
CANADIAN TREE IMPROVEMENT ASSOCIATION/
ASSOCIATION CANADIENNE POUR L'AMÉLIORATION DES ARBRES



Tree Seed Working Group

NEWS BULLETIN

No. 25, June 1996

A WORD FROM THE CHAIRMAN

Things have been on the move, at least at my office and research laboratory since our last TSWG Newsbulletin. It must have been similar in your office, organization, and/or research unit!! After much meditation, I have decided to focus on three items in my Chairmans remarks: 1) Tree Seed Working Group meeting in Quebec City in August 1997, 2) National Forest Genetic Resources Centre, and 3) E-mail discussion group on the internet.

1. Tree Seed Working Group meeting

The upcoming TSWG meeting to be held in Quebec City in August 1997 is slowly but surely becoming a reality. Stephan Mercier of the Quebec Ministry of Natural Resources has worked hard with local organizers in preparing the meeting. The theme for this meeting will be "The Use of Artificial Pollination in Seed Orchards". Stephan is actively looking for speakers. If you would like to present a paper or if you have any suggestions for the Workshop, please contact Stephan soon! We intend to publish the workshop proceedings as refereed articles - that is for those wishing to do so! For additional information, please read the announcement under Upcoming Meetings later in this Newsletter.

2. National Forest Genetic Resources Centre

I am pleased to announce that Dale Simpson, CFS - Atlantic Forestry Centre has accepted the position as manager for the Centre. Dale prepared an update on the NFRGC for this Newsletter. A special meeting for the National Forest Genetic

Resources Centre (NFRGC) was held in Fredericton on May 23, 1996. The two main objectives of the meeting were to discuss 1) the move from PNFI to Fredericton, and 2) objectives and policies for the NFRGC.

I had recently expressed concerns regarding the NFRGC (see minutes of TSWG business meeting in Victoria). Specifically, I was concerned about a perceived lack of formal links between the NFRGC and Canadian scientists and practitioners. At this time, I want to state emphatically that my perception and concerns regarding an apparent lack of relevance of the NFRGC with scientists and practitioners was in-fact, probably not well-founded. It became evident during the meeting in May that the NFRGC would maintain the National Tree Seed Centre and a CFS Germplasm Data base. Dale is developing a policy for the Centre.

3. E-mail INTERNET Discussion Group

By the time you read this Newsletter, the transfer of the e-mail discussion group on the internet should be completed. Ron Smith and I had difficulty this past year getting comments on the internet while at the same time not being able to make any changes or corrections as required. This problem should now be solved. See Rons update in this issue.

Finally, I should be ready to report, once again, that Ron, our Editor, is doing a great job in improving the TSWG NewsBulletin. Special thanks and keep at it Ron!

Guy Caron

EDITORS NOTES

I want to start by thanking everyone who contributed to this issue of the Tree Seed News Bulletin. In addition to making my job easier, receiving articles from different contributors across the country certainly makes for a more interesting read!

The next issue of the Newsletter is scheduled for November (We should now be back on track for producing issues in the spring and fall). When you are writing up your summer reports, please keep this newsletter in mind, and mail, fax, or email a few words of wisdom.

I would like to thank Carole Leadem, B.C. Ministry of Forests for sending along a collection of "Seed Trivia" for this issue of the Newsletter. Carole has assembled these tidbits into a collection called "Cool Facts About Seeds".

Do any of our other readers have similar 'little known facts' you would like to share? Perhaps these tidbits can become a regular part of the Newsletter. What do you think of using them as was done with this issue? Please let me know!!!

I would strongly encourage readers to send comments, suggestions and contributions for the Newsletter to the chairperson, working party coordinators, or the editor.

Note These Addresses

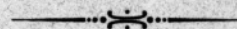
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[Editors note: I inadvertently left off Dave's name in the last Newsletter, sorry about that Dave!].



Update on Internet Discussion Group

The transfer of the server for the TREESEED discussion group on the Internet has now been completed.

**ALL SUBSCRIBERS WILL HAVE TO
RESUBSCRIBE TO THE DISCUSSION
GROUP AT THE NEW ADDRESS**

Current subscribers should have received a message describing the changes that have occurred and what you have to do to resubscribe. If you are a subscriber and did not receive this message, please contact me directly.

For those reading this Newsletter and who have not subscribed, below is a brief overview of the Internet Discussion Group.

The discussion group is a forum for rapid exchange of research/technology information, ideas, and opinions related to the topic of tree seed

and also welcomes announcements of meetings, calls for papers, help/employment wanted messages, and book reviews. Messages between members of the group are sent by electronic mail. All members are sent electronic copies of each piece of correspondence, keeping everyone informed of the ongoing electronic 'discussion'.

How does it work?

There are two parts to the service: the discussion group, and an automated list server. The discussion group operates in a very simple manner. All mail received at the address

TREESEED@EMR1.NRCAN.GC.CA'

will be copied and sent automatically to all subscribers on the list. Subscriptions are managed automatically by the list server. NOTE: The new ListServer is actually located at NRCan in Ottawa, but managed out of Fredericton.

To add your name to the subscription list, send a message to:

LISTSERV@EMR1.NRCAN.GC.CA'

The message should be a single line as follows:

SUBSCRIBE TREESEED FirstName LastName

A message confirming that your name has been added to the list will be sent to you. When you subscribe, I receive notification that you have done so.

Ron Smith



National Tree Seed Centre Moves

The National Tree Seed Centre was established at Petawawa National Forestry Institute in 1967 to obtain, store, and disseminate seed of known origin and quality to be used for species trials, tree breeding, and genetics studies or other silvicultural

and biological experiments. It is the only such centre in Canada. About 100 requests from around the world are processed annually. With the closure of the Institute, the Centre was transferred to the Canadian Forest Service - Atlantic Forestry Centre in Fredericton, NB. This move necessitated developing facilities to extract, process, and store seed.

Seed was shipped from Petawawa in mid June. It has taken time to unpack the seed and organize the containers in the freezer and coolers (a chilling experience!). Associated with the Seed Centre is a database containing information on all the seedlots. The database has to be converted to operate on a PC platform. This is requiring the complete development of new software applications to handle the many aspects of managing the database. The initial work on this has gone quite smoothly and every attempt is being made to get the Centre up and running as quickly as is possible.

A fairly extensive range of species is represented in the Centre including hardwoods and softwoods but the number of seedlots per species varies widely. Replenishment of seedlots is required on an ongoing basis. Centre staff (Bernie Daigle and I) will make collections as is required and as resources permit. However, it will also be necessary to obtain seed through donation, exchange, or purchase. Because the Seed Centre is national in scope, it is desirable to have seedlots from throughout Canada. All agencies, (provincial, industrial, educational, etc.) are invited to submit seedlots that would be accessed for research purposes only. Seed from rare, isolated, or unique populations can also be sent.

Please contact me if you wish to donate seed.

Tel (506) 452-3530

Fax (506) 452-3525

E-mail dsimpson@forestry.ca

Dale Simpson



Upcoming Meetings

**Tree Improvement for Sustainable Tropical
Forestry -**

Caloundra, Queensland, Australia

Oct. 27-Nov. 2, 1996

Sponsored by Queensland Forest Research
Institute and IUFRO

Contact: Stephen Walker
MS 483, Gympie, Queensland.

4570, Australia

Tel: National: (074) 822244

International: +61 74 822244

Fax: National: (074) 828755

International: +61 74 828755

email: stevew@qfri.fh.dpi.qld.gov.au



**International Symposium on In Situ
Conservation of Plant Genetic Diversity**

4-8 November, 1996

Sponsored by the Global Environmental Trust
Fund and the Turkish Ministries of Agriculture
and Rural Affairs, Forestry, and Environment

Contact: Nusret Zencirci

Central Research for Field Crops

PO Box 226, 06042 Ulus,

Ankara, Turkey

Tel: 90-312-287-89-57

fax: 90-312-287-89-58



The Western Forest Genetics Association

July 29-Aug. 1, 1996

Newport Oregon

The theme is "Genetics of Adaptation" with
subthemes of "Natural patterns of adaptation"
and "Maintaining adaptability under
domestication". The North American Forest
Genetics Group will meet on July 29 to address
the topic "maintaining genetic variation in future
generations". For more information, call the
Oregon State University Forestry Conference
office at (541) 737-2329.

ISTA, Tree Seed Pathology Meeting

[The following announcement was taken from
Dendrome 3(1), April 1996]

A 3-day-long Tree Seed Pathology Meeting will
be held during the first week of October, 1996 at
Opocno, Czech Republic. The meeting will
feature workshops, invited papers, and field trips
to a seed processing facility and an ISTA-
approved, tree seed testing laboratory. The
meeting is sponsored by the ISTA Tree Seed
Pathology Committee and the Ministry of
Agriculture, Czech Republic. The registration fee
is \$300 US which includes all ground
transportation to and from Prague, room and
board, and the field trip. Interested parties should
contact:

Jack Sutherland

Pacific Forestry Centre

506 West Burnside Rd.

Victoria, B.C.

V8Z 1M5

Fax: (506) 363-0775

Email: jsutherland@a1.pfe.forestry.ca

or

Zdenka Prochazkova

VULHM VS, 686 02

Uherske Hradiste

Czech Republic

fax (42) 632-549-119



IUFRO Working Party: S2.07-01

Cone and Seed Insects Meeting

2-9 September 1996

Alpine Ecology Centre of

Monte Bondone

Contact: Dr. Andrea Battisti



**Combined Meeting for the 25th Atlantic
Forest Nursery Workshop, 9th Maritime
Forest Seed Orchard Managers Workshop
and 13th Canadian Forest Nursery Weed
Management Association**
October 7-9, 1996
Edmundston N.B.

This workshop, being hosted by Fraser Paper Inc., Canada, will feature technical sessions, field trips, progress reports and research updates from Atlantic forest nursery and seed orchard managers. On Wednesday, October 9, a technical session has been organised with the theme:

**"Linking Seed Orchard Production with Nursery
Crop Production"**

Among the presentations on Wednesday include:

Current status of seed orchards in the Maritimes -
Ron Smith, CFS- Atlantic

Maximizing genetic gain from seed orchards -
Greg Adams, J.D. Irving Ltd.

A holistic approach to tree improvement
delivery systems - *Yousry El-Kassaby, Canadian
Pacific Forest Products*

National Forest Genetic Resources Centre - aka
National Seed Bank - *Dale Simpson, CFS-Atlantic*

Additional presentations on various topics will also
be made. For additional information, please
contact the hosts:

Luc Ouellet or Andre Paillard
Fraser Paper Inc. Canada
Forest Tree Nursery
55 Fraser Private Road
St-Joseph-de-Madawaska, N.B.
E7B 2V1
tel: (506) 737-2220
fax: (506) 737-2116

Insect Management in Seed Orchards
October 7, 1996
Fredericton, N.B.

The program for this half-day workshop will
include recent research findings on the following
topics:

Managing cone beetles with pheromones - *Peter de
Groot, F.P.M.I.*

Potential for biological control of insect pests of
seed orchards - *Ecki Brockeroff*

Use of marking pheromone in cone maggots and
potential applications in seed orchard management
- *Dan Quiring, U.N.B.*

Managing insect pests in B.C. seed orchards: State
of the art - *Robb Bennett, B.C. Min. For.*

Factors affecting egg lay and survival of black
spruce cone maggots - *Laura Fidgen, U.N.B.*

Potential for using entomopathogenic nematodes
for management of cone maggots - *Jon Sweeney,
C.F.S. Atlantic*

There will be on-site registration and a fee of
\$10.00.

NOTE: This workshop is scheduled to allow
participants to attend the Joint Maritime Seed
Orchard Managers & Nursery Managers Workshop
which starts the following day in Edmundston,
N.B. If interested, please contact:

Jon Sweeney
Tel: (506) 452-3499;
Fax: (506) 452-3525;
e-mail: jsweeney@fcmr.forestry.ca.

26th Biennial Meeting of the Canadian Tree Improvement Association

The 26th biennial meeting of the Canadian Tree Improvement Association will be hosted by the University of Laval in Sainte Foy, Quebec, August 18-21, 1997. The theme for the meeting will be "Tree Improvement: its Contribution to Sustainable Development".

The program will feature plenary sessions with invited speakers, volunteer oral presentations as well as poster sessions. Both french and english will be the official languages. A translation service in both languages will be provided. Both the Tree Seed and Wood Quality Working Groups will be holding workshops in conjunction with the meeting. The program will also include a day-long field trip on August 21. For further information on the CTIA/AACA meeting contact:

Chairman

Michel Villeneuve, Quebec Ministry of Natural Resources

Vice-chairman local arrangements

Jean Bousquet, University of Laval

Vice-chairman symposium

Jean Beaulieu, CFS Laurentian Forestry Centre

Secretary

Ariane Plourde, CFS Laurentian Forestry Centre



Tree Seed Working Group Workshop

A workshop and business meeting of the Tree Seed Working Group will be held in conjunction with the 26th meeting of the CTIA/AACA to be held in Quebec in August 1997. The theme for the workshop will be "The Use of Artificial Pollination in Seed Orchards". We hope to develop this theme to include presentations/discussions on the advantages and disadvantages of controlled and supplemental mass pollination with the goal of reducing pollen contamination and increasing seed yields. We would also welcome contributions on recent scientific and technological developments in

pollination biology and pollen management.

If you would like to make a presentation and/or have any suggestions regarding the workshop, please contact Stephan **before September 1996**:

Stéphan Mercier

Ministère des Ressources naturelles du Québec

Direction de la recherche forestière

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New Members

Gwen McGimpsey

Manitoba Dept. Natural Resources

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R.R. #2

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R0E 0K0

Bill Sery

U.S. Forest Service

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Address Changes

Kim Creasey

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Effect of Morphology, Genotype, and Pre-germination of Red Oak Acorns on the Growth of Containerized Seedlings.

Northern red oak (*Quercus rubra* L.) acorns from 50 families representing 10 provenances from Québec, Ontario and Vermont were collected with the aim of establishing provenance-progeny tests in Québec. The objectives of this study, were to evaluate the effects of acorn morphology (mass, volume and density), pre-germination during cold storage (stratification) and maternal genotype, on seedling growth over a two-year period under a cold frame. There was a strong correlation between mass and volume, but we found no relation between the parameters evaluated and geographical or ecological location of the provenances, or among families within provenances. Similarly, variation in the measured traits was not correlated with either genotype or collection, nor were acorn morphology and rate of pre-germination strongly correlated. The final germination rate after six weeks in the containers was widely variable among and within provenances, but was homogenous within lots (or family). This supports the theory that the observed heterogeneity in the nurseries is due to the genetic diversity of the material. At the end of the first growing season, height growth of the seedlings was significantly influenced by the genotype; this tendency persisted till the end of the second growing season. A significant genotype effect on diameter, was only observed at the end of the second year. Provenances showing a high proportion of pre-germinated acorns in cold storage also had a high rate of germination after six weeks in containers. Acorns from these provenances germinated faster and more uniformly, thus producing a better quality crop. There was no significant relation between acorn volume (and density) and seedling development after two years in containers. However, we noted that seedling height and diameters after two years in the nursery was related to the mass of the acorns.

Stéphan Mercier
André Rainville

TICtalk : A Newsletter is born

The first issue of the newsletter TICtalk was recently released. This represents the first publication of a newsletter from the Tree Improvement Councils of British Columbia. This inaugural issue contains information on various issues related to tree improvement, seed production, seed orchards, etc. Among the articles included in this first issue are announcements of updates to the B.C. Seed Planning Registry System (SPAR) and Orchard Information System (OIS), notices of meetings and workshops, an overview of the Tree Improvement Councils of B.C. and some research updates. This first issue was very well done!

To subscribe to TICtalk contact:

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email ropainte@mfor01.gov.bc.ca

Seed Trivia - Did you know?

The reserves stored in tree seeds makes them an excellent food source for insects, birds and mammals (e.g., coconuts, pine nuts). Seeds of Siberian pine (*Pinus siberica*) represents such an important food source in Russia that trees cannot be cut down.

Fir Coneworm, *Dioryctria abietivorella*, Prefer Cones Previously Exploited by Spruce Cone Maggots.

Larvae of the fir coneworm, *Dioryctria abietivorella* (Groté), feed in cones, twigs and bark of a variety of conifers including fir, pine and spruce species across Canada. Damage to cones ranges from slight in years of good cone crops to severe destruction in years of light crops. While conducting studies on the life history and survivorship of the spruce cone maggots, *Strobilomyia neanthracina* Michelsen and *S. appalachensis* Michelsen, we observed that fir coneworm damage often occurred in cones previously damaged by the maggots. To test whether fir coneworm was more prevalent in maggot-damaged cones than in undamaged cones, cones were collected from black spruce and white spruce seed orchards throughout the Maritime provinces from 1990-1992 and the numbers of cones that were 1) healthy, 2) damaged by spruce cone maggots only, 3) damaged by fir coneworm only, and 4) damaged by spruce cone maggot and fir coneworm, were recorded. Fir coneworm attacked a significantly greater proportion of maggot-damaged than healthy cones in each species-year but one. Higher densities of fir coneworm in cones previously damaged by cone maggots could be caused by preference for, and/or greater suitability of, cone maggot-damaged cones for coneworm establishment and development. Maggot-damaged cones may release greater concentrations of volatiles that are attractive to *D. abietivorella* larvae or adults. Cone maggot damage may increase host suitability for fir coneworm by providing an entry for larvae and/or increasing nutritional quality of cones for fir coneworm (e.g., by stimulating pitch production).

Both species of cone maggot and the fir coneworm are considered significant pests of seed orchards in Canada. The cone maggots destroy about 60% of the seeds per cone and viable seeds remaining in damaged cones are difficult to extract. Thus, additional seed loss due to fir coneworm feeding in a maggot-damaged cone will

be minimal, less than 40% of the seeds per cone. The obvious preference of fir coneworm for maggot-damaged spruce cones suggests that its additional impact on seed production, at least in spruce orchards already infested with cone maggots, will be less than if attack was random. Also, if the presence of maggot damage increases the survival of fir coneworm during larval establishment, and this remains to be tested, then measures to reduce cone maggot damage may also reduce the percentage of cones infested with fir coneworm. Thanks to H. Kunze of J.D. Irving Ltd., R. LeBlanc and P. Roussel of Fraser Inc., W. MacKinnon of P.E.I. Department of Agriculture, Fisheries and Forestry, and K. Tosh of N.B. Department of Natural Resources and Energy for cone collections and the Integrated Forest Pest Management Initiative of Green Plan for funding. Results of this study are currently in press in the Canadian Entomologist.

Laura Fidgen, UNB

Jon Sweeney, NRCan, CFS

Use of Molecular Tools in Seed Orchard Research

The seed orchard seedlot rating protocol for BC's coastal conifer species is now complete (Woods *et al.* 1996). The assumptions of the protocols used to calculate genetic worth will be frequently checked and updated based on new experimental data. For this reason, we are engaging in research in orchard management practices using molecular techniques to confirm/change our assumptions underlying this seedlot rating protocol. Previous assumptions were based on data gathered using isozyme analysis for estimating supplemental mass pollination (SMP) efficacy, rate of out-crossing and pollen monitoring for pollen contamination. In Douglas-fir, we now have a DNA-based marker as an additional tool to monitor orchard performance and efficacy of orchard management practices.

The advantages of this marker are that it is highly polymorphic, is located on the chloroplast genome

(therefore inherited through the male parent) and that it can be amplified using PCR. BC Research Inc., (Dr, Craig Newton) under contract to the BC Ministry of Forests has developed and streamlined the application of this marker by sequencing the flanking region of the hyper-variable region for the design of specific PCR primers.

Currently, this marker is used to evaluate natural selfing in our clonal-row meadow orchard of Douglas-fir. Initially, we had concerns that due to the close proximity of ramets of a clone (clonal rows) coupled with keeping the crowns topped, natural selfing may increase compared to selfing found in a conventional (i.e., permuted neighborhood) orchard. Data from one year show that selfing is very similar in the meadow orchard as in other orchards of Douglas-fir (approximately 5% with clonal means ranging from 0 to 18%) (Stoehr and Newton 1996). However, the extent of correlated mating has not yet been evaluated.

Preliminary analyses of SMP data showed that in the meadow orchard SMP efficacy ranged from 30 to 64%. These data were obtained from a research trial where all seed conelets were individually pollinated twice with a power hitter within two days of peak receptivity. Further, as expected, clones with a high SMP success rate had lower outside-orchard contamination. Contamination can be estimated if the hyper-variable fragment in an embryo can not be matched to a fragment observed in an orchard clone. In SMP-treated clones, 9% of all tested seed were sired by a male parent that is not present in the orchard. In contrast, In non-SMP control clones, outside contamination was found to be 18% (Newton, unpubl. Report).

As the success of each genetically distinct pollen lot can be estimated (by the presence of the unique fragment in an embryo), pollen competition, first-on first-in, and optimum time of pollination type of studies can be easily evaluated. However, this genetic marker is currently only available for Douglas-fir. BC Research with funding from Forest Renewal BC is attempting to transfer this technology to some of our other commercial conifer species in BC. The next useful

polymorphic genetic markers are expected for lodgepole pine.

References:

Stoehr, M. And C. Newton. 1996. Estimation of natural selfing in a clonal row Douglas-fir seed orchard. Poster presented at 1996 SRIEG Workshop, Texas A&M Univ. Houston TX, June 23-26, 1996.

Woods, J.H., M.U. Stoehr and J.E. Webber. 1996. Protocols for rating seed orchard seedlots in British Columbia. Min of Forests Research Rep. 06, Research Branch, Victoria, BC.

M. Stoehr and J. Webber
B.C. Ministry of Forests

IUFRO Seed Physiology and Genetics Project Group Newsletter

Chairman George Edwards produced a long-awaited issue of the Project Group (PG) newsletter (NOTE: The name of this project was formerly "Seed Problems"). In the newsletter, he outlined the 'Company' changes following the restructuring of IUFRO. George also included abstracts of 12 papers presented at the technical sessions of the Project Group during the IUFRO XX World Congress, Tampere, Finland. Many of these papers would probably be of interest to our readers.

In addition to presenting summaries of several recent meetings, George outlined some of the PG work projects including a revised **World Directory of Tree Seed Workers**, a **Tropical Tree Seed Manual**, as well as a **Directory of Tropical Tree Seed Sources**. If you would be interested in helping with any of the above projects, you should contact George directly.

Seed Yields in Jack Pine Controlled Pollinations

Background

The Tree Improvement Unit of the New Brunswick Department of Natural Resources and Energy began the cross pollination of second generation jack pine clones in the spring of 1989. At first, most of the crosses were done in family tests which are located at various places throughout New Brunswick. This task was extremely tricky and time consuming as the phenology of the various sites did not coincide. One of the problems that was encountered was low seed set and high conelet abortion. This was especially discouraging as there was much time and money invested in these crosses.

At the present time, most of the crossing is done in the breeding garden located at Kingsclear. This makes the problem of phenology less of a concern, however, we are still encountering a major problem with seed set. The reason for this could be due to several factors including the timing of pollen application, the number of applications, as well as the actual quantity of pollen applied in the pollination bag.

To identify which of these factors is causing low seed yields, a study in conjunction with the jack pine mini-orchard research project was started in May of 1994. The details of this research is outlined on the pages following. The results of this research will be used operationally as soon as they are available.

Materials and Methods

Test Site

The Kingsclear jack pine breeding garden was used for this study. Established in 1989, this second generation breeding garden has three ramets per clone planted in rows, which makes it ideal for this type of study.

Clone Selection

A minimum of 40 flowers for each of twenty clones were bagged for these experiments. Selection was based on cone counts, and whether the clone had already been progeny tested. Each tree had a minimum of 40 flowers bagged in order to conduct the various tests.

Phenology Observations

For each of the clones in the study, the phenology of the seed and pollen cones was monitored during the pollination season. Below is the phenological chart that was used to monitor development (Table 1). This information will provide us with valuable clues as to the timing of pollen application.

Table 1. Phenological chart for seed and pollen cones.

SEED CONES

Stage

- 1 Dormant Bud
- 2 Buds beginning to break
- 3 Bud scales opening at top, cone visible
- 4 Seed cones enlarging
- 5 Scales slightly open
- 6 Scales fully reflexed, maximum receptivity
- 7 Seed cones past receptivity, closing up
- 8 Seed cones completely closed

POLLEN CONES

Stage

- 1 Dormant bud
- 2 Buds beginning to swell
- 3 Pollen cone cluster enlarging, very wet
- 4 Just before pollen shedding, little moisture
- 5 Pollen shedding
- 6 No pollen, cone dried and desiccated

Pollen Application

For each clone, pollination bags were placed on the branches as soon as the females were evident. Usually by the third week in May the female cones are easily identifiable. For each clone a minimum of 18 bags was needed.

The pollen used for this study was a jack pine polymix collected in 1993. The pollen has a germination percent of 82%, which is more than adequate for good seed set. The pollen was applied with a powder insufflator, and the number of puffs varied between treatments. After application, the bags were shaken to obtain a good pollen cloud within the pollination bag.

Description of Experiments

There are a number of factors that can cause of poor seed set. For this study, three experiments were designed to answer the question of poor seed set in jack pine.

Experiment 1- Timing of Pollen Application

There is evidence in the literature to suggest there is a correlation between the time of day when the pollen is applied and the success of the cross. To test this theory, the number of bags to be crossed was divided into a morning application, between 8:30 am and 9:30 am, and an afternoon application, from 3:15 pm and 4:15 pm. The bags were identified by an "am" or "pm" designation. Ten clones were selected for this study.

Experiment 2- Number of Applications

Another factor that has been found to contribute to the success of crossing is the number of pollen applications per bag. At the present time most of our crossing is only done once, however if we could increase seed set and decrease conelet abortion by increasing the number of applications, the extra time and effort would be worthwhile.

In this experiment the number of pollen

applications per pollination bag was 1, 2, or 3. For example, some bags were pollinated once and others twice and three times. The time of pollen application was spread out over the receptivity period. A total of 10 clones were selected which were different than the clones used in the "am" and "pm" experiment.

Experiment 3- Pollen Quantity

As indicated earlier, pollen is applied by means of a powder insufflator. There are other more sophisticated methods for pollen application, but this is a simple, inexpensive and relatively effective method. Although it depends on the number of female cones in the bag, in most cases each pollination bag receives one "puff" from the insufflator. However, with the low seed set that has been encountered with jack pine, perhaps the number of "puffs" per bag needs to be increased.

As the quantity of pollen applied by one puff is difficult to measure, for operational purposes the treatments were simply, "one" puff, "three" puffs, or "five" puffs. The same clones as used in experiment 2 were used for this study.

RESULTS

Experiment 1- Timing of Pollen Application

All of the pollinations for this experiment were done between June 2 - June 5, 1994. The seed cones were pollinated at stage 6 or maximum receptivity. Mature cones were collected from the trees in late August of 1995 and the seed extracted.

The cone loss from pollination until the conelet count on June 16, was 25% and the total cone loss from the time of bagging to the time of collection was 40% (Total loss = 119 of the original 291 cones).

The results of this experiment showed that there is no difference in whether pollen is applied in the morning or afternoon. The number of seeds per cone from the "am" and the "pm" were virtually

identical. Although there was no indications that the timing is a problem in jack pine, this study eliminates the possibility that the time of application is a factor in the seed set.

Experiment 2 & 3- Number of Applications and Quantity of Pollen

Similar to the other experiment, a total of 10 clones were selected. For each clone, nine separate trials were set up. After the cones were collected, the seed was extracted separately for each treatment. The total cone loss from the time of bagging was 40%, which is identical to the timing experiment. This in itself is good information to know as it allows staff to base cone numbers on a 40% loss ratio. The numbers of seeds per cone by treatment is given in Table 2.

As can be seen from Table 2, there was no difference between the three "puffs" and the five "puffs" treatment. This indicates that as long as each bag is getting at least three "puffs" the seed set should be adequate. Applying more pollen does not further increase seed set and if pollen is in short supply the application of more than three "puffs" is a waste of pollen. Although seed yields from cones receiving the one "puff" treatment were lower than from the other treatments, when pollen is limiting, it may be possible to get 'just enough' seed to complete the desired cross.

The phenological stage at which the pollen was applied did not seem to be as critical. Application 1 treatment was stage 4-5 which is just before peak receptivity and as indicated in Table 2., by applying more pollen the stage of the cone became less important. One "puff" at the early application date did result in some seed set, but it was much lower than the other treatments. The results for application 2 which coincided with peak receptivity was slightly higher with the more pollen applied, however was not significantly different. The results would indicate that it is better to apply the pollen at peak receptivity or just past in order to maximize seed set. Applying the pollen at stage 6-7 (application 3) resulted in lower results, but again not significantly.

Table 2. Mean numbers of seeds per cone by treatment, all clones pooled.

Treatment	No. Puffs/bag		
No. Applic.	1	3	5
1	11	21	21
2	21	23	23
3	18	22	22
Avg.	17	22	22

Conclusions

The results from these experiments will allow staff to feel more confident that the amount of pollen being applied is sufficient to result in good seed set. As quite often is the case, time is a limiting factor during the period of pollination, and therefore from this experiment one application and three "puffs" would be the most efficient use of time and pollen. The time of day when pollen is applied had no effect on seed set. These experiments have also given us a good figure on the expected cone loss over a two-year period. In all of the experiments the cone loss was close to 40%. This information is valuable when determining the number of cones to be bagged for cross pollinations.

Kathy Tosh
Tree Improvement Manager

Seed Trivia - Did you know?

Abies (true fir) seeds are generally more dormant than those of other B.C. conifers. Once dormancy is broken, however, *Abies* seeds are able to germinate at very low (above zero) temperatures, and have often been observed germinating on snow.

Extracting Seed from Norway Spruce Cones using a Solar Shed



The following study was conducted while I was serving as Technical Coordinator for the Ontario Tree Seed Plant.

Norway spruce cones were collected Sept. 2, 10, and 11, 1996. The collections originated from the following locations:

- Medonte Township

☞ Lat. 44° 37' N; Long. 79° 37' W

- Oro Township

☞ Lat. 44° 34' N; Long. 79° 36' W

Extraction: Cones were placed on plastic cone trays, with approximately 20 litres/tray and stacked in tiers of 6 in a solar shed. The mature, fresh green cones were allowed to dry naturally using only heat supplied through solar radiation into the shed from Sept 12 1995 to January 24 1996.

Trays of dried cones were brought into the second floor of a mill building, left overnight and tumbled in a cone drum outside the kiln unit. No heat other than what occurred in the solar shed and overnight building heat, was used in the extraction of seed.

Seed Cleaning: Seed cleaning was conducted on Jan. 27, 1996 using the following steps:

- wet dewinging.
- surface drying of dewinged material.
- hand scalping.
- gravity separation @ approximately 15% to 18% mc fw - purity test **98.9%**.
- dried to a fresh weight moisture content of **5.3%** - Dickey John moisture meter (DJ).
- warm water separation to remove resin impurities - purity test **99.9%**.
- dried to a storage moisture content of **6.7%** (DJ)
- February 2, 1996 process finished → **5.8%**

Estimated yield based from historic normal yield figures .950 kg./hl. = 5.700 kg.

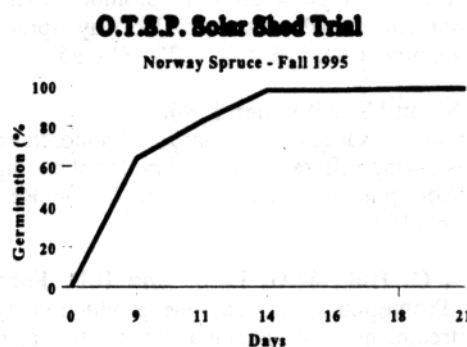
Actual Yield - 4.444 kg. from 6.00 hl.

Germination Assessment

Cutting Tests - Estimated germination percent based on a cut test with 100 seed was 98%

Stratification - 21 days, →→ begun 96/02/06
→→ out 96/02/27 ←←

Actual Germ. Test Results - 99% in 21 days -



Kim Creasey - Western Tree Seeds Ltd.

Western White Pine Stratification Treatment

The Tree Seed Centre in Surrey recently adopted changes to their standard procedures for testing and operationally preparing western white pine seed. Using their new procedure, comprised of a 14-day soak followed by 98 days of cold stratification, they produced an average improvement in germination of 21 %, with individual lots exhibiting improvements as high as 43%. For more specific information, readers are told to contact Dave Kolotelo at the Tree Seed Centre, 18793 - 32nd ave., Surrey, B.C. V4P-1M5 tel (604)541-1683, fax (604)541-1685.

[See **Seed and Seedling Extension Topics**, Winter 1995, vol 8 no.2.]

Recent Publications

Requests for reprints of the following publications should be sent to the respective authors.

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