

**INTERNATIONAL COOPERATION
IN FIELD TRIALS ON SOIL FERTILITY
(REPORT OF THE WORKING COMMITTEE OF THE 4th COMMISSION)¹**

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1. The working committee was set up during the 6th Congress of the I.S.S.S. Joint research into soil fertility by means of field trials was decided to be the task of the committee, restricting it to the temperate climate of Europe.

The project was defined as: "Study of the influence of physical, biological and climatological factors on the nitrogen condition of the soil and the nitrogen supply of the crops." This project was considered scientifically and economically important for all participating countries. It could be expected that the different approaches to the problem, using also different methods, would influence one another and would stimulate their mutual understanding and appreciation when dealing with data obtained by joint research.

2. From the very beginning two main sites of research could hereby be distinguished: Giessen and Groningen. Two set-ups of the work therefore were proposed, afterwards linked up with one another.

The research-centre at Groningen gave the impulse to start with short term (one year duration) trials using series of increasing applications of nitrogen. In 1958 eight series could be realized, comprising 30 of such trials (six levels of dressing with four replications) at Oldenburg, Linz, Rostock München, Giessen, Leuven, Ljubljana and Groningen. As test-crop was used oats. These series are designated "Internationale Stickstoffversuche — I.N.V." (International nitrogen experiments). The set-up of the experiments followed an outline allowing a detailed evaluation of the fertility factors affecting the growth and yield of the crop. Different field-observations and analytical data were necessary herefore. The aim of this approach to the problem is to deduce and interpret the "fertility" of the soil from all the separate factors.

The research-centre at Giessen advocated the so-called "Internationale Dauerversuche — I.D.V." (International permanent field experiments). Tentatively it is decided to maintain these trials during 10 years. Every year the three crops — potatoes, winter-wheat and oats — are grown on each

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plot, comprising a rigid rotation. The fertilization levels are $N_0K_1P_2$, $N_1K_1P_2$, $N_2K_1P_2$ and $N_3K_1P_2$; this means that not a single factor is changed but the whole fertilization level. These permanent field-trials are started by the research-institutes at Oldenburg, München, Giessen (2), Dülmen, Braunschweig-Völkenrode, Stuttgart, Thyrow-Berlin, Leipzig I, Leipzig II, Rostock, Linz, Wien, Leuven, Versailles, Groningen, Liebfeld-Bern, Ljubljana (3) and Zagreb.

The aim of these experiments is the investigation of the complex factors: habitat, fertilization, year (weather) and crop and of the interaction of these factors. The computation of the results is always accompanied by the analysis of variance. In these long-term trials a detailed study of the effect of the growth-factors is possible due to the determination of the many data in soil, crop and climate.

In addition to the above field trials it was decided to perform pot-experiments in some of the research centres. Oats is used hereby as test-crop with 6 to 8 levels of nitrogenous fertilization, applied in triplicate. In 1958 for the pot-experiments was used the soil from one of the I.N.-trials, whereas in 1959—1961 the soil was derived from one of the I.D.V.-plots. These experiments were performed at the institutes Oldenburg, Giessen, Rostock, Leipzig I, Linz, Groningen, Versailles and Ljubljana. For all the trials as well for the field as for the pot experiments uniform batches of seed and potatoes were applied, provided with by the institute at Giessen. The necessity hereof was clearly demonstrated by a preliminary investigation in 1957.

3. We are of the opinion that a good co-operation, studying the strictly defined problems, is achieved, as it can be illustrated by the following considerations:

a) The data obtained in the I.N.V.-series are centrally brought together and tabulated. The different cooperating institutes derive herefrom interesting data, using them for their reports and publications. The methods to be used for the compilation of the results, which will be performed by Th. J. Ferrari at Groningen, are chosen by mutual deliberation.

b) The data of the I.D.V.-series are every year sent-in, already neatly tabulated. From 1961 onward all members of the Working Committee are provided with the results of the last year. These "Bericht über die internationalen Dauerversuche" (Report about the international permanent field experiments) is already issued for the years 1961 and 1962. The description of the soil profiles is performed as far as possible centrally. Soil profiles preserved by lacker are collected. Though the final compilation of the results only will be possible after the complete 10-year period, experience for that task is already gained by doing it now for shorter series of years. For this centralized compilation is responsible E. von Boguslawski at Giessen with his staff.

c). The results of the pot experiments raised the doubt whether the observed differences are brought about by differences in the habitat or in the applied methods. Mutually now the performance of pot experiments is studied at Giessen and Groningen, and since 1964 also at Oldenburg. The technical staffs of the different institutes contacted one another regularly.

The way of watering the pots proved to be very important. The result of this effort is an in detail defined procedure for pot experiments. This guarantees a better possibility to compare series of pot experiments performed by institutes in different countries.

d) Modern tabulation and computation equipment was provided by the "Österreichische Stickstoffwerke" (Austrian nitrogen industries) at Linz, and by the university at Giessen.

e) Much additional research had to be done with soils, crops and seed from the participating institutes.

f) The performance of the experiments and the obtained results have successively been discussed during assemblies at Groningen, Giessen, Hamburg, Groningen, Braunschweig-Völkenrode, Linz, Bern and München.

g) The different methods of soil fertility research mutually influenced one another. On the one side it was recognized that a detailed study of the separate factors, applying the adequate techniques, is necessary, but the significance of the whole complexes of factors, characterizing the fertility of the different habitats, is also realized. Take for instance the conception "Bodenzahl", generally used in Germany. It was evaluated for all the experimental plots. The value of the soil profiles of the I. D.-trials was also estimated, especially by G. Schmidt at München, E. Brauer at Giessen and H. Schiller at Linz. The visual evaluation of the structure of the soil, developed in Groningen, must also be mentioned in this connection. This also was done on all plots used for this research.

There is gradually growing a desire to recognize and formulate the laws which determine the reactions of the crop upon fertilization, hereby following the principles laid down by Mitscherlich.

h). The schemes of the I. N.-and the I.D.-trials are already followed in some countries.

4. The additional investigations performed with the soil, crop and seed, used for the experiments, and also with the experimental plots can be specified as follows:

a) The methods for the determination of pH, P, K and Mg used in the laboratories at Leuven, Linz, Oldenburg, Rostock and Oosterbeek (the Netherlands) were compared.

b) The seed, harvested on the different I.D.V.-plots, is used for the study of the influence of the origin on the developing crop.

c) The biological quality of the seed obtained on the I.D.-experiments will be studied.

d) The determination of the digestibility of the straw is initiated.

e) The baking quality of the wheat of different origin is compared.

f) On the experimental plots the pH(H_2O)-values are periodically determined since it is presumed that the pH reflects the changes in the fertility of the soil brought about by variations in the weather.

5. The obtained data are worked up and interpreted in different directions and for different purposes:

a) The centralized analysis of the data of the I.N.-trials by Th. Ferrari can be described as follows: he analyses the different aspects with the aim

to derive hereby models, which then can be treated with the regression analyses or with the method of the path coefficients. Twelve factors are hereby connected with the parameters of the N-curve.

b) E. von Boguslawski intends to elucidate the working up of the data of the I.D.-experiments during the congress ("Der Einfluß von Standort und Düngung auf den Pflanzenertrag am Beispiel der I.D.V.-Serie").

c) H. Schiller and E. Lengauer at Linz analysed the results of their I.N.-trials with the numeric-graphical method, and reported about that already.

d) E. Primost and G. Rittmeyer at Linz delivered a report entitled: "Ergebnisse der Qualitätsuntersuchungen aus den I.D.V.-Serien 1961 des Winterweizens" ("Results of the investigation of the quality of the winter-wheat from the I.D.V-series in 1961").

e) G. Schmidt at München used the data of the there performed I.N.V.-series for the investigation of the influence of nitrogen fertilization upon the yield of dry matter and protein on soils with different levels of organic matter, Mg, P and K. Besides that he also studied the influences of nitrogen on soil-structure and weed-flora. Dr. Ferrari could deduce from his own data the influence of nitrogen fertilization upon the attack by the oat cyst nematode.

f) At Giessen was published a Ph.D.-thesis of Helmut Rasp entitled "Der Einfluss der Stickstoffdüngung auf Ertrag und Nährstoffentzug von Hafer auf Lösslehm Böden" ("The influence of nitrogen fertilization on the yield and uptake of nutrients of oats on loess-clay-soils").

g) The fixation of NH_4 by the soils used in this research has been investigated at Giessen and at Linz.

h) The relation is determined between the fertilization, uptake and alteration of the fertility of the soils of the I.D.-trials.

6. What is now planned for the future? The analysis of the results of the I.N.-trials is just in full progress. We consequently hope before long to complete the final report. It is the intention to publish the conclusions of the separate reports in the Bulletin of the I.S.S.S.

We are full of good expectation and the tone is healthy among the participants. But we are aware of the weakness of the administrative and material structure of our Working Committee. A central person for the strengthening of the internal contact would improve the solidity of the committee and could perhaps open new perspectives. We are looking for assistance with respect to the documentation work and the evaluation of our cooperation at Giessen. We try to consolidate the connections between the institutes since we are convinced that hereby the chance to come to a more permanent co-operation in the field of soil fertility research would be increased. The support of the I.S.S.S. is for us essential.