TREE IMPROVEMENT

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Seed and Seedling Extension Topics

Extension Services Section - Editor, Glenn Matthews

It's finally happened. The first issue of a newsletter for nurseries, seed orchards and others interested in the regeneration phase of forestry. The initiative comes from the ever increasing size of the nursery program, which is making it difficult to keep everyone up to date technically by means of regular nursery visits, and from the expansion of duties resulting from reorganization within the Silviculture Branch.

Our new group, called **Administration and Extension,** is currently headed by Acting Manager, Clare Kooistra. On the Administration side are:

Nursery Planning-	Mike Pelchat
Nursery Planning-	Patti Kagawa
Seed/Seed Orchard Admin/Planning-	Paul Birzins
Seed /Seed Orchard Planner-	Cam Bartram
Nursery Admin. Coast-	Jim Sweeten
Nursery Admin. Island-	Helmut Mueller
Nursery Admin. North-	Drew Brazier
Nursery Admin. South-	Stewart Haywood-Farmer

The remainder compromise the Extension Services Section:

Nursery Culturist, Container and Bareroot-	Glenn Matthews
Greenhouse Specialist, & Seed Orchard Culture-	Wayne Gates
Nursery Pest Management-	Gwen Shrimpton
Seed Orchard Pest Management-	Don Summers
	Bev McEntire
Saanich Test Nursery-	Allan McDonald
	Susan Zedel

The newsletter will be a vehicle of Extension Services to enhance communication among nurseries, seed orchards, research agencies, administrators and field staff. It is organized in sections designed to accommodate different levels of interest and available time. The purpose of the newsletter is to disseminate technical information from anyone who would like to contribute. We need input from readers on any new equipment, procedures or observations that might be useful to others producing seed or seedlings. We hope to send out newsletters 3 or 4 times per year, but the frequency will partly depend on your cooperation. Submissions will be typed in the required format by the Silviculture Branch. Please forward items for the next issue by October 15, along with your comments on the format and suitability of the newsletter to any member of Extension Services.

Grower's Notes*

Florida researchers have found that plant stress affects Pythium development in English Ivy *(Hedera Helix).* With greenhouse techniques becoming more refined by controlling light, temperature, soil pH, moisture and fertility, plant stress has dropped but not disappeared. Few plants in production are free of pathogens, so stress can become an important consideration. Vigorous plants may have an undetectable level of *Pythium* root rot but appear healthy because they produce more roots than the pathogen is damaging. If excess moisture remains in the medium for several days, root tips may die due to lack of oxygen. Dead or dying root tips are easily invaded by *Pythium* species. Foliar symptoms then develop and the root disease becomes evident.

Wayne Gates

Now you can see what's bugging your crop with the aid of an excellent pocket sized field microscope. This 30 power microscope made by Micronta is less than 15 cm long and has a thumbscrew focus. Light is directed onto the object by means of 2 "AA" batteries. It is available under #63-850 in the Radio Shack catalogue.

The fungicide Rovral is now registered for control of *Botrytis* in conifer seedling nurseries. Growers should have received a copy of the new label and specific control recommendations this spring. Overuse of this product will lead to the development of Rovrat tolerant strains of *Botrytis.*

All nurseries growing *Abies* species at any location in the province for any purpose must obtain an annual permit through the Ministry of Agriculture and Fisheries. Details of this permit will be included in the next newsletter.

*Mention of commercial products in this newsletter does not constitute endorsement by the Ministry of Forests.

Populations of the cranberry girdler, a small pyralid moth, appear to be increasing across the province. Larvae girdle seedling stems at the soil line in the fall. Larger stock types are preferred in both container and bareroot crops. Douglas-fir and true firs are attacked most frequently, followed by spruce. An effective control program using pheremone traps and insecticides is available for this pest.

The western spruce bud worm *Choristoneura occidentalis* will again be a problem at nurseries in the southern interior. Larvae are active from mid-May to the end of June and are very destructive feeders. They prefer Douglas-fir and spruce, and insecticide applications ihay be necessary to protect the crop. Adult moths fly from mid-june to mid-July. Larvae resulting from eggs laid on seedlings could be a problem in the nursery or at reforestation sites the following spring. A pheremone monitoring program combined with an insecticidal spray has been effective in reducing or preventing oviposition.

Damage from the Lygus bug has now been found at almost all facilities and in the most stock types across the province. An effective control program using the synthetic pyrethroid Cymbush has been developed for this pest. Although Cymbush is not yet fully registered, a special use permit has been granted for B.C. nurseries for 1988. A copy of the permit and details of the control program were sent to all nurseries this spring.

Gwen Shrimpton

The cone bug *Leptoglossus* reproduces in June and July. They damage seeds by piercing them with long beaks and sucking out the contents. Watch for them congregating on branches and cones on the sunny side of the trees.

Douglas-fir cone gall midge populations were low to moderate in most coastal seed orchards this spring. In general, levels were below the spray threshold of 2.7 infested scales per conelet.

Pineus pinifoliae is a gall aphid that alternates between spruce and white pine. It's galls are almost identical in appearance to spruce cones. In the southern interior this year, adults were emerging from mature galls in May. This is much earlier than most of the other gall aphids, which emerge in late June or July.

Gall aphids in general seem to be a minor problem on spruce this year, however *Adelges* populations on the now Douglas-fir growth are higher than usual. Observations on subsequent damage and/or successful control programs would be welcomed.

Don Summers

A great deal has been learned about the use and interpretation of tissue analysis in the last two or three years. It is now an appropriate time to modify and standardize sampling procedures so that results will remain comparable.

In the first several weeks of growth, there is little point in tissue analysis unless a serious problem is suspected. Since nutrients are reported in percent of dry weight, most results will be very high at this stage as tissue is mostly fluids. For the remainder of the first growing season, whole tops should be sampled.

In the second and subsequent growing seasons, it makes more sense from a diagnostic point of view to sample only the current year's flush. If the whole tree or all needles are sampled, elements like calcium and boron may appear to be normal because they have accumulated to relatively high levels in the old needles. Since these and other elements are immobile in the plant, the new fast growing tissue could be deficient, but it will not be apparent by analysis of the whole tree.

Samples from seed orchard trees should be taken from the second or third whorl near the top of the tree if possible for similar reasons. Analyses from seed orchards may be more like typical forest analyses rather than the standards developed for nurseries, i.e., several nutrients (N, P, and some trace elements) may appear to be low by nursery standards.

Sampling every 4 - 6 weeks during the growing season is adequate unless a problem is suspected. Five grams of dry weight is the usual lab requirement. After collection, samples should be rinsed in tap water, then in distilled water to remove any external nutrients, especially trace elements. They should then be air dried or dried at 60'C to prevent mold during shipping.

New standards for tissue analysis of coniferous nursery stock have been developed recently. These are general guidelines that must be modified to accommodate species, environment and growth stage differences. Except for the iron analysis, abnormalities in crop development will not be due directly to nutrition if levels fall near the target range. If pH is high (6+), iron in susceptible species like Douglas-fir will become unavailable and the analysis for total iron will be meaningless.

Element		Target %	Range %
N	Nitrogen	2.00	1.5 - 3.5
P	Phosphorous	0.25	0.2 - 0.4
K	Potassium	1.00	0.8 - 2.0
Ca	Calcium	0.35	0.2 - 1.0
Mg	Magnesium	0.15	0.12 - 0.3
S	Sulphur	10% of N level	0.15 minimum
		ppm	**ppm**
Fe	Iron	100	80 - 600
Cu	Copper	8	4 - 20
Zn	Zinc	30	25 - 80
Mn	Manganese	100	80 - and up
B	Boron	30	20 - 50

Rob Scagel (Pacific Phytometric Consultants) has been awarded a two year FRDA contract to establish the physical qualities required of the growing medium, and to survey properties of media currently in use. When tar- gets for aeration, drainage etc. have been established, the qualities of individual components will be more readily defined. At present, specifications for materials like peat moss are evolving based on experience. Following are typical air-dried peat screening specifications requested and received by the Ministry of Forests.

	% Finer Than 100 Mesh	100-20	20-10	Coarser Than 10 Mesh
Received - 1987	10.7	44.4	26.1	18.8
Specification - 1988		35	30	35
Received - 1988	1.3	40.3	36.9	21.5
Specification - 1989 (pH 3.54-5)		35	35	30

Current supplies of sphagnun peat moss should meet the proposed 1989 specifications. Depending on the results of Scagel's work, we may in future increase the percentage in the coarsest fraction, or include amendments that will improve aeration. The "percent finer than I 00 mesh" should be as low as possible to avoid water-logged, anaerobic conditions.

Another useful measure of peat particle size distribution is the coarse/fine ratio. Using a 2mm (10 mesh) screen and air-dried peat, the weight of the coarse fraction is divided by the weight of the fine fraction. A desirable ratio is .5 or more.

Glenn Matthews

Tech Talk

Growth Under Warm Night Temperature Regimes

Work with several horticultural crops has found an advantage in maintaining night temperatures as high or higher than day temperatures. Yields of tomatoes have increased using the technique of maintaining day temperature settings into the night at least until all the products of daylight photosynthesis have been metabolized. This point can be estimated for some crops by knowing the sum of the light energy that the crop received during the previous day.

More recently, work on flower crops in Michigan has shown that height of tall growing crops can be controlled by temperature, rather than having to use growth retardants. For lilies, chrysanthemums and poinsettias, crops can be kept short by increasing night temperatures above those of the daylight hours by 1.5 - 3C. The higher the day temperatures are, relative to nights, the taller the crops are, and the larger the difference of night temperature over those in the day, the more compact the growth is. Within limits that do not result in heat stress, plant maturity and flowering dates are unaffected because these factors depend on 24-hour average temperatures, not day or night temperatures by themselves or the difference between them.

Flower producers have found they can follow predetermined height curves precisely and reduce height growth rates by raising night temperatures from 1 - 3C above day temperatures when necessary. The response to elevated night temperatures can be seen within a few days. The rate of maturity, in this case flower bud development, can be hastened by raising both day and night temperatures without resulting in taller plants, as long as the night - day differential is maintained.

For conifers, Hellmers found that Engelmann spruce produced the greatest height, RCD and root weight when night temperatures were higher than those in the day (19° day - 23° night). After a 5-week establishment period and a 24-week treatment period, strong lateral branching, RCD's of 6.5mm and root weights of 2.2g were achieved on seedlings less than 20-cm tall (grown in pots). Generally speaking, the higher the day temperatures and the lower the night temperatures, the poorer growth was, and days of 35° followed by 3° nights were lethal for Se. Night temperature did not affect timing of bud set, but 15° days were conducive to setting of buds, even under 16-hour photoperiods.

Night temperature is a key environmental factor for Engelmann spruce, but in other trials Norway spruce did not show the marked response to night temperature that Engelmann did, and redwood grew best at lower night temperatures (15°C). Redwood and Engelmann both grew best at day temperatures of 19°C.

In 1972, Brix found that Sitka spruce grew best at a constant 18°, or at 24° days and 18° nights. White spruce was also best at 24° days and 18°nights. Night temperatures higher than day temperatures were not tried.

Shepperd followed up on Hellmers' work to show the importance of soil temperatures. His results for Engelmann were best at day air temperatures of 19° and soil temperatures of 23°, and night air and soil temperatures of 23°. The second best treatment, having shorter and lighter roots, was the same as Hellmer's, i.e., 19° days for both soil and air, and 23° nights.

In Hellmers' trial, total growth was enhanced in Se by elevating night temperatures. Unlike the results in flower crops this included increased height growth under 19° days and 23° nights. This may have been a result of the experimental methods used, i.e., the "day" temperature regime of 8 hours was in a greenhouse under natural light. The 16-hour "night" temperature regime was in growth rooms using 8 hours of darkness and 8 hours of light at 400 ft.c. This artificial light that satisfied photoperiod requirements during the "night" temperature regime amounted to 10 - 15% of the total light received during the trial.

A trial to evaluate the effect of high night temperatures under production greenhouse conditions is being conducted at Saanich Test Nursery this year.

Glenn Matthews

Humidity and the Plant Environment

The most common discussion about humidity centers around disease control. Recently a significant amount of research has been carried out to determine the effects of humidity on plant growth and crop yield. This research was triggered by the fact that yields of some greenhouse vegetable crops were much higher in polyethylene covered greenhouses than might be expected given the lower light conditions in these structures. The Dutch have a rule of thumb that says that for every 1% reduction in light received by the crop there is a similar 1% reduction in yield. This rule does not always hold true under polyethylene.

It is generally observed that humidities arc, higher in poly structures. There are a number of reasons for this. Poly covered greenhouses may be better scaled than older glasshouses. In old glasshouses, air leakage con- tributes to a reduction of humidity. Double polyethylene cladding results in energy savings because of its insulation properties. This means that the inside layer is not as cold as glass. And as a consequence, less moisture is condensed out of the air. Finally, with less light passing through the polyethylene, less ventilation is required which in turn helps in maintaining higher humidities.

Water Transport and Nutrition

The transport of water and nutrients in the plant are influenced by the relative humidity (r.h.). If the humidity is too low, the transpiration rate will be too high. This can happen very easily in a greenhouse with good soil covering and dry grit and blocks. When the transpiration rate is high, large amounts of water and nutrients are transported into the plant. Under these circumstances the needles will be smaller and their colour darker.

The situation is reversed when the r.h. is too high. Transpiration becomes limited resulting in far less water moving through the plant. This reduces the nutrient levels in the tissue. This is particularly true of the tracer elements. The needles will be large and long and generally light in color. The resulting plant is soft and is susceptible to damage if the weather becomes hot and dry and the humidity drops suddenly. Elements such as calcium will be low or deficient in the tissue and may result in growth abnormalities.

Humidity and Photosynthesis

Many factors can have an impact on photosynthesis and reduce its efficiency. One of these is closure of the stomata which prevents carbon dioxide from entering the leaf. With no carbon dioxide available, photosynthesis stops. Although growth may apparently continue, dry matter accumulation has ceased. The opening of the stomata is controlled by water levels in the plant cells. When the stomatal guard cells lose their turgidity because of a water deficit they close as a protective mechanism. Low humidities can cause this to happen. This situation is more severe where root growth is less than optimum or where there is inadequate water avail- able at the roots. Moderate levels of moisture in the surrounding atmosphere are necessary to aid the plant if maximum growth is to be achieved.

It is common for researchers to find that photosynthesis has all but ceased by 10 AM in the field situation. This is invariably due to drought often combined with low humidities. Unfortunately the situation may also occur in the nursery and the grower may not be aware that it is happening. As earlier mentioned, one possible time is during early growth when there is little free water for evaporation and weather conditions are bright. If there is an opportunity to prevent humidities dropping below 60 to 70%, crop growth will likely benefit. If this can be accomplished without free water on the plants, disease will not be a problem. Those nurseries having cooling pads for their greenhouses should find them effective for this purpose.

Another situation that has not been recognized until recently is in the open compound. Water restriction has been used as a height management tool yet block weights have not been commonly used to determine water needs in the second year. It has been found that water demand is extremely high due to the large top mass of the plants. Studies have shown that under management programs that do not supply enough water, the trees will lose rather than gain carbon for a significant portion of the summer. There is no doubt that foliage diseases become an important factor in the crop at this time, so the grower must make a decision as to the lesser evil - less disease or lower vitality.

Wayne Gates

Pest Management

Cylindrocarpon Study - 1988

Introduction

Root rots in container seedlings have increased over the past 3 years. Seedlings die or become stunted and do not meet grading standards, or survive poorly when out- planted. Losses have reached unacceptable levels, e.g. in 1987 root necrosis of Douglas-fir cost the B.C. Forest Nursery Industry approximately $300,000 (Mr. C. Kooistra, personal communication).

Although several fungi have been implicated in seedling root rots, a *Cylindrocarpon* species has been consistently isolated from unhealthy Douglas-fir seedlings in late August, during storage and after outplanting. There is little information on this fungus pertaining to container grown seedlings. To date, prevention and control measures have been unsuccessful.

The Pacific Forestry Centre (PFC) with help from a BCMF seasonal employee is addressing the Douglas- fir / *Cylindrocarpon* problem by monitoring three nurseries which have previously had this problem. It is not known where this fungus originates or when it first enters the plant. By sampling continuously over the growing season, we can determine when the fungus gets into seedlings and when root necrosis begins. By studying several isolates of *Cylindrocarpon* in the laboratory it will be possible to determine the biology and pathology (especially as it relates to environment and cultural practices). The ultimate goal is to find ways to either preventthe disease from occurring or to correct the problem on it is established.

Results to date

Sample #1 (May 13 to 18)

Cylindrocarpon was isolated from all three nurseries in the first sampling (6%,12% & 40%). There was no apparent root necrosis at this time. For fungus isolation roots had been surface sterilized, so it is assumed the fungus was inside the roots.

Sample # 2 (June 2 to 8)

Cylindrocarpon was isolated from seedlings at two of the three nurseries. The nursery with 6% in the first sample did not produce any in this sample. The intensity of infection at the other two nurseries increased. Roots had brown areas and some necrosis was evident.

When the tap root of each sample seedling was divided into top 1/3, middle 1/3, and bottom 1/3 of the container cavity, the Cylindrocarpon was mostly on the roots from the middle of the cavity. This may be because this area stays wet for the longest period of time.

Sensitivity to benomyl of two isolates of *Cylindrocarpon* obtained from sampled seedlings was determined by plating them onto an agar containing benomyl. Although their spores germinated, the two isolates would not grow on the benomyl amended medium.

Future Work

Samples from these three nurseries are continuing to be, analyzed for *Cylindrocarpon*. The shoots of these trees look excellent. Quality control technicians at nurseries growing Douglas-fir should look for root necrosis even if the shoots look healthy. Don't hesitate to send samples to John Dennis at PFC if you see any root rot.

John Dennis - PFC

Sirococcus Slight of Spruce Seedlings in British Columbia: Experimental Work Done at the Pacific Forestry Center

Background

Sirococcus blight, caused by the fungus Sirococcus strobilinus, is a seed-borne disease of container-grown spruce (Picea spp.) in British Columbia. The disease first appears on germinants and young seedlings early in the growing season, especially when cool, moist, overcast weather conditions are prevalent. Initially the disease occurs on seedlings of *S. strobilinus*-infected seedlots and then it spreads to seedlings of other seedlots.

Currently, management of the disease consists of detecting infected seedlots prior to sowing and then alert- iiig nursery staff so that fungicides can be applied promptly if the disease appears. The main disadvantage of this practice is that sometimes the disease becomes well established before it is noticed and secondly, even when the disease is detected early, it is often necessary to apply a fungicide several times to protect the new tissues of the rapidly growing seedlings.

A desirable solution to the *"Sirococcus* problem" would be to either eliminate diseased seeds from infected seed- lots or to kill the pathogen before the seeds are sown. At- tempts to eliminate diseased seeds, e.g., by repeated cleaning of infected seedlots, have been unsuccessful. One method considered having merit for killing S. *strobilinus* in spruce seeds was thermotherapy i.e., treatment with hot water, aerated steam, or hot air.

Hot Water Treatment of Spruce Seeds

1986 trial at PFC

A set of preliminary experiments in the laboratory revealed that the optimum combination of hot water temperature and exposure period for eliminating s. *strobilinus* from pre-soaked but unstratified spruce seeds was 47°C for 30 minutes. (Seeds were pre-soaked to enhance imbibition of the hot water; unstratified seeds were believed to be less sensitive to heat damage than stratified seeds). However, when tested in a container nursery, this temperature/ time combination caused a significant decrease in germination percentages as com- pared with the controls. Heat-treated seeds were also found to have higher R50 values (days to reach 50% germination) than both control seeds (i.e. unstratified and non heat-treated seeds) and seeds which had undergone normal stratification. These results suggest that thermotherapy of spruce seeds with hot water may not be a practical means of sanitizing infected seedlots.

Fungicide Trial

1987 trial at PFC

This trial was initiated because of the apparent impracticality of thermotherapy as a means of combating *Sirococcus* blight and the knowledge that alternative fungicides are needed by nursery staff to manage this disease,. Three fungicides were tested. Two of them, Bayleton 5OWP (triadimefon) and Tilt 250E (propiconazole), have been shown to be effective against *S. strobilinus* on pine in forest nurseries in the USA. The third fungicide, Daconil 2787F (chlorothalonil), is currently used in B.C. nurseries for *Sirococcus* control. These fungicides were applied to stratified spruce seeds at one of five different times, i.e.: (1) in pre-stratification water soak, (2) at sowing, (3) at 50% seedling emergence, (4) at 100% seedling emergence, or (5) at 50 and 100% seedling emergence.

Results

All three fungicides reduced incidence of *Sirococcus as* compared to controls. Keeping in mind that general incidence of *S. strobilinus* was quite low in this experiment (incidence in control treatments ranged from 0 to 1.8%), applications of fungicides at Times 1 and 5 were most effective at combating *Sirococcus.* Daconil, Tilt and Bayleton were equally effective against *S. strobilinus* when used at Time 1. Tilt and Bayleton were more effective than Daconil for all other application times. None of the fungicides had a significant effect on germination rates, germination percentages, or seedling growth.

These results suggest that treating spruce seeds with fungicides in the pre-stratification water could significantly reduce incidence of *Sirococcus strobilinus.*

Rona Sturrock - PFC

Control Program for Root Weevils in Containerized Conifer Seedling Nurseries

Weevils are becoming increasingly important pests in container conifer stock, particularly with the advent of 2+0 culture, because populations are allowed to build for 2 years before stock is lifted. Most infestations have occurred at coastal nurseries to date, however, several nurseries in the southern interior have also been affected. Nurseries in the northern region have not had weevil problems to date.

A) Control program for adult weevils girdling stock.

Several species of adult weevils have been confirmed or are suspected to girdle conifers in greenhouses. Adults of three root weevils *Otiorhynchus ovatus* the strawberry root weevil, *0. rugosostriotus* the rough strawberry root weevil and *0. sulcatus* the black vine weevil has been observed feeding on seedlings.

Adults of *Trachyphloeus bifoveolatus* the small grey grass weevil and *Strophosoma melanogrammum* have been observed in sufficient numbers where damage has occurred to suspect them as the cause.

Girdling consists of a uniform little ring about 7mm wide, often just below the point at which foliage begins in the fleshiest part of the stem. Damage usually occurs in June and July. Weevils seem to attack seedlings for a limited period of time, about 8 weeks after emergence when enough bark tissue has developed for them to feed, but before the stems have become too woody. Most girdled seedlings are between 9 and 15 cm in height. Seedlings at the edges of the greenhouses and ones on the outsides of the styroblocks are attacked most frequently. Usually only one seedling is girdled at a time. There appears to be a preference for spruce, however cedar, larch, fir and pine have also been attacked.

Adult root weevils are elusive, feeding at night and hiding during the day. As a result, populations usually go undetected until damage occurs. Monitoring programs have been attempted at several nurseries. Weevil boards, bait stations, pitfall traps, indicator plants such as rhododendrons and sticky traps have all been tried without success.

A control program to reduce girdling by adult weevils has been developed and successfully implemented at one nursery. Use Belmark (fenvalerate) P.C.P. #15840 (a.i. 3OOgm/L) for adult weevils.

Belmark is not readily available. If your local supplier does not have this product in stock, it can be purchased through:

Growers Supply, Kelowna, B.C. Phone: 762-5335

Adult black vine weevils are about 9 mm. long, and brownish-black in colour with patches of yellow hair on the abdomen. All adults are parthenogenetic females, and populations emerge from late May to late June. This is also the time when many of the nursery seedlings have reached a susceptible stage. Often nursery personnel are unaware of adult presence because weevils feed at night and hide during the day.

If adult populations are discovered, apply Belmark at 33OmL in I IOOL water/ha.

The first application should be during the second week of May. Follow this with a second application 3 weeks later. It appears that the insecticide acts more as a repellant than as an insecticide. These insects have a wide host range, and will move to feed on plants in a more favorable environment.

B) Control program for weevil larvae infesting seedling plugs.

Most infestations of weevil larvae in container stock have been from the black vine weevil to date. These larvae can cause considerable damage to container grown stock.
The seedlings are often killed outright due to severe root damage and/or stem girdling.

Adults lay their eggs in the seedling plugs, the resulting larvae feed on the seedling roots, and girdle the stem at ground level. The larvae are white, C-shaped, legless grubs with brown head capsules. Feeding continues throughout the fall and during warm periods in the winter. One larvae is capable of consuming the entire root system of one conifer seedling. Presence of larvae is often undetected because seedlings have set bud, become dormant for the winter, and do not show foliar stress. Infestations are sometimes found during routine monitoring when seedling plugs are pulled, but often the presence or extent of an infestation is not realized until the crop is lifted.

Newly emerged adults must feed for about one month before egg laying begins. Oviposition will normally begin around the end of June with peak egg laying in August.

To prevent the adults from laying eggs in the seedling plugs, again use:

Belmark at 330m] in I IOOL water/ha.

The first application should be made during the last week of June. The second application should be made three weeks later. It is advisable to apply a third spray 3 weeks after the second application, around the middle of August.

If you have any questions or comments concerning these control programs please contact Gwen Shrimpton.

The Pine Needle Mite *Trisetacus campnodus* - A New Pest in B.C. Reforestation Nurseries

Introduction

This last growing season, 1987, the small pine needle mite *Trisetacus campnodus* has been identified on pine seedlings from several reforestation nurseries. Mites have been collected from outplantings and bareroot production stock at some lower mainland and southern interior nurseries.

The damage caused is sometimes referred to as kinky disease. It is often misidentified as the effects of poor site, needle cast diseases, air pollution, herbicides, poor drainage, and lack of fertility. Magnesium deficiency can produce similar symptoms, but this can be easily rectified with applications of magnesium sulfate. Kinky disease trees are not adversely low in magnesium, nor do applications solve the problem.

Hosts and Distribution

T. campnodus occurs on Scots pine *(Pinus sylvestris)* and lodgepole or shore pine *(Pinus contorta).* It has been a major pest in Scots pine Christmas tree plantations, and is distributed throughout Washington, Oregon and B.C.

This mite is probably a native host of shore pine where it is not a large problem. However, it is a relatively new pest on lodgepole pine. Interior lodgepole pine planted on the coast is readily attacked and the mite can become a major debilitating problem. R. Hunt (1981), made observations of 70 provenances of *P. contorta* ranging from California to the Yukon growing in a five year old plantation near Cowichan, B.C., and found that damage varied according to provenance. Damage to coastal provenances was slight compared with interior provenances, and within the coastal provenances north- em ones were damaged more than southern ones.

Interior lodgepole pine seedlings have been grown at coastal nurseries and then planted in interior native habitats. It is possible that the mite could spread from native shore pine in and around the nursery site to the lodgepole pine in the nurseries, and then from the seedlings in reforestation sites to native lodgepole pine stands.

Damage and Detection

Mite infestations occur at the base of the needles beneath the sheath. At first they occur at the interface where the needles meet, but as the population increases the entire needle base covered by the sheath may be invaded. In heavy infestations there can be up to 200 mites per needle base, but 10-20 can cause damage. Eventually, the epidermis of the entire needle base is destroyed and appears necrotic, browned and sometimes calloused.

Mite damage is often easily detected by the presence of discoloured and distorted needles. The needles become chlorotic, pale yellow, blotched, stippled or mottled. Growth in needle length can be reduced by up to 70%, and the needles are twisted or hooked, with the new growth being crinkled. Twigs where needles are at- tacked for several years may become twisted and deformed. Mites also cause premature needle drop. Severely infested trees retain only the current year's needles, and in some instances even the current needles are sparse and greatly shortened.

Repeated infestation reduces vigour and may kill trees within a few years. Infested trees are chlorotic and generally appear unthrifty and can be spotted by their thinner crown of paler foliage. Most pines infested for any length of time are noticeably stunted, and there can be a decrease in annual increment of up to 20%. Infested trees are often erratically distributed with a healthy tree growing next to a badly infested one. Also, the distribution doesn't seem to follow wind patterns because there are often as many infested trees to the windward as there are in more sheltered places. There is some evidence that infested pines may be predisposed to bark beetle attack.

The opportunistic secondary imperfect fungus *Sclerophoma pithyophila* is commonly found fruiting on necrotic foliage and shoots. Dieback associated with the fungus may occur, resulting in bushy, stunted and broomy trees with an exceptional number of buds on each shoot.

Life Cycle

T. campnodus are extremely small mites that appear only as specks with the naked eye. A hand lens or microscope is necessary to see them, and they must be identified under high magnification. The mites are less then .3 mm long, light yellowish-white, translucent, wormlike, elongate and usually sedentary, but can move very slowly with their four legs.

The population overwinters as both adults and eggs within the needle sheaths. During the time of candle elongation in the spring the mites move to the new growth, and lay several overlapping generations of eggs. It is at this time they cause considerable damage to the new needles producing the symptoms of kinky disease. During the summer, as necrotic tissue begins to develop at the needle base, the mites often disappear, presumably they move on to other healthier needles. Possibly, these tiny mites are carried by birds, squirrels, or insects. Several other species of mites attach themselves to in- sects for transportation.

Management

T. campnodus does not seem to have a large number of natural parasites and predators. Due to its small size it is free from internal parasites, and its inaccessible hiding place protects it from most predators. When the needle sheath becomes loosened with age, or the mites are migrating to new needles, they can be subject to predators, of which the large mite *Seius* seems to be important.

Chemical control is also difficult. Pesticides will not readily penetrate into the base of the needle sheath in which the mites are enclosed. Studies show that the most effective time to control this pest is from April to early June, during the period after candle elongation but prior to needle elongation depending on the species and location. At this time the mites move out of last years needle sheaths and migrate up the shoots into the elongating needles of the new growth. A second application should be repeated 10-14 days later to kill hatched mites.

Sevin and oil has shown to provide the best control over other pesticides tested in several studies. The oil is necessary to penetrate through or around the sheath to the infested area. The length and tightness of the needle sheath can vary considerably and will affect the control achieved.

Gwen Shrimpton

Current Projects

Jim Arnott, Pacific Forestry Center

This year Jim is working on the control of growth in coastal species using reduced photoperiods and moisture stress. This trial incorporates the resources of FRDA and outside research agencies such as the University of Victoria and B.C. Research Council. The long-term effect of treatments will be followed up for 1 and 2 years after planting.

Jim is also continuing basic work on photoperiod ex- tension to prevent bud set. Application method's are- being further investigated to minimize the use of boom operating time on moving lighting systems. A great deal has been learned already and Jim will be presenting a paper on this subject at the TUFRO conference at York University. The abstract of his paper is included in the Literature Review section.

Rona Sturrock (PFC) - Doug Clark (UVIC)

Fusarium on Douglas-fir Seeds: "Clean-up Trial"

Rona Sturrock and UVIC biology student Doug Clark are investigating the efficacy of a simple seed cleaning treat- merit to reduce levels of seed-borne *Fusarium* on Douglas- fir from British Columbia. The treatment, which involves soaking seeds in a bleach solution for 10 minutes and then rinsing them in running tap water for 48 hours prior to stratification, is being used at several forest nurseries in the USA.

Seed-borne fusaria on Douglas-fir very likely serve as inoculum sources for early season damping-off and late season root rot. The use of a practical seed cleaning technique would enhance current sanitation measures (e.g., styroblock washing) being used in B.C.'s forest nurseries and would ultimately reduce the incidence of diseases caused by *Fusarium.* The technique could also be used to clean up other conifer species affected by seed-borne *Fusarium* such as western larch and white pine.

Don Summers

Spruce Cone and Seed Insects

Sampling and damage appraisal studies are being carried out by the CFS. The aim is to be able to predict losses based on insect egg counts in the spring. Contact Jon Sweeney, PFC.

Efficacy tests are being conducted with Metasystox-R to control *Lasiomma (Hylemya).* Phytotoxicity is also being assessed for Dimethoate on interior spruce clones.

Western Red Cedar Cone Midge

Distribution, damage and control measures are being investigated for this insect pest. The goal is to establish a management system similar to that used for Douglas-fir cone midge in coastal seed orchards.

Western Spruce Budworm

Research results indicating that early sprays against this insect can protect cones, are being tested operationally for the second year. Sampling methods to predict the need to spray are also being evaluated.

Spruce Spider Mite

A pilot project to test predator mites against spruce spider mite has been initiated in the container spruce orchards. This project should provide guidelines for future work on biological control measures for this pest.

Gwen Shrimpton

Goal and Devrinol Herbicide Trials

Under FRDA project NITAC 1.47, a large pesticide trial with the herbicides Goal (oxyfluorfen) and Devrinol (napropamide) and the fungicide Benlate (benomyl) is being conducted at Surrey Nursery. The purpose of the project is to conduct the container portion of a standard Canada-wide Goal trial designed to gain a registration for the use of Goal in Canada. At the same time, Devrinol, which has recently been registered for use in nurseries, will be tested to extend the species on the label and develop specific use patterns for nursery stock.

Root rots, namely *Pythium, Cylindrocarpon, Phythophthora* and *Fusarium* are becoming significant problems in container stock. A trial with the fungicide Benlate will be conducted to gain a registration for control of *Fusarium* root rot.

Disease and Insect Guide

In co-operation with the staff at the Nursery Pest Clinic at Pacific Forestry Center, the *Diseases and Insect Pests in B.C. Forest Nurseries Guide* is being updated under FRDA project 2.48. Sections on pests in the old guide will be up- dated, and several new pests will be added.

Balsam Woolly Aphid

Trials to develop an effective control program for the balsam woolly aphid will continue, in co-operation with Rona Sturrock at PFC. This summer different timings, rates, volumes, and application methods for Safaris Insecticidal Soap will be tested.

Trisetacus Pine Needle Mite

A survey for the pine needle mite *Trisetacus campnodus is* planned in co-operation with Regional staff. Infested seedlots have been identified from the nurseries and these lists will be forwarded to the appropriate Regions to see if this pest has become a problem in the planting areas.

Wolfgang Binder - Forest Research Lab

Wolfgang is working on the ecophysiology program, and a shading experiment. FRDA 1.30, stock quality assessment testing of white spruce has commenced and will continue, along with work on variable fluorescence.

Chris Hawkins - Red Rock Research

Current work includes photoperiod induction of dormancy and spruce winter injury, and variable fluorescence.

Carole Leadem - Forest Research Lab

Carole is continuing seed dormancy studies on *Abies amabalis* and *Abies lasiocarpa* using a redrying technique to reduce moisture during part of the stratification, and thus increase germination rates considerably. Work on germination temperature for *Abies* has resulted in new recommendations, 25°C days and 15°C nights. Work has started on a test for seed vigour, possibly based on measurements of respiration and food reserves. Further work will examine germination temperatures on white spruce and lodgepole pine. Carole will continue redrying work on production Abies seedlots in co-operation with Surrey Seed Center.

Dave Simpson - Kalamalka Research Station

Stock quality research has consisted of implementing operational RGC and cold hardiness testing, and examining family differences in RGC and cold hardiness. Examination of the relationship of RGC to performance on different sites is being conducted in co-operation with Vyse, Thompson and Sutherland (FRDA 3.9).

Temperature and photoperiod effects on root hardiness development are being examined now that the correct equipment has been obtained and information gained from Sweden (FRDA 3.14).

Nursery culture research deals with the effects of spacing and cell volume on container seedling growth, and methods of controlling height and dormancy comparing photoperiod and drought stress (FRDA 3.17 and 3.18).

Work on deep undercooling of spruces is being written up

Bob van den Driessche - Forest Research Lab

Work over the past year was devoted to developing a method of predicting drought hardiness in nursery stock. A relationship between drought tolerance and the electrical conductivity of diffusate was examined.

A project to develop and record macro-nutrient deficiencies in Douglas-fir and white spruce container stock is complete except for chemical analysis.

Three experiments to determine the activity of PP333, a gibberellin synthesis inhibitor, and its effect in increasing drought resistance in Douglas-fir have been conducted.

Further work is planned to relate osmotic potential to electrical conductivity, and to examine drought avoidance mechanisms in Douglas-fir and lodgepole pine.

Nutrient trials will develop and record micro-element deficiency symptoms in Douglas-fir and white spruce.

Work is planned to substantiate effects of PP333 on Douglas-fir growth and water relations.

Data will be processed on Douglas-fir genotype X nutrient interactions jointly with Y. El-Kassaby.

Literature Review

Effects Of Dolomitic Lime and Alkaline Water In Sphagnum Peat-Based Container Growing Medium

B.J. Williams, J.C. Peterson & J.D. Utzinger HortScience 23(1): 168-169. 1988

Peat-perlite medium was limed with varying amounts of dolomite then irrigated with water of varying degrees of alkalinity. Alkaline water sources caused a steady in- crease in pH throughout the 84 day trial period which was additive with the incorporated lime. The report recommends that lime amendments to media be made on the basis of the alkaline effects of the irrigation water.

Wayne Gates

Control of the Balsam Woolly Adelgid *(Homoptera: Adelgidae)* In Fraser Fir Christmas Tree Plantations

F.L. Hastings, F.P. Hain, A. Mangini, & W. T. Huxter J. Econ. Entomol. 79:1676-1680 (1986)

Note: Unregistered pesticides can only be used under special federal/provincial permits.

Abstract

Single applications of 0.51 % insecticidal soap/diazinon (40%:0.4% AI), 0.52% insecticidal soap/methoxychlor (38.7%:3.0% AI), 0.01% fenvalerate, 0.01 % permethrin, and one and two applications of 0.63% Safer's insecticidal soap were tested against the egg, crawler, nymph, and adult of the balsam woolly adelgid, *Adelges picaeae* (Ratzeburg). With the exception of the soap/methoxychlor, all materials appeared to be effective against non-egg stages. The residual toxicity of fenvalerate and permethrin killed all non-egg stages, resulting in no egg production in later samplings. Fenvalerate and insecticidal soap did not adversely affect nontarget organisms in the litter. Fenvalerate showed no phytotoxicity applied to Fraser fir, *Abies fraseri* (Pursh) Poir. Christmas trees at 0.01, 0.02, 0.04, and 0.08% concentrations. A soap discoloration study indicated that succulent foliage (June growth) may be sensitive to soap treatments, but multiple sprays of either high or low concentrations may be used with little discoloration at times later than June.

Oxyfluorfen Shows Promise in Lodgepole Pine Seedbeds

John P. Sloan and Richard H. Tbatcher.
Tree Planters - Notes 38(2):03-9; 1988.

Note: Oxyfluorfen (Goal) is not registered for our use at this time.

Abstract

The herbicide oxyfluorfen was applied at 0.75 and 1.50 pounds per acre to lodgepole pine *(Pinus contorta* Dougl. ex Loud) nursery beds. First-year treatments reduced seedling heights. Second-year applications had little effect on seedling heights or densities. Oxyfluorfen reduced weeding times by 76%.

Seed Collection From Loblolly Pine Cones After Tree Shaking

J. A. Vozzo, James L - McConnell, Jerry L. Edwards, and Eli Milodragovich.
Tree Planters' Notes 39(2):19-21; 1988.

Abstract

Seed collection from loblolly pities *(Pinus taeda* L.) is compared in bagged cones from trees shaken mechanically or by the turbulence from a helicopter in flight. Seeds were collected from full unopened cones and then collected in bagged cones after a shaking treatment. Timing of the helicopter flight seriously affected the number of seeds loosened by the shaking

Reference Material

The following are two very useful references for insect identification and general background information on life history and habits.

Western Forest Insects by R.L. Furniss and V.M. Carolin. Miscellaneous Publication No. 1339. November 1977. USDA Forest Service.

An Introduction To The Study Of Insects fourth edition. Donald J. Borror, Dwight M. Delong, Charles A. Triplehorn. Holt, Rinehart and Winston. New York, Montreal, Toronto.

Western Forest Insects is available through the UBC bookstore. An *Introduction To The Study Of Insects* should be available on order from most large book retailers.

Forest Nursery Notes

Forest Nursery Notes is produced twice a year in the fall and spring by Tom D. Landis, Western Nursery Specialist, USDA Forest Service. This newsletter provides an excellent literature review of information pertaining to conifer seedling nurseries. Most major journals available in North America are surveyed and relevant articles listed. A copy service is available. Tom also mentions coming meetings that may be of interest, new guides or bulletins recently published and any other topical information. This newsletter is available free of charge by writing:

Tom D. Landis, Western Nursery Specialist
USDA Forest Service, P.O. Box 3623
Portland, OR
USA 97208

Gwen Shrimpton

Jim Arnott - PFC, will be presenting a paper at the IUFRO conference at the University of York in September.

Regulation of White Spruce, Engelmann Spruce and Mountain Hemlock Seedling Growth By Controlling Photoperiod
J.T. Arnott. 1988

Abstract

A range of photoperiod treatments in two experiments were evaluated for controlling seedling growth and crop uniformity of three long-day tree species in two container seedling nurseries in southern British Columbia, Canada. In the first experiment, 1-0 seedlings of *Picea glauca* (Moench) Voss, *Picea engelmannii* (Parry) and *Tsuga mertensiana* (Bong. Carr.) were grown under (a) a control or natural photoperiod; (b) a 1-hour exposure of

supplemental lighting from a stationary high pressure sodium (HPS) light source in the middle of the night, i.e., a 1-hour night-break; (c) a 2-hour night-break and (d) sufficient HPS supplemental lighting after sunset to maintain a constant 18-hour photoperiod. In the second experiment, the growth of *1-0 Picea engelmannii* seedlings was compared under two intermittent photoperiodic lighting treatments (e) all night; and (f) for 2 hours in the middle of the night - using HPS lamps mounted on nursery irrigation booms. Growth data were tabulated for seedling height, stem diameter, total dry weight, number of stem units and stem unit length, and degree of terminal bud set.

In the first experiment all supplemental lighting treatments suppressed the formation of terminal buds and significantly increased and extended seedling growth when compared to the control (a). Seedling shoot growth was greatest in treatment (c) with few significant growth differences in root dry weight or stem diameter among treatments (b) to (d) for all three species. Night-break treatments (b) to (c) significantly increased the number of stem units in *Picea* spp. but not in *Tsuga mertensiana* where they created significantly longer stem unit lengths. In the second experiment, there were no significant differences between *Picea engelmannii* grown in treatments (e) and (f). It is concluded that a night-break of supplemental lighting in the middle of the darkness from a stationary or moving (intermittent) HPS light source can effectively control seedling growth and crop uniformity of these tree species.

Glenn Matthews

Events

International Plant Propagator's Society Annual Conference.

September 6-9, Hyatt Hotel - Vancouver.
Conference theme is "Plants and the Practical Propagator".

Contact: Bruce Macdonald
UBC Botanical Garden
6501 Northwest Marine Drive
Vancouver, B.C. V6T I W5

Producing Uniform Conifer Planting Stock - *IUFRO.*

University of York, UK. **September 19-22**.
Chairman: R.W. Tinus, USDA Forest Service
For information contact:
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Sources

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