

Changes in soil tillage research during ISTRO life.

Contribution of ISTRO meetings and publications

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Abstract

In the first part of the paper a brief history of ISTRO development is presented, showing the ever increasing number of participants, countries and papers. Secondly, other ISTRO activities and publications are mentioned. In the third part of the paper, the trend of changes in subjects of the presented papers is discussed. Papers mainly related to tillage systems, to their effects on soil properties, as structure, and on crop yields, and to depth and number of tillage operations were the main ones since the earlier ISTRO meetings. Reduced and zero tillage, and soil and subsoil compaction were items also present since the first ISTRO meetings, when interest in practice for such problems was still reduced, but much more widely discussed in more recent meetings. Papers on relationships of tillage to sustainability, carbon sequestration, soil pollution, precision agriculture are only more recently presented. Relationships of soil tillage to socio-economic and energy consumption seem also to be of more recent interest. Current development in research methodology, as simulation modelling, is present in more recent ISTRO meetings. With extent of ISTRO to more and more countries, discussion on diversity of tillage systems under different soil and climate conditions is developing. It may be concluded that research results of ISTRO members were of great help for solving current problems of agriculture, but also one step forward in studying possible developments of such problems.

Keywords: soil tillage systems, conservation tillage, compaction, precision farming, modelling

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1. Introduction

Decision to formally establish an International Soil Tillage Research Organisation (ISTRO) was taken in Wageningen, The Netherlands, on September 27, 1973, during the 6th International Conference, at the initiative of Prof. H. Kuipers. The basic regulations of the new ISTRO were accepted by the participants to the Wageningen meeting.

In fact, there were earlier 5 other such Conferences, namely:

- 1955, Uppsala (Sweden), organised by G. Torstensson;
- 1958, Stuttgart / Hohenheim (Germany), organised by H. Frese;
- 1962, Doorwerth (The Netherlands), organised by H. Kuipers;
- 1965, Aas (Norway), organised by N. Njøs;
- 1970, Silsoe (England), organised by N. J. Brown;

These Conferences had a relatively limited participation, only some one dozen of papers, mostly from several North-Western Europe countries, being presented. Nevertheless, once ISTRO constituted, it was decided to consider these earlier Conferences as part of ISTRO activity, and as such the next Conference, held in 1976 in Uppsala (Sweden), became the 7th ISTRO Conference. A complete listing of these Conferences is given below:

- 6th ISTRO Conference, September 24 - 29, 1973, Wageningen (The Netherlands), president H. Kuipers;
- 7th ISTRO Conference, June 15 - 18, 1976, Uppsala (Sweden), president R. Heinonen;
- 8th ISTRO Conference, September 9 - 16, 1979, Stuttgart / Hohenheim (Germany), president G. Kahnt;
- 9th ISTRO Conference, June 21 - 25, 1982, Osijek (Yugoslavia), president V. Mihalić;
- 10th ISTRO Conference, July 8 - 12, 1985, Guelph, (Ontario, Canada), president J.W. Ketcheson;
- 11th ISTRO Conference, July 11 - 15, 1988, Edinburgh (Scotland), president B. D. Soane;
- 12th ISTRO Conference, July 8 - 12, 1991, Ibadan (Nigeria), president R. Lal;
- 13th ISTRO Conference, July 24 - 29, 1994, Aalborg (Denmark), H. E. Jensen;
- 14th ISTRO Conference, July 27 - August 1, 1997, Pulawy (Poland), president H. Domzał;
- 15th ISTRO Conference, July 2 - 7, 2000, Fort Worth (Texas, USA), president J. Morrison;

- 16th ISTRO Conference, July 13 - 18, 2003, Brisbane (Australia), president J. Tullberg
- 17th ISTRO Conference, August 28th – September 3rd, 2006, Kiel (Germany), president R. Horn.

This paper will discuss the development of ISTRO since its formal establishment, that is from the 6th to the 16th Conferences.

2. Increased extent of ISTRO Conferences: number of scientists attending and countries taking part

Participation to ISTRO Conferences increased almost steadily (Table 1), from 21 papers in 1973 to more than 200 papers in 2003, that is more than ten times, exceptions being when Conferences took place in far-reaching countries (12th Conference in Nigeria, 16th Conference in Australia).

Table 1
Number of papers published at the 6th - 16th ISTRO Conferences

Conference	Number of published papers by continents							Total
	Western Europe	Eastern Europe	North America	South America	Asia	Africa	Oceania	
6 Wageningen	14 *	4	1	0	1	1	0	21
7 Uppsala	28 *	8	6	1	3	1	1	48
8 Hohenheim	34 *	17	10	3	3	2	2	71
9 Osijek	57	34 *	6	3	5	4	0	109
10 Guelph	35	7	61 *	2	9	15	12	141
11 Edinburgh	66 *	12	39	1	11	18	9	156
12 Ibadan	15	7	13	2	6	20 *	9	72
13 Aalborg	81 *	36	41	1	8	27	11	205
14 Pulawy	52	84 *	23	3	5	6	9	182
15 Fort Worth	54	42	56 *	7	21	19	15	214
16 Brisbane	36	21	19	6	23	11	37 *	153
Total	472	272	275	29	95	124	105	1372

* refers to continents where the respective Conference took place.

Considering papers for the whole of the 11 Conferences, 34 percent of the total are from Western Europe, 20 percent each from Eastern Europe and North America, some 8 percent from Africa, Oceania and Asia, and only 2 percent from South America. These percentages are of course higher for the continents where each Conference was located. If at the beginning of ISTRO activity participation of scientists coming from other than Western European countries was quite limited, it increased especially after the second half of the 80',

certainly showing a globalisation of ISTRO. Participation of Eastern European countries became significant after the political events of 1989 - 1991.

Similar are observations resulting when examining the number of countries, also classified by continents, whose scientists attended ISTRO Conferences (Table 2).

Table 2
Number of countries represented at the 6th - 16th ISTRO Conferences

Conference	Number of countries by continents							Total
	Western Europe	Eastern Europe	North America	South America	Asia	Africa	Oceania	
6 Wageningen	4 *	3	1	0	1	1	0	10
7 Uppsala	7 *	2	1	1	3	1	1	16
8 Hohenheim	9 *	4	2	1	2	2	1	21
9 Osijek	11	4 *	2	2	3	3	0	25
10 Guelph	11	2	2 *	1	6	8	2	32
11 Edinburgh	15 *	5	2	1	4	7	2	36
12 Ibadan	7	2	2	2	4	7 *	2	26
13 Aalborg	13 *	12	2	1	5	7	3	43
14 Pulawy	10	14 *	2	2	4	2	1	35
15 Fort Worth	12	11	2 *	4	7	9	1	46
16 Brisbane	13	7	2	4	10	5	2 *	43
Total	112	66	20	19	49	52	15	333

Of course, we have to take into account here that North America and Oceania have only 2 main countries each, which were both represented since 1979, respectively since 1985. As for the other continents, there is a similar general trend as discussed earlier: a predominance of Western European countries at the beginning of the ISTRO activity, an increase in the number of countries since the 80' for Asia and Africa, and since the 90' for Eastern Europe.

3. Other results of ISTRO activity and of ISTRO related activities

One of the main periodic publications on soil management is the now well-known Soil & Tillage Research, and I hope I am not wrong if mentioning that the initiative for issuing this journal belongs to ISTRO members. The Editorial Advisory Board, including scientists from all over the world, consists mainly (or entirely ?) of ISTRO members. Soil & Tillage Research has been, and is, published by Elsevier Science (Amsterdam, The Netherlands), in collaboration with ISTRO, and is an international journal including research and development papers concerning soil tillage, field traffic and related items as land use, crop

production and environment. The journal has been initiated in 1981 and in 1988 it incorporated the former Soil Technology journal published by the same company. Each year, several volumes, each consisting of several issues (at present, four volumes with two issues each), are published, 86 volumes being published by now.

Another main event in ISTRO development may be considered to be the initiative to organise country branches. It started during the Ibadan Conference (1991), immediately after the political changes in Eastern Europe, the idea being to stimulate and help scientists of these countries to join ISTRO, to take part and to organise themselves professional meetings, to make known to the rest of the world their results and to get more information on results obtained in other countries. In the following years some actions were taken to extend such branches also to other parts of the world, as Africa or Latin America. The initiative belonged, I hope I am not wrong, to C. Van Ouwerkerk, for many years ISTRO Secretary General. In any case, he was the one who did a tremendous work, in the next few years until his too early death, to contact scientists in various countries and to help them organising such branches, now existing in Bulgaria, Czech Republic, Estonia, Hungary, Kenya, Nigeria, Poland, Romania, Russia, Slovakia, Ukraine, and perhaps other countries. Most of these branches, and also Kazakhstan which does not formally have an ISTRO branch, organised during the 90' local meetings, with international participation. Last year, the Czech Republic ISTRO Branch had its third meeting in Brno.

Even before establishment of country branches, an International Conference on Soil Compaction (1989) was organised in Lublin, Poland, with participation of many scientists from various countries, most of them ISTRO members, the presented papers being published in two volumes. Another International Conference in Firenze, Italy (Pagliai and Jones, 2001), with a larger scope, included some 30 papers referring to soil structure, soil compaction and modelling of compaction processes.

In 1988 - 2001 two concerted actions on subsoil compaction were carried out within the European Union FAIR and INCO COPERNICUS Programmes, almost all of the 50 participants to these projects being ISTRO members. Within these two concerted actions there were five workshops. Proceedings of these workshops were published each in a volume (Van den Akker et al., 1999, 2003; Horn et al., 2000; Arvidsson et al., 2001; Birkas et al., 2000; Canarache et al., 2001), with a total of more than 200 papers.

As a consequence of this project, an International Conference was organised in 2002 in Constanta, Romania (Canarache et al., 2002), the Romanian ISTRO Branch being one of the organisers. It included some 20 papers on compaction, soil physical properties related to tillage, and other subjects of interest for ISTRO.

Besides volumes of Proceedings of ISTRO Conferences and of other Symposia mentioned above, several volumes of interest were published by ISTRO members. Could be quoted: Lal (1979), Nugis (1983), Mc. Kyes (1985), Soane (1987), Kovda (1987), Soane a. Van Ouwerkerk (1994), Carter (1994), Dumitru et al. (2004). Recently, a book was published by Håkansson (2005), one of the few founding members of ISTRO still active.

4. Development of fields of research: subjects discussed at ISTRO Conferences

To analyse development of research on soil tillage and of its application in soil management practices, it was necessary to classify the papers presented at the ISTRO respective Conferences. In a first stage, this classification was the one already used by the organisers of these Conferences, as shown in the Proceedings. Unfortunately, not all volumes have such a classification and, moreover, the classifications used are very different. It was then necessary, in a second stage, to develop a wider classification, using the ones in the different Proceedings, but merging them into a unique one. This classification takes into account 18 subjects, as shown in Table 3.

A first result when analysing this table is that the more or less classical subjects referring to soil tillage, as general farming systems, effects of tillage on crop yields, and relationships of soil tillage with soil physical properties are still the most studied ones, reports on each of these subjects representing 12 - 16 percent of the almost 1400 published papers. These items were of course present since the early ISTRO Conferences. Accepting that such classical fields of research are and will be still of interest, it may nevertheless be said that at the same time such a percentage means that other subjects, more recently taken into account and certainly of more interest for current and future developments in soil science, crop management, environment, etc., will need to be more in the attention of scientists.

Papers on tillage machinery represent only 7 percent of the total number of papers presented at the ISTRO Conferences, also being present since the early ISTRO meetings. It seems this is a relatively low figure, lower than necessary in the actual period when increase in efficiency of man work, as well as prevention of negative effects of inadequate machinery on soil quality, are of much interest. In fact, it is probable that research on tillage equipment has an adequate development, but that scientists doing such work are not enough related to ISTRO. More co-operation of soil scientists, agronomists and agricultural engineers in fields of research of this kind seems to have to increase, and it will be good to have more tillage machinery scientists attending the ISTRO meetings.

Next according to the amount of subjects published in the ISTRO Proceedings (7 - 8 percent each of the total number of published papers) are those referring to conservation tillage, soil compaction and tillage / chemical soil properties interrelationship, many of this last group of papers referring to soil pollutions. Reports on such subjects have been presented since the early ISTRO Conferences, but their amount sharply increased after the 90'. All these items became of interest in the last half of century, and their relatively high presence in ISTRO meetings is certainly very adequate. Concerning conservation tillage, it is already well used in practice in many American countries, but much less than possible in Europe and in other parts of the world, and the role of research in extending these practices, adjusting them to various local conditions, and making them known to farmers is obvious.

Subjects on precision agriculture, energy consumption, economical and social effects of soil tillage, effects of tillage on soil biology, and soil properties / root development interactions represent each 1 - 3 percent of the published papers. These items were not present in the earlier ISTRO Conferences, but only since the mid 90'. They are of course new fields of research, and their presence, even if still reduced, is of interest, demonstrating that ISTRO is contributing to further developments of research and practical agriculture.

A subject of certain interest for research methodology is the development of modelling techniques, both physical and simulation (mathematical) modelling. Papers on this subject are present in ISTRO Conferences since the early 80'. They reached for the whole of the time interval discussed here a total of 4 percent of the total number of published reports, with a higher number (9 - 11 percent) at the Edinburgh and Fort Worth Conferences. This fact is certainly a good demonstration of ISTRO contribution to development of better research techniques, and also to possible use in practice of some specific models.

4. Conclusions

An analysis as tentatively made in this paper, which certainly may be better renewed and more detailed renewed, shows the important extent of ISTRO from one Conference to the other as number of participants, number of countries involved, and number of subjects discussed. It also shows that ISTRO has an important role in summarising existing classical knowledge on soil tillage and related fields of research, in supporting exchange of such information between scientists, in promoting application in practice of available techniques. ISTRO is essentially contributing to development of more recent areas of research, as those referring to conservation tillage, soil compaction, soil tillage / pollution relationships. New subjects, as precision farming or modelling of various processes related to tillage, are also present in more recent ISTRO meetings, contributing to their development.

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