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## History of international provenance experiments on Norway spruce (*Picea abies* (L.) Karst.) and cooperation difficulties

### Abstract

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Organisation, establishment and attempts at mutual evaluations of results from the IUFRO provenance experiments on Norway spruce are described and suggestions are given for improvements in international cooperation. The recurrent objective of simultaneous mutual action proved unattainable. Thus in all provenance experiments data about establishment procedures including plans of experimental areas should be published at the time of establishment with a clear pledge from all participants that the experiment is international, should be jointly evaluated and data should always be made available to all interested. Later periodic joint evaluations should be made and published regardless of the number of participants actually contributing and with the non-contributing ones reproached. International money may be needed for the purpose. Much effort is wasted by establishing large forest experiments and then abandoning their utilisation in the juvenile stage.

*Additional key words:* —

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### HISTORICAL SURVEY

In 1907 IUFRO organized its first international provenance experiment with Scots pine. The first review of results (Wiedemann 1930) indicated that racial differences are substantial and of possible relevance to other species. At the Nancy 8th IUFRO Congress 1932 the subject of tree seed provenance was given much prominence. Gustav Vincent from Czechoslovakia proposed that scientific institutions be made responsible for the control of provenance in seed trade. This was opposed

strongly, particularly by Jan Hausbrandt from Poland, who insisted that control of seed trade is the responsibility of Forest Administration and not of research institutions. After much discussion, extensively reported upon in the Congress proceedings, it was formally recommended that state control of seed trade be enforced and that it should conform with international norms. On the other hand there should be international cooperation in provenance control of seed moving for research purposes, and this should be the responsibility of research institutions.

At the next, 9th IUFRO Congress in Budapest, 1936 the subject of seed provenance was again much discussed. Gaston Delevoy (Groenendaal, Belgium) proposed that now, after 25 years, the results of the first IUFRO Scots pine provenance experiment be jointly evaluated and reported upon at the next Congress in 1940 in Helsinki. Needless to say the Second World War prevented this from happening. Also at the same session on Sept. 8th 1936 in Lillafüred in northern Hungary, on the initiative Werner Schmidt (Eberswalde) and Stanisław Tyszkiewicz (Warsaw), a subcommittee was established for the "Study of Seeds and Races". The subcommittee included Werner Schmidt Chairman, Henry Baldwin, Olli Heikinheimo, Stanisław Tyszkiewicz, Gustav Vincent and Aldo Pavari (Roth 1936, p. 61 - 62). Olof Langlet and O. Hagem were added to the subcommittee in 1937 (Baldwin and Petri 1941). It was decided that a series of international provenance experiments is to be organized and Werner Schmidt was entrusted with the responsibility for the work. Cooperating institutions from various countries were to supply cones from various well documented stands. These cones were gathered and extracted in Eberswalde and then seed was sent out to cooperators in various parts of Europe and North America for the establishment of comparative plantations. As regards Norway spruce (*Picea abies* (L.) Karst) this was done twice, in 1937 and 1938, for sowing the following spring. The experiments are henceforth known as the Norway spruce IUFRO 1938 and IUFRO 1939 series respectively.

In the late thirties a compilation of results from all previous provenance experiments, including those of Norway spruce has been produced by Arno Kalela (1937/38). Kalela's thesis is organized in the form of a consecutive presentation of latest results from each experimental area. Arno Kalela produced this study under Olli Heikinheimo, a member of the IUFRO Subcommittee for the "Study of Seeds and Races". Thus the 1938 and 1939 Norway spruce experiments started when all up to date informations on the provenances studied in Norway spruce were readily available (in German).

It was Olli Heikinheimo (1954) who first produced a sum-

mary of the earliest (nursery) results from the new study. In an interesting table he compiled data on seedling weight obtained for 13 provenances in 6 different nurseries, from Rovaniemi in northern Finland to Zürich in Switzerland.

In a mineo circular I have not seen Werner Schmidt (1940 ex Baldwin et al. 1973) recommended that the lay-out of the experiments should include a standard provenance replicated several times in various parts of the area. Most cooperators have adopted this design, though some have tried to replicate more than one or even all of the provenances. Apparently at the sub-committee meeting in Vienna in October 1940 the question of design was discussed and they "agreed upon a scheme for planting out the seedlings at a distance of  $1.3 \times 1.3$  m, using 1000 seedlings from every provenance, so that there shall be 5 parts with each 200 plants" (Baldwin and Petrini 1941). However the need for replicates, randomisations and block designs was a new thing at the time since the idea of using variance analysis (Fisher 1937) was only beginning to enter agricultural and forestry sciences. Inadequacy of the experimental design often led to disregard of these experiments, particularly by authors who have had access to only one of the plots. Indeed a single unreplicated, non-randomized, plot is not producing much evidence for anything. Only in conjuncture with similar plots elsewhere do these results begin to mean something. It is for this reason that an international evaluation of all plots has always been the not very successful aim of IUFRO.

At the first post World War II IUFRO Congress, the 10th, in 1948 in Zürich, the Committee for Seeds and Races now headed by Giacomo Piccarolo (1948) has submitted to the Permanent Committee the following proposals:

"1. As soon as possible a Committee for genetics of forest trees should be created.

...

4. Former results collected by the Committee, including Institutes for testing of seeds, should be published in common".

As a result of this recommendation in 1949, at a meeting of the Permanent Committee in Helsinki, section 22 Study of Forest Plants was established and Carl Syrach Larsen from Denmark was asked to lead it.

In 1951, at a meeting in Wageningen of the Permanent Committee and Sections Carl Syrach Larsen proposed that the Union should find a skilled collaborator who would spend 4-6 months visiting the international provenance tests with *Pinus*, *Picea* and *Larix*. There was a need for exact information on the state of these experiments. FAO was approached and it assigned \$ 1000 for the purpose; Prof. Houtzagers from the Agricultural University in Wageningen agreed that his

assistant, Barend Veen should do the trip (Syrach Larsen 1953 a).

Veen made his trip in 1952 and reported upon it for the 11th IUFRO Congress in Rome. Unfortunately the full report (Veen 1953a) is only available in mimeo form, the Congress proceedings (Veen 1953b) having only the text but not the all important tables. It is from these tables that the basic information about provenances and planting sites has been available to scientists.

At the 11th IUFRO Congress in Rome 1953, the report was discussed in detail, particularly on the subject of thinning methods in provenance experiments which might lead to completely different results. However there was considerable opposition to centralized enforcement of specific procedures. A resolution was adopted:

"We stress the need for the formation of a Working Group which would in no way interfere with the activities of individual institutes but would enable the establishment of closer contacts between those specially interested in provenance tests. This working group might later develop into a committee to prepare an exact report on recommended methods. The section repeats the thanks which the President of the Union has already expressed to FAO, the University of Wageningen and Dr. Veen for the work already conducted".

The Chairman of section 22 Study of Forest Plants, Dr. Carl Syrach Larsen, called for the assistance from Michael V. Edwards, U. K., in the future work of the group (Syrach Larsen 1953b).

At the 12th IUFRO Congress in Oxford, 1956, Michael Edwards gave a report on the 1938-1944 International Provenance Experiments. In the light of Edward's (1956) report Section 22:

"a) Considers that the completion of the collection of data regarding the origins of the seed lots employed is of the highest priority and all the countries concerned are required to facilitate this work so that it can be completed within three months after which the data should be printed and published;

b) Agrees that the draft code which has been circulated should form the basis for the assessment of the experiments. The minimum assessment required consists of height, basal area, volume (when old enough) and at least one of the simpler expressions of habit of growth;

c) Adopts the sets of photographs (which were exhibited) for the determination of the stages of flushing and recommends that they be made available;

d) Considers that an assessment for as many characteristics as possible should be made in all experiments after the 20th year of growth from seed, and all countries concerned are requested to co-operate to this end".

As regards the IUFRO 1938 Norway spruce series the 20th year assessments should have been made around 1957/1958. For the IUFRO 1939 series one year later. To my knowledge this was done for the two experimental areas in Belgium, three in Sweden, and three in Czechoslovakia. Usually only tree height is available. This only serves to demonstrate how difficult it is to obtain simultaneous action in these experiments. Even Michael Edwards and Carl Syrach-Larsen, who made this proposal, failed to implement it in their own countries, at The Bin forest and near Hørsholm respectively. Recommendations a, b and c remained unimplemented.

In 1961 at the 13th IUFRO Congress in Vienna Carl Syrach Larsen (1961) reported for Section 22 that in 1959 in Prague a Committee on Provenance Research was set up under the chairmanship of Miroslav Vyskot. This was reorganized into a Working Group on Provenance Research and Testing with Miroslav Vyskot remaining chairman. John D. Matthews took over leadership of section 22.

At the same congress Olof Langlet, Sweden, proposed that a simultaneous measurement be made in the 25th year of growth of the tests. For the IUFRO 1938 series that would be in the 1962/63 season. This time the measurements were made on 10 plots that is on almost half of the existing ones.

In 1963 the 1st FAO/IUFRO World Consultation on Forest Genetics and Tree Improvement was held in Stockholm. In its recommendation no. 8 (Unasylna 18(2-3); p. 3, 1964) the Consultation asks section 22 of IUFRO:

"a) to prepare and distribute summaries of the results obtained from past international provenance tests;

b) ...

c) to prepare instructions concerning the collection of seeds, the design of field experiments and evaluation of results to aid in the development of local studies of provenance".

At the next 14th IUFRO Congress in 1967 in Munich the Working Group on Provenance Research and Testing reported on the internationally produced "Standardization of methods of provenance research and testing" (Lines 1967). This was produced by Roger Lines, U. K. translated into the three IUFRO languages and officially adopted. This effort was in compliance with recommendation 8c of the Stockholm Consultation, but no progress was made on recommendation 8a except for a compilation of results made by Vasso Gøhrn (1966) in Danish from all published results. Comparative presentation of spruce provenances superior in height growth on various sites, based on published reports, was the only reviewing effort at the time (Baldwin 1967). The "Standardization..." is a document useful only in the establishment of new provenance trials, having no suggestions for the treatment of

old ones, with deficient experimental designs. Needless to say when the new provenance trials reach maturity new ideas about experimental designs will make the "Standardization..." obsolete and the same type of problems will arise. Whatever the Working Group on Provenance Research and Testing has done was not meeting the main objective of the recommendations from the Oxford IUFRO Congress in 1956, which were concerned with the standardization of evaluation procedures for old provenance experiments. Thus at the Munich IUFRO Congress in 1967 it was decided to set up a Working Group on Provenance Research to be concerned with organisation and assessment of international provenance tests (Matthews and Callahan 1967).

Meanwhile in 1959 on the initiative of Olof Langlet, Sweden, (Krutzsich 1973a) a new series of provenance experiments with Norway spruce was launched. The aim was to review a maximal number of populations, indigenous, presumably indigenous and introduced. Seeds were collected over 4 years from all possible sources including commercial ones with rather general information on source. In all 1615 samples were collected of which, after rejection of those most poorly documented and poorly germinating ones the seeds of 1300 samples were sown in the spring of 1964 in the nurseries of the Institut für Forstgenetik und Forstpflanzenzüchtung in Schmalenbeck near Hamburg under supervision of Prof. Wolfgang Langner. In 1966 the seedlings were transplanted to the nurseries of Pein and Pein at Halstenbeck near Hamburg with Walter Neugebauer in charge of the transplanting work, labelling, lifting, assorting and shipping of the material. In 1968 each cooperator received 25 trees of each provenance. At that stage there were only 1100 provenances in view of poor seedling emergence from some seed lots. In the spring of 1968 20 experimental areas were established in 13 countries with a single-tree-plot fully randomized design. The study got to be known as the Inventory Provenance Test with Norway Spruce of 1964/68 (IPTNS 1964/68).

At the 2nd World Consultation on Forest Genetics and Tree Improvement in Washington, 1970, it was reported that in compliance with recommendation 8 of the previous Consultation the following progress was made:

8a "A new working group has recently been formed under the leadership of Pierre Bouvarel (France) for this purpose. Individual members of the group are appointed as coordinators for particular species or groups of species. A preliminary register of existing international provenance trials has been compiled.

8b ...

8c Report on "Standardization of methods for provenance research and testing" was published in the proceedings of the IUFRO Congress

held in München (1967). A revised version will appear in volume 19 of *Silvae Genetica*" (Unasylva 24 (2-3); 125-129.).

No revised version appeared in *Silvae Genetica* and what is perhaps more important the Washington Consultation had no new recommendations concerning old provenance experiments. In 1970 only a bibliography on these experiments was published by Michael Edwards and Roger Lines (1970).

For the 15th IUFRO Congress in Gainesville, 1971, Robert Z. Callahan and Max Hagman reported (mimeo) that in the Working Group on International Provenance Trials led by Pierre Bouvarel "A summary of international provenance trials is now underway..." A meeting was held at the Congress on "Status and future activities in international provenance tests". However all effort was devoted to new provenance trials planned or currently being organized. No "register" or "summary" of international provenance trials was produced. Interest in old experiments was clearly waning.

Among the new initiatives we should start mentioning the Polish one. In 1972 Stanisław Tyszkiewicz, Poland, proposed to the international community that he is ready to supply seed of Norway spruce from 20 selected seed stands placed under protection in Poland, covering most areas of spruce occurrence in the country. In all, 25 institutions from 12 countries responded and received the seed. (Circular letter of Stanisław Tyszkiewicz, May 14th 1973). Eventually 43 experimental areas were established in 14 countries (Circular letter of Stefan Kocięcki 8th April 1982).

The reorganisation of IUFRO made in Gainesville led to the creation of a working party for each species with new provenance experiments under way. With the recently established 1964/68 Norway spruce experiment on hand the Working Party on Norway spruce Provenances was created under the leadership of Jon Dietrichson, Norway, and Peter Krutzsch, Sweden. This brought together people more specifically concerned with provenance work on Norway spruce. At the first meeting of the new Working Party in Biri, Norway, it became apparent that interest in the old experiments still exists. Among the conclusions and recommendations from the meeting (Krutzsch 1973b) there are the following:

"The IUFRO experiments with Norway spruce from 1938 are of great scientific value. The most recent results of this series should if possible be made more widely available. The first results from the more intensive Inventory Provenance Test with Norway spruce (IPTNS) of 1964(68) (it was agreed that this experiment should be known in future as the IUFRO experiment of 1964(68)) seem to be highly correlated with the results of the 1938 trial (where similar provenances occur). The

possibilities of comparison between the two series would increase the reliability of the new findings. It is planned to maintain the bibliography of the IUFRO experiments, enlarged by reports upon the experiment of 1964/68. It is recommended, that data and results on the development of the IUFRO Norway Spruce series of 1938, if possible complemented by new assessments, should be published by each cooperator before the next IUFRO Congress in 1976..... Cooperation in assessment and evaluation has begun. As a key assessment, total height and the length of the last one to three leaders was strongly recommended to be measured by all the participants. Full scale height assessments should be made before the growing season of 1975, preferably after the 1973 or 1974 growing seasons. The advantages of international cooperation in this experiment are clear, and show how assessment work can be shared out between countries. One country may have facilities for studying wood-properties, while others need not assess this parameter, but could investigate morphological or biochemical traits. Ireland and Hungary have made a thorough full scale assessment on the time of flushing in spring 1973, so that other participants may reduce their work on that trait. The working Party suggested work-sharing for the following special traits: Frost damage (climatic damage), Biological damage, Lammas shoots, Branching angle, Crown-shape, Needle characters (Indumentum), Initial studies on taper. ... The Polish experiment of year 1972 (S. Tyszkiewicz) awoke great interest and it was agreed that this project should be integrated with the existing experiments of IUFRO".

While not many cooperators complied with these recommendations a review of the available results on the 1938 experiment was published by Roger Lines (1974) as well as a revised bibliography on all old provenance experiments (Lines 1975).

At the 16th IUFRO Congress in Oslo in 1976 the leadership of the Norway spruce provenances Working Party changed, Peter Krutzsch, Sweden, becoming Chairman and Stefan Kocięcki, Poland, Co-chairman. The previous Chairman and Co-chairman, Jon Dietrichson and Peter Krutzsch (1976) have come up with a novel idea of treating results from the IUFRO 1938 Norway spruce experiment. Using data from 12 experimental areas they have shown that much of the variation in tree height can be accounted for by latitude and longitude of the provenance when a multiple regression approach is adopted. A lively discussion at the session in Oslo has generated considerable interest in the old experiments. A review of data on height growth prepared by me appeared in *Silvae Genetica* (Giertych 1976).

Also for the 1976 Congress in Oslo a joint compilation was prepared (Dietrichson et al. 1976) in mimeo form giving latest height mea-



surements (at age 9 - 12) from the IUFRO 1964/68 experiment. While the list of tables constitutes only material for future evaluation it is one of the most successful joint efforts at internationally simultaneous action. It provides data for 1100 provenances from 14 experiments in 8 countries. An evaluation of the material for 130 selected provenances was published by me later (Giertych 1978).

The renewed interest in old provenance experiments became very apparent at the 3rd World Consultation on Forest Tree Breeding held in Canberra, 1977. In the recommendations from the Consultation (Unasylva 30 (119 - 120), 1978 p. 55 - 57) the problem of evaluation of provenance experiments is raised several times (in general recommendations 6 and 11 and in technical recommendation 2). Specifically the suggestion is to uniformize evaluation procedures, employ computer-based systems for the purpose, include data on phenological, physiological, morphological and biochemical traits and also the Consultation "noted the value of periodic visits to all trial sites of experienced international, or regional, assessment officers to facilitate overall appraisal and to assist in the local evaluation of individual trials, and urged concerned organizations to provide the requisite staff and finance for such assessments".

In 1979 there was a meeting in Bucharest of Working Parties 2.02.11 and 2.03.11 on "Norway spruce provenances and Norway spruce breeding". At a session chaired by Stefan Kocięcki (1979) "The Working Party strongly recommended and encouraged the evaluation of existing IUFRO provenance trials. Research results are of utmost importance in the current improvement of seed supply and breeding policies.

1. The conference members agreed that the IUFRO experiment results of 1938 and 1939, if available, should be given to Maciej Giertych of Kórnik, Poland, for an overall evaluation before the next meeting of the working parties.

2. Results from the IUFRO 1964/68 provenance trial should be made available to Jon Dietrichson, Oslo, for compilation and publication before the next meeting of the working parties. Only mean values within provenances (however, for any character assessed) should be submitted. A common assessment of these IUFRO trials at age 15 - 18 (1979 - 1982) was agreed upon. Jon Dietrichson and Anders Persson (Garpenberg, Sweden) were appointed for the organization and standardization of assessments to be made. The experiments were planned for short evaluation which should be followed by a medium term, step 2 investigation. Competition between single-tree-plots questions the reliability of results at later ages. The future treatments of the experiments were discussed and several possibilities were pointed out. No general suggestion for the method of thinning and manitenance resulted.

3. The IUFRO experiment started in 1972 with primarily Polish ma-

terial of Norway spruce, should be evaluated and if possible, standard procedures should be organized. Suggestions for future standard measurement and cooperation will be coordinated by Stefan Kocięcki, Warsaw.

4. The need of new provenance trials with Norway spruce was discussed. In order to meet the demand for international cooperation. Peter Krutzsch will ask the members of the three working parties upon planned experiments by means of a questionnaire. If there is a broad interest, a joint IUFRO experiment will be suggested." (Kocięcki 1979).

The next meeting was originally planned for 1983 (Circular letter no. 4 of Working parties S2.03.11 Breeding Norway spruce and S2.02.11 Norway spruce provenances — Peter Krutzsch and John Kleinschmit, 1980) in South Scandinavia, again as a joint meeting between the two working parties. However in 1982 a meeting materialized on "Breeding strategies, including multiclinal varieties" involving WP S2.03.11 and several others but not S2.02.11 on Norway spruce provenances. As of Jan. 1st 1982 this latter working party had a new leadership, Peter Krutzsch, Sweden, Chairman and Ladislav Paule, Czechoslovakia, co-chairman.

In late 1982 Peter Krutzsch stepped down from this position leaving Ladislav Paule as chairman. However, during the European Tree Breeders Meeting in southern Scandinavia in June 1983 there were sufficient number of members of Working Party S2.02.11 to hold a business meeting, and in the absence of Ladislav Paule it was chaired by Peter Krutzsch. It was decided to hold a meeting of the Working Party in 1985 which was to be hosted by Leo Günzl in Austria. It would be primarily concerned with Norway spruce provenance trials with emphasis on "cooperation in future planning, action and evaluation". The organisers wish to have "an overall view of what has been achieved". All having access to data from IUFRO provenance experiments on Norway spruce were asked to supply it to the coordinators appointed in 1979 in Bucharest, including myself for the IUFRO 1938 and 1939 trials. Nothing new was sent to me but I think I already had all that is available.

As regards the 1972 trial of Polish provenances, Stefan Kocięcki who coordinates the efforts has three times sent to cooperators a list of latest height measurements as they were being supplied to him from measurements at age 3-7, 5-8 and 7-10 years from 18, 22 and 24 areas respectively. Gradually the international community is becoming accustomed to sharing unpublished data.

In June 1985 the Working Party on "Norway spruce provenances" met in Vienna. In compliance with the Bucharest recommendations 1 and 3 a report was prepared on the 1938 and 1939 experiments by my-

self (Giertych 1984) and on the 1972 experiment by Stefan Kocięcki. Unfortunately both of us were unable to attend but the reports were presented. Recommendations 2 and 4 remained unimplemented. Instead a new set of recommendations was made (Circular letter 1/1985 by Ladislav Paule).

"3. Regarding the evaluation of the IUFRO 1964/68 Norway spruce provenance experiments after 20 years the participants agreed upon the following conclusions:

a. Each country should prepare as soon as possible a summary report evaluating its provenance trial(s) including the blockwise comparison of individual provenances and investigated characters.

b. The coordinators of the individual experiments and the heads of their institutions are kindly asked to submit all data available for final evaluation and synthesis of results.

c. The submitting of original data in requested form is a voluntary matter of individual coordinators, or their institutions, respectively. In any case, those coordinators who will submit their data to the common data base will have the right of the utilization of any data being in this data base, except the final evaluation and synthesis. The final evaluation and synthesis will be the matter of the coordinator and the advisory group.

d. The coordinator of the final evaluation will be Dr. Armin König, Federal Research Institute for Forestry, Grosshansdorf, FRG, and is authorized to prepare the methodology for submitting the data and their from by the end of year 1985.

e. For the final evaluation and synthesis of the results following persons were nominated for the advisory group: Peter Krutzsch, Tore Skrøppa, Anders Persson, Alphonse Nanson, Ladislav Paule.

f. The final evaluation of this experiment is planned for next two years and it is presumed that the results will be published in a book form.

g. It was suggested that J. Dietrichson will prepare a paper for the IUFRO Congress in Ljubljana 1986 reviewing the results of IUFRO 1964/68 Norway Spruce provenance experiment, similar to that which was prepared and presented at the IUFRO Congress in Oslo, 1976.

4. Regarding the future evaluation of the experiment and planning the new experiment the participants agreed upon the following recommendations:

a. J. Dietrichson presented a proposal of a new re-grouping of 1100 provenances into 20 groups. This proposal was distributed to participants and is also added to this report. These zones are based on Norway experiments and seem to be optimal ones.

b. It is recommended that individual coordinators should make an appropriate analysis of their experiments regarding these proposed 20 zones and to stress their interest on the best three zones and native one with regard to the adaptation and risk evaluation, quality, volume (yield). When making this analysis according to the proposed 20 zones coordinators of individual experiments may contact J. Dietrichson or T. Skrøppa.

c. Countries with interest in the same breeding zones can cooperate in: obtaining the breeding material from the selected zones, establishment of the breeding trials, elaborating of the common breeding strategy.

d. It is assumed that in the near future our working party will organize a new collection of provenance material based on the recommendations from the analysis of the best zones. The sampling of the new material should be mainly based on halfsib family samples. It was suggested that the coordinator of this collection of new samples for progeny and provenance testing will be Ladislav Paule. Another circular letter dealing with new collection of samples will be distributed by the end of year 1985".

At the meeting it was also decided to appoint Dr. Armin König, FRG, as co-chairman of the Working Party.

So far no new circular letter was produced. When seeing the recommendations I wrote to Ladislav Paule and Armin König suggesting "that those who are going to write the report on the 1964/68 experiment attempt to review what data is available without waiting for the data to be supplied by cooperators ... It is almost impossible to achieve simultaneous action and this should not prevent us from having a joint evaluation of what data is available".

#### DIFFICULTIES ENCOUNTERED IN REPORTING ON INTERNATIONAL EXPERIMENTS

An obvious difficulty often referred to is the absence of an adequate experimental design in the older experiments. This is truly a problem. Many statistical procedures are impossible because of that. However I do not wish to exaggerate the importance of this difficulty. The experiments were layed out according to the best ability of responsible investigators. Some designs were considered to be experimental or pilot procedures which later either proved to be the more acceptable ones or else were disqualified by the scientific community. Thus for example the use of a replicated standard provenance recommended in 1940 by Werner Schmidt for the study (Baldwin et al. 1973) is now criticized and no longer employed in provenance research, while re-

plicates and randomisations used in some of the experimental plots are now standard procedure. It is absolutely certain that the experimental designs we use today in our new plantings will in a few decades become obsolete and much criticized. Thus we have to accept this fact in forestry experiments and benefit as best we can from what we have.

What perhaps is more of a problem is that important recommendation as for example that concerning the use of certain "obligatory" provenances throughout the 1938 experiment was disregarded by so many cooperators. As a result not a single provenance is present on all the experimental areas. Even if one ignores one or two sites such an analysis is not fully justified because each provenance demonstrates its own interaction with the environments and thus is inadequate as a standard. It would be best if there were a permanent block of several diverse provenances on all sites (as was recommended) the average of which could be used as a standard. This however is not available. Removal of a few locations and a few provenances from consideration is insufficient, because the most abundantly represented provenances have missing plots scattered over almost all the locations.

Thus it is not so much an inadequency of the recommended design that is a problem, but the disregard of it by cooperators.

Another consistent problem is the lack of simultaneous measurement. The data refer to trees of various age and thus only relative comparisons are possible. In view of changes in ranks occurring with age such comparisons are not fully justified.

As was outlined above, international recommendations for periodic measurements were extremely difficult to implement. This continues to be a major problem with such international experiments. The cause lies in the fact that interest in these experiments is so extremely divergent. When there are several plots in one country these are regularly assessed and reported upon, while some of the others were not measured for many years or in fact never.

Some have been abandoned due to destruction by calamities but more commonly due to lack of interest in the results. With the death or retirement of the person who established the experiment it often gets forgotten or is deemed useless. Locally, considered apart from the other locations, this is frequently true, particularly if there are no replications. The potential value is only international, but this requires joint periodic assessments. At best only growth measurements are available. Other traits are very rarely considered on more than one site.

Finally there is a difficulty in contradiction to the one mentioned above which I feel embarrassed to mention, yet I have encountered it analysing old provenance experiments though perhaps not so manifestly in connection with my spruce report. Some people are very jealous of

their results. Even though they are of little local value, perhaps unworthy of publication, they are still kept unavailable for review purposes. Also some scientists feel uneasy about divulging details of an inadequate design, for example lacking randomisations, particularly if earlier invalid statistical analyses have been performed and published.

#### RECOMMENDATIONS

Now a word is needed about the future. Having analysed in so great a detail all the information that is available about the 1938 study (Giertych 1984) I have some suggestions about the way the experiments should be dealt with from now on. Here are my recommendations which I hope will be brought under discussion by IUFRO WP S2.02.11 and implemented if approved.

1. The 1938 and 1939 IUFRO provenance experiments continue to produce useful information and thus they should be maintained as an experiment for as long as possible, periodically renewing labels etc. The same is true of the more recent studies of 1964/68 and 1972.

2. All planting sites of IUFRO provenance experiments on Norway spruce should remain on file as active experiments as long as the experimental spruces grow there, regardless of local interest in the study and the extent of damage inflicted to the area by various calamities.

3. When damaged an area should be assessed as regards losses and survivals and if necessary underplanted with a different genus, but still maintained with sufficient labelling to be able to identify spruce trees of different origin.

4. Cooperators should be encouraged to make assessments at least every 10 years, preferably simultaneously for the whole experiment. Similar recommendations made earlier generally remained unimplemented.

5. In view of the difficulty of obtaining simultaneous and equally reliable evaluations of productivity and qualitative traits an international team of IUFRO scientists should visit all experimental areas in one season, make the necessary measurements and observations with the help of local staff and at the same time report the actual status of the experiments. FAO should be approached to finance such an effort as it did in 1952 when dr. Barend Veen was sent to report (Veen 1953a, 1953b) on all the experimental areas.

6. On all sites best trees from best provenances should be selected, numbered and clonal material made available to those wishing to include it in the gene pools of their breeding programs. This should be particularly valuable with respect to the most generally adaptable and

highly producing provenances such as Istebna, Crucea, Vadul Rau, Lan-kowitz, Planice etc.

7. International experiments are not the private property of the scientist who established them nor of their institution. They have a significant input of an international effort. The value of these experiments is international and even when local interest is nil data on performance should be internationally available. IUFRO should make it clear that it expects from cooperators a readiness to maintain the experiments for international use and to share the data.

8. In all future provenance experiments lay-out of each planting site should be promptly published together with a maximal amount of detail concerning the location and mode of establishment. This is the kind of information that is most difficult to reach decades after local interest in the experiment waned.

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### Historia międzynarodowych doświadczeń proveniencyjnych z świerkiem pospolitym (*Picea abies* (L.) Karst.) i trudności kooperacyjne

#### Streszczenie

Publikacja omawia organizację, zakładanie i próby wspólnych opracowań wyników doświadczeń IUFRO (Międzynarodowej Unii Leśnych Instytutów Badawczych) nad świerkiem pospolitym. Podstawowy cel tych doświadczeń — równoczesne działanie — nie został osiągnięty. Znaczący wysiłek organizacyjny przy zakładaniu dużych doświadczeń idzie często na marne na skutek rezygnacji z prowadzenia tych doświadczeń w okresie młodocianym. Wobec powyższego autor przed-



stawia swoje sugestie dotyczące przyszłości współpracy międzynarodowej w dziedzinie badań proveniencyjnych, a w szczególności: zobowiązanie wszystkich uczestników do: publikowania danych metodycznych wraz z planami powierzchni już w trakcie zakładania doświadczeń; traktowania doświadczeń IUFRO jako międzynarodowych; udziału we wspólnych cyklicznych opracowaniach wyników; udostępnienia wyników niepublikowanych wszystkim zainteresowanym. Okresowe syntezы wyników należy publikować niezależnie od liczby współpracujących uczestników, wraz ze wskazaniem tych, którzy uchylają się od współpracy. Celowe byłoby dokonanie pomiarów i ocena stanu wszystkich powierzchni doświadczalnych IUFRO w ciągu jednego sezonu wegetacyjnego przez międzynarodowy zespół naukowców przy finansowym wsparciu organizacji międzynarodowych.

История международных опытов с географическими культурами ели обыкновенной (*Picea abies* (L.) Karst.) и трудности в сотрудничестве\*

Резюме

В работе представлены организация, закладка опытов и попытки совместной обработки результатов опытов ИНФРО (Международный Союз Лесных Научно-Исследовательских Институтов) с елью обыкновенной. Основная цель этих опытов — одновременное действие — не была достигнута. Значительные организационные усилия связанные с заложением больших опытов часто идут на смарку в результате отказа от ведения этих опытов в молодом возрасте. В связи с этим автор представляет свои соображения относительно международного сотрудничества в географических культурах. Оно должно включать выполнение всеми участниками следующих обязательств: опубликования методических сведений вместе с планом опытов уже на стадии их закладки; отношения к опытам ИЮФРО как к опытам международным; участия в совместных циклических обработках результатов; обеспечения всем заинтересованным доступа к результатам неопубликованных еще работ.

Периодические обобщения результатов необходимо публиковать независимо от количества сотрудничающих участников с одновременным указанием на тех которые от сотрудничества уклоняются. Целесообразным является проведение замеров и оценка состояния всех опытных площадок ИНФРО в течение одного сезона международным коллективом научных сотрудников при финансовой поддержке международных организаций.

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