUR D'ALENE, IDAHO

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ABSTRACT

An outbreak of stem tip and lateral branch dieback caused by the fungus *Sirococcus strobilinus* was detected on 2-0 ponderosa and lodgepole pine seedlings during the spring and early summer of 2000 at the USDA Forest Service Nursery, Coeur d'Alene, Idaho. Ponderosa pine was generally more severely affected by the disease than lodgepole pine. Affected seedlings were either scattered or concentrated in groups of varying sizes within seedbeds. More severe disease was noted toward the eastern ends of seedbeds adjacent to large ponderosa pine trees that border seedbeds. Bi-weekly applications of chlorothalonil were not very effective in reducing disease impacts until prolonged periods of warm, dry weather occurred after July 4th. Slightly-affected seedlings recovered from the disease by producing new terminals and lateral branches from adventitious buds. However, more severely-affected seedlings were either killed by the pathogen or never recovered sufficiently and had to be culled following lifting.

INTRODUCTION

Ponderosa (*Pinus ponderosa* Laws.) and lodgepole pine (*P. contorta* Dougl.) are important reforestation species in the inland Pacific Northwest. Production of these species constitutes an important part of the bareroot seedling program at the USDA Forest Service Nursery, Coeur d'Alene, Idaho. Bareroot pine seedlings are grown for two years at the nursery prior to lifting. These crops are

infrequently impacted by diseases at the Coeur d'Alene Nursery. However, during the spring of 2000, 2-0 ponderosa and lodgepole pine crops became seriously damaged by a disorder, resulting in dieback of the main stem and lateral branches (figure 1 – page 7). Many affected main stems were bent over with necrosis extending part way down the stem. Necrotic lateral branches were mostly concentrated near the base of affected seedlings. Affected seedlings were for the most part scattered throughout seedbeds. However, in a few cases large groups of affected seedlings occurred, particularly within ponderosa pine (figure 2 – page 7). More affected seedlings were concentrated within the interior rather than the outside seedling rows. It was apparent that the disease had spread readily from one seedling to another. The preponderance of large disease groups were concentrated near the eastern edge of seedbeds, adjacent to large ponderosa pine trees that border production beds.

This report describes work designed to determine etiology of this disorder and briefly outlines some important aspects of the biology of the causal agent and control considerations of the disease.

METHODS

Fifteen ponderosa and lodgepole pine seedlings with various levels of terminal and lateral branch dieback were analyzed in the laboratory for presence of associated, potentially-pathogenic fungi. Necrotic stem tips and lateral branches were washed thoroughly and placed in moist chambers to promote fungal sporulation. In addition, isolations were made from the margins of necrotic tissues, i.e., where necrotic tissues met healthy, green tissues. Pieces of tissue were extracted aseptically, surface sterilized in 0.525% aqueous sodium hypochlorite, rinsed in sterile, distilled water, and placed on 2% water agar. Plates were incubated at about 24°C under diurnal fluorescent light for 24-48 hrs. Emerging fungi were transferred to potato dextrose agar, incubated for a few days, and examined for fungal sporulation.

RESULTS AND DISCUSSION

Fungal sporulation was common on all incubated tissues; pycnidia were usually profusely formed, especially under fasicle sheaths at the base of needles. Spores produced from most pycnidia on all examined seedlings were hyaline, two-celled, with pointed ends at each cell terminus. This fungal morphology was indicative of the fungus *Sirococcus strobilinus* Preuss (Funk 1972; Robak 1956; Shahin and Claflin 1978; Skilling and O'Brien 1973). Pycnidia of *S. strobilinus* were also readily formed in culture from isolations made from necrotic margin tissues; spores produced within these pynidia were similar to those observed from pycnidia found directly on necrotic stem tissues (Skilling and O'Brien 1973).

Sirococcus strobilinuus is a fairly common pathogen that occurs on large forest and plantation trees as well as nursery stock. This pathogen has been reported in native forest stands and is especially common on younger plantation trees or natural regeneration (Grand and Jones 1980; Wicker et al.

1978). Conifers in the genera *Abies, Picea, Pinus* and *Tsuga* may all be affected (Grand and Jones 1980; Wicker et al. 1978). In natural stands, the fungus usually causes low levels of branch dieback and does not seriously impact infected trees (Magasi 1975; Shaw et al. 1981). However, some severe disease outbreaks in natural forests have been reported, especially on young natural regeneration in areas where cool, wet conditions prevail throughout much of the year (Nicholls and Robbins 1984; Shaw et al. 1981; Wicker et al. 1978).

The pathogen has also previously been detected on several different conifer species in bareroot forest nurseries, including red (Croghan 1981; Magasi 1975; O'Brien 1973), ponderosa (James 1983a, 1985c, 1986b, 1986c), Jeffrey (Kliejunas and Allison 1983; Smith 1973), Coulter (Smith 1973), sugar (Smith 1973), and lodgepole pine (Illingworth 1973; James 1985c, 1986b). Other common nursery hosts include Engelmann (James 1983b, 1985b, 1987; Sutherland et al. 1981), blue (James 1986a, 1986c), Sitka (Sutherland et al. 1981), black (Magasi et al. 1975) and white spruce (Magasi et al. 1975; Sutherland et al. 1981). In bareroot operations, the pathogen causes primarily tip and lateral branch dieback of *Pinus* and *Picea* spp. (James 1986c; Nicholls and Robbins 1984). Infection initially occurs on young needles; the fungus eventually colonizes elongating succulent shoots in the spring (Nicholls and Robbins 1984; Smith 1973). Infection can occur during each growing season in nurseries (Smith 1973). Primary inoculum in bareroot nurseries usually comes from nearby infected large pine trees (Nicholls and Robbins 1984; Srago 1978), although in some cases the pathogen may be seedborne (James 1987; Nicholls and Robbins 1984; Sutherland et al. 1981). Seedling mortality is usually rare on bareroot seedlings, although some seedling death may occur, particularly during the first growing season, if infection levels are high and environmental conditions are conducive (James 1986b). In most cases, infected seedlings are not killed but usually have to be discarded after lifting because they do not meet production standards (James 1986b, 1986c). *Sirococcus* may sometimes be introduced into natural forests or plantations on infected nursery stock (Shahin and Claflin 1978).

Sirococcus strobilinus may also occur in container nurseries where it is often seedborne on spruce species (James 1987; Sutherland et al. 1981); under such conditions, the pathogen reduces seed germination (pre-emergence damping-off) and causes post-emergence mortality early in the growth cycle (James 1987; Sutherland et al. 1981).

When the disease became apparent during the spring of 2000, growers at the Coeur d'Alene Nursery began applying chlorothalonil (Bravo®) at biweekly intervals to reduce disease impacts and spread. Cholorothalonil has previously been effective in controlling this disease (Croghan 1981; Kliejunas and Allison 1983; Smith et al. 1972; Srago 1978). Other reported effective fungicides include triadimefon (Kliejunas and Allison 1983), ectaconazole (Kliejunas and Allison 1983), difolitan (Smith et al. 1972) and maneb (Smith et al. 1972). Iprodione (Kliejunas and Allison 1983) and benomyl (Smith et al. 1972) have generally been ineffective.

Unfortunately, cool, wet weather persisted at the nursery throughout the spring so that fungicide applications were only of limited efficacy in restricting disease buildup and pathogen spread. Warm, dry weather finally occurred shortly after July 4th and disease severity reduced greatly. Further development and spread of the disease did not occur during the prolonged warm dry summer months that occurred during 2000. In many cases, slightly-infected seedlings seemed to recover by producing new terminals and lateral branches from adventitious buds. However, low levels of seedling mortality occurred on severely-infected seedlings. Some diseased seedlings had to be culled during lifting because they did not meet production standards.

Sirococcus strobilinus has periodically caused diseases at the Coeur d'Alene Nursery, usually resulting in limited amounts of damage (James 1983b, 1985c, 1987). However, when disease-conducive weather conditions prevail in the spring and early summer and pathogen inoculum occurs at high levels, severe damage is possible. Rapid disease spread in bareroot beds seems mostly related to prolonged cool, wet conditions.

Routine spring fungicide applications, such as those used to annually control *Meria laricis* on bareroot western larch seedlings (James 1985a, 1998), are probably not currently warranted. However, if disease levels remain high, some form of prevention may be required. This may involve routine fungicide applications. However, a more effective and practical approach may be to restrict bareroot production of susceptible pine species in fields where they will not be near surrounding large ponderosa pine trees. Since primary fungal inoculum likely comes from these large trees, particularly on infected cones (Nicholls and Robbins 1984), pine seedlings produced in portions of fields near the center of the nursery would probably not be exposed to pathogen inoculum as much as those produced near the edges of fields. There are several locations where seedlings would probably be of sufficient distance from inoculum sources to reduce the likelihood of high levels of infection during most years.

Another important disease management procedure is early detection. If the disease is detected, confirmed, and seems to be spreading during early spring on second-year seedlings, fungicide applications can be made which would likely be more efficacious than if they were applied later when the disease is more widespread and inoculum levels are significantly higher. By combining prevention and direct pesticide applications, future impacts of Sirococcus tip blight should be greatly reduced at the Coeur d'Alene Nursery.

LITERATURE CITED

Croghan, C.F. 1981. 1981 Forest Pest Management Nursery Report. USDA Forest Service, Northeastern Area, State & Private Forestry. 7p.

Funk, A. 1972. Sirococcus shoot-blight of western hemlock in British Columbia and Alaska. Plant Disease Reporter 56:645-647.

Grand, L.F. and R.K. Jones 1980. Sirococcus shoot blight of blue spruce in North Carolina. Plant Disease 64:413-414.

Illingworth, K. 1973. Variation in the susceptibility of lodgepole pine provenances to Sirococcus shoot blight. Canadian Journal of Forest Research 3:585-589.

James, R.L. 1983a. Fungi associated with tip dieback of ponderosa pine seedlings at the Clifty View Nursery, Bonners Ferry, Idaho. USDA Forest Service, Northern Region, Forest Pest Management. Nursery Disease Notes No. 2. 6p.

James, R.L. 1983b. Sirococcus strobilinus on containerized Engelmann spruce seedlings at the Coeur d'Alene Nursery, Idaho. USDA Forest Service, Northern Region, Forest Pest Management. Report 83-20. 3p.

James, R.L. 1985a. Meria needle cast of western larch seedlings at the USDA Forest Service Nursery, Coeur d'Alene, Idaho. USDA Forest Service, Northern Region, Forest Pest Management. Report 85-20. 6p.

James, R.L. 1985b. Sirococcus tip blight on bareroot Engelmann spruce seedlings at the Clifty View Nursery, Bonners Ferry, Idaho. USDA Forest Service, Northern Region, Forest Pest Management. Nursery Disease Notes No. 19. 3p.

James, R.L. 1985c. Top blight of bareroot ponderosa and lodgepole pine seedlings at the USDA Forest Service Nursery, Coeur d'Alene, Idaho. USDA Forest Service, Northern Region, Forest Pest Management. Nursery Disease Notes No. 20. 3p.

James, R.L. 1986a. Mortality of bareroot Colorado blue spruce seedlings, Clifty View Nursery, Bonners Ferry, Idaho. USDA Forest Service, Northern Region, Forest Pest Management. Nursery Disease Notes No. 37. 3p.

James, R.L. 1986b. Sirococcus tip blight of bareroot pine seedlings at the Champion Timberlands Nursery, Plains, Montana. USDA Forest Service, Northern Region, Forest Pest Mangement. Nursery Disease Notes No. 33. 3p.

James, R.L. 1986c. Tip blight of bareroot ponderosa pine and blue spruce seedlings at the Montana State Nursery, Missoula. USDA Forest Service, Northern Region, Forest Pest Management. Nursery Disease Notes No. 41. 3p.

James, R.L. 1987. Containerized Engelmann spruce seedling mortality, USDA Forest Service Nursery, Coeur d'Alene, Idaho – 1987. USDA Forest Service, Northern Region, Forest Pest Management. Nursery Disease Notes No.50. 3p.

James, R.L. 1998. Recovery of 2-0 western larch from severe Meria needle cast - USDA Forest Service Nursery, Coeur d'Alene, Idaho. USDA Forest Service, Northern Region, Forest Health Protection. Nursery Disease Notes No. 139. 6p.

Kliejunas, J. and J. Allison. 1983. Evaluation of fungicides for control of Phoma blight of red fir and Sirococcus

tip blight of Jeffrey pine at the Humboldt Nursery. USDA Forest Service, Pacific Southwest Region, Forest Pest Management. Report No. 83-22. 8p.

Magasi, L.P. 1975. First record of Sirococcus shoot blight on red pine in Nova Scotia. Plant Disease Reporter 59:623-624.

Magasi, L.P., S.A. Manley and R.E. Wall. 1975. *Sirococcus strobilinus*, a new disease of spruce seedlings in Maritime nurseries. Plant Disease Reporter 59:664.

Nicholls, T.H. and K. Robbins. 1984. Sirococcus shoot blight. USDA Forest Service, Forest Insect & Disease Leaflet 166. 6p.

O'Brien, J.T. 1973. Sirococcus shoot blight of red pine. Plant Disease Reporter 57:246-247.

Robak, H. 1956. Some fungi occurring on died-back tops and branches of *Picea abies* and *Abies* spp. in western Norway. Friesia 5:366-389.

Shahin, E.A. and L.E. Claflin. 1978. The occurrence of Sirococcus shoot blight of spruce in Kansas. Plant Disease Reporter 62:648-650.

Shaw, C.G. III, T.H. Laurent and S. Israelson. 1981. Development of Sirococcus shoot blight following thinning in western hemlock regeneration. USDA Forest Service, Pacific Northwest Forest & Range Experiment Station. Research Note PNW-387. 6p.

Skilling, D.D. and J.T. O'Brien. 1973. How to identify Scleroderris canker and red pine shoot blight. USDA Forest Service, North Central Forest Experiment Station. Pamphlet. 6p.

Smith, R.S., Jr. 1973. Sirococcus tip dieback of *Pinus* spp. in California forest nurseries. Plant Disease Reporter 57:69-73.

Smith, R.S., Jr., A.H. McCain, M. Srago, R.F. Krohn and D. Perry. 1972. Control of Sirococcus tip blight of Jeffrey pine seedlings. Plant Disease Reporter 56:241-242.

Srago, M.D. 1978. Nursery disease problems – *Sirococcus strobilinus*. *In*: Gustafson, R.W. (ed.). Proceedings of the 1978 Nurseryman's Conference & Seed Processing Workshop. Forest Nursery Council & Intermountain Forest Nurseryman's Association. pp. B-134 – B-137.

Sutherland, J.R., W. Lock and S.H. Farris. 1981. Sirococcus blight: a seed-borne disease of container-grown spruce seedlings in coastal British Columbia forest nurseries. Canadian Journal of Botany 59:559-562.

Wicker, E.F., T.H. Laurent and S. Israelson. 1978. Sirococcus shoot blight damage to western hemlock regeneration at Thomas Bay, Alaska. USDA Forest Service, Intermountain Forest & Range Experiment Station. Research Paper INT-198. 11p.

Figure 1. Scattered 2-0 ponderosa pine seedlings with main stem and lateral branch dieback caused by *Sirococcus strobilinus* at the USDA Forest Service Nursery, Coeur d'Alene, Idaho.

Figure 2. Large group of 2-0 ponderosa pine seedlings with tip dieback caused by *Sirococcus strobilinus* at the USDA Forest Service Nursery, Coeur d'Alene, Idaho.

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