

Fifty plus years of the International Silage Conferences

Unpublished paper by RJ Wilkins, Jan 2022

The early development of this series of Silage Conferences was outlined by Wilkins (1996) and Wilkins and Wilkinson (2015). This paper will provide an update on the Conferences and how the major themes of the presented papers have changed over this 50-year period, contrast the state of knowledge now with that in 1970 and discuss future opportunities and challenges. This is very much the personal perspective of a long-retired scientist who was involved in the planning of the first meeting and has attended all but one of the meetings. It may be a timely review as the proposed formation of an International Silage Science Society at the next meeting in China, may well be another landmark in the development of this series of meetings.

The venues of the meetings are listed in Table 1. The 19th Conference was scheduled to be held in Beijing, China, in 2021, but has been postponed because of the covid pandemic and is now planned for 2023.

Table 1 Years, venues, titles of meetings and number of participants

				No. participants
1	1970	Edinburgh, Scotland	Silage Seminar	35
2	1972	Hurley, England	Silage Seminar	63
3	1974	Edinburgh, Scotland	Silage Conference	66
4	1976	Hurley, England	Silage Conference	57
5	1978	Ayr, Scotland	Silage Conference	81
6	1981	Edinburgh, Scotland	Silage Conference	87
7	1984	Belfast, Northern Ireland	Silage Conference	91
8	1987	Hurley, England	Silage Conference	112
9	1990	Newcastle, England	Silage Conference	94
10	1993	Dublin, Republic of Ireland	International Conference on Silage Research	141
11	1996	Aberystwyth, Wales	International Silage Conference	203
12	1999	Uppsala, Sweden	International Silage Conference	229
13	2002	Auchincruive, Scotland	International Silage Conference	204
14	2005	Belfast, Northern Ireland	International Silage Conference#	193
15	2009	Madison, USA	International Silage Conference	253
16	2012	Hameenlinna, Finland	International Silage Conference	328
17	2015	Piracicaba, Brazil	International Silage Conference##	286
18	2018	Bonn, Germany	International Silage Conference	344

Also Satellite Workshop of 20th International Grassland Congress

Also 4th International Symposium on Forage Quality and Conservation

The first meeting was held in Edinburgh in 1970 and was entitled 'Silage Seminar'. There were 35 participants, all from the UK and Ireland. There were no papers, but the sessions on particular topics involved a panel of researchers who outlined their recent findings and future intention, prior to a full discussion of the topic. Meetings were then held at two or three year intervals in different centres in the UK until the 10th meeting in Dublin in 1993. The format evolved to that of a conference built around offered papers reporting recent research and development, together with a small number of invited contributions. These include some particularly valuable review papers. Although summaries of most of the papers presented were available at the meetings, a bound collection of papers was not produced until the 5th meeting at Ayr in 1978 and full Proceedings were not published until the 10th meeting at Dublin in 1993. Copies of reports of early meetings and published proceedings can be accessed from the ISC website ([give reference and indicate which ones available there](#)).

Attendance at the first meeting was only by invitation and the 35 participants were all from the UK and Ireland and restricted to people working in the public sector. This limitation to the public sector continued until the 10th meeting and participation from outside the UK and Ireland was also limited until then, although attendance at meetings had increased to around 100 (Table 2). Thus the meeting in Dublin was a landmark meeting with open attendance and

fully published Proceedings. This pattern has continued to the present, with meetings held at three or four year intervals. The venues have become very international. The first meeting outside of the UK and Ireland was in Sweden in 1999 and the first meetings outside of Europe were in USA in 2009 and Brazil in 2015. Attendance exceeded 200 for the first time in Aberystwyth in 1996 and the highest attendance (344) was at the most recent meeting in Bonn in 2018. Not surprisingly the geographical spread of the delegates changed with time and with the location of a particular meeting. There was just one delegate from outside of Europe in 1976 and 1978, but this increased to 30 to 113 in meetings held in Europe from 1996 to 2018 and not surprisingly much higher figures for the meetings in USA (170) and Brazil (213). So what started as a domestic UK and Ireland meeting has developed into a truly global forum for discussion of silage research. The participation from Africa and Australasia has, however, remained low, reflecting the lesser importance of silage in animal feeding in those continents.

Continent of delegates at International Silage Conferences from 1996 (% of total)

			Total delegates	% from Continents					
				Europe	North America	South and Central America	Asia	Africa	Australasia
11	1996	Aberystwyth, Wales	203	85	6	1	4	2	2
12	1999	Uppsala, Sweden	229						
13	2002	Auchincruive, Scotland	204	81	7	1	6	2	3
14	2005	Belfast, Northern Ireland	193						
15	2009	Madison, USA	253	33	50	10	6	1	<1
16	2012	Hameenlinna, Finland	328	75	7	7	8	3	<1
17	2015	Piracicaba, Brazil	286	25	10	57	5	2	1
18	2018	Bonn, Germany	344	67	13	9	8	2	1

A feature of the series has been the presence at the meetings and contributions from researchers from many disciplines. Successful systems of forage conservation and feeding require inputs from agronomists, engineers, chemists, biochemists, microbiologists, physicists, mathematicians, animal nutritionists, animal production specialists, veterinarians and economists. Individuals, or more likely teams, with the capability of integrating information from these different disciplines are needed. The Conferences have provided a forum for people from these disciplines to meet and interact and these contacts have stimulated the development of several successful international inter-disciplinary research projects, including Eurowilt (Zimmer and Wilkins, 1984), Eurobac (Lindgren and Petterson, 1990) and Legsil (Wilkins and Paul, 2001).

State of knowledge in 1970 The Proceedings of the 3rd General Meeting of the European Grassland Federation held in Braunschweig in 1969 on 'Crop Conservation and Grassland' present a good account of knowledge and issues being studied at that time. Significant papers were presented by Zimmer (1969) and Raymond (1969). The major biochemical pathways involved in silage fermentation had been identified and the importance of the contents of dry matter (DM), water-soluble carbohydrates (WSC) and buffering capacity in influencing the course of fermentation was recognised. The magnitude of losses in the field and in the silo had been quantified and it was realised that losses could vary greatly according to method of ensiling and particularly the DM content at ensiling. The main thrust of research on additives was on the use of formic acid and salts, although Gross (1969) reported favourable results with inocula of lactic acid bacteria, particularly when added at high rates. Whilst the digestibility of silages had been shown to generally be similar to that of the crop prior to ensiling, animal outputs from silage-based diets were often disappointing because of low levels of feed intake, but the factors limiting intake had not been elucidated.

Themes at Silage Conferences There has always been a broad mix of contributions to the Conferences, reflecting silage research activity in progress at the time of the meeting.

Figure 1 illustrates the large changes that have taken place. Wilkins and Wilkinson (2015) identified three phases in the series of meetings. The first meetings (1 to 5) were dominated by contributions relating to the silage fermentation, the determinants of feeding value of silage and sources of loss, with about half of the papers being concerned with aspects of feeding value. This work was particularly important to provide a scientific basis for production of silage on farms. Linked with progress in mechanisation and the availability of polythene sheeting, silage could be made on farms reliably and with enhanced feeding value. A rapid increase in silage making with silage replacing hay as the major conserved forage in Britain (the venue of these meetings) and throughout much of Europe.

The main thrusts of the next series of meetings (6 to 11) concerned aerobic deterioration (a problem that had increased consequent to better control of the anaerobic fermentation), inoculation, the prediction of feeding value and feed complements for silage. The third phase (meetings 12 to 16) has continued to the two most recent meetings, with change and diversification in the contributions, reflecting increased size of meetings and greater global participation. Many papers have focussed on the ensiling and use of silages from a wide range of crops and by-products, including tropical forages, with this category accounting for around 30% of the total number of papers. Research on grasses, legumes and maize has included more integral studies on the development and evaluation of whole systems of animal production, including increasing concern with effects on hygiene and health and impact on the environment.

The use of silage for biogas, first featured in the 15th Conference in 2009, opened up a whole new area of research as previous contributions had been concerned almost exclusively with producing silages for domesticated ruminant animals. There had, however, been a paper by, Henderson and Whittemore (1976) on feeding silage to pigs and a poster session on feeding silage to horses at Auchincruive in 2002. A further example of diversification has been papers on the ensiling of products from the biorefining of forages, with the first paper being by in.

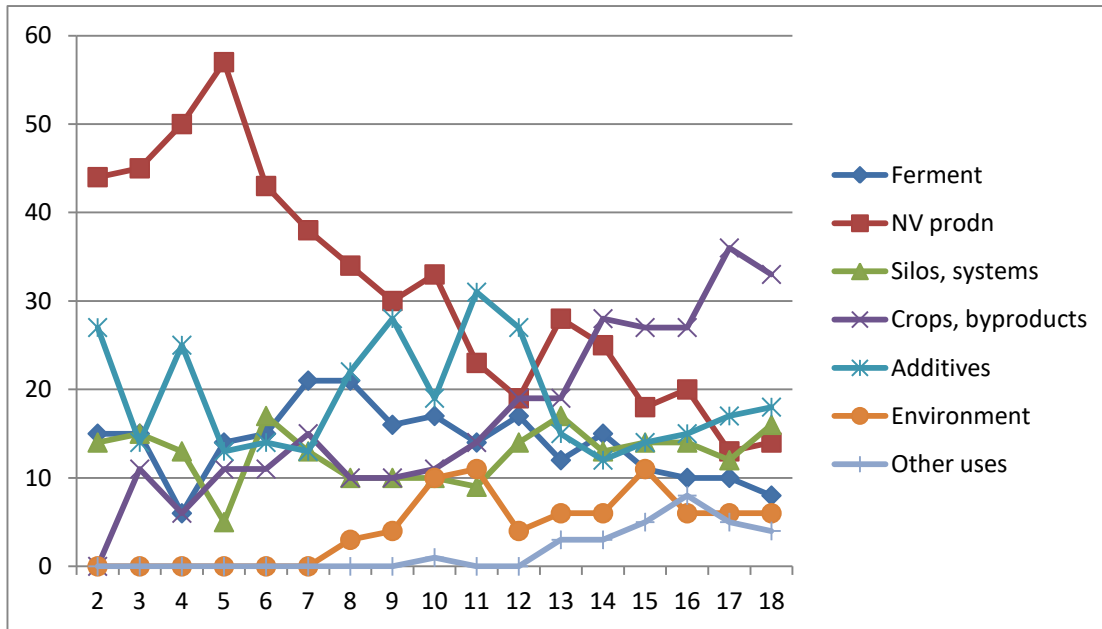
Main topics of papers presented to Silage Conferences (%)

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Fermentation, deterioration	15	15	6	14	15	21	21	16	17	14	17	12	15	11	10	10	8
Nutritive value, ruminant prodn	44	45	50	57	43	38	34	30	33	23	19	28	25	18	20	13	14
Silos, mechanisation, losses, systems	14	15	13	5	17	13	10	10	10	9	14	17	13	14	14	12	16
Crops, by-products		11	6	11	11	15	10	10	11	14	19	19	28	27	27	36	33
Additives	27	14	25	13	14	13	22	28	19	31	27	15	12	14	15	17	18
Environment, hygiene, safety							3	4	10	11	4	6	6	11	6	6	6
Non ruminants, biogas, biorefinery									1			3	3	5	8	5	4

Topic

	2-10/meeting	11-18/meeting	
Fermentation, aerobic deterioration		16	12
Nutritive value, ruminant production		42	20
Silos, mechanisation, losses, systems		12	14
Crops, by-products		9	25
Additives		19	19

The percentage of papers by topics at Conferences 2 to 18



Key to categories

Ferment	Fermentation, deterioration
NV prodn	Nutritive value, ruminant production
Silos, syste	Silos. mechanisation, losses, systems
Crops bypr	Crops, by products
Additives	Additives
Environme	Environment, hygiene, safety
Other uses	Non-ruminants, biogas, biorefinery