Presentation of Results

THE PRESENTATION OF RESULTS OF FIELD EXPERIMENTS

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Summary

This paper discusses the presentation of experimental results to the Society both verbally and in the Proceedings. Suggestions are made for improvements.

INTRODUCTION

THIS paper discusses results presented to the Weed and Pest Control Society, and not the wider topic of scientific publication in general. Our Society asks, in effect for 2 papers from each contributor; 1 for the printed Proceedings and 1 which is a 5-minute verbal presentation at the meeting "to present the main points of the paper and show relevant slides before a general discussion of the session". The requirements for each of these are quite different.

VERBAL PRESENTATION

The proceedings are "pre-printed" and it is not necessary to show slides which merely reproduce graphs or tables that have been printed and are in the listeners' hands.

There are a few points to consider about slides.

1. *Slides should be simple* and directly illustrate the paper. One message, one subject per slide should be the rule. Reduce numbers to an absolute minimum. Round-off numbers. Show no more than three figures to a number (for example 13 thousand, not 13,000). Identify treatments with abbreviated simple key words.
2. *Don't show too many slides.* Ten slides, if properly prepared and to the point should be adequate for a 20 minute paper and in a 5 minute discussion, 5 slides should be a maximum.
3. *Don't repeat the same message in different slides.* You haven't time to do this. It is boring to see the same plots photographed from different angles.
4. *All your slides must be first-class.* The last thing an audience wants to hear is an apology for poor slides. If a slide is not first-class, discard it.
5. *Make your slides as contrasty as possible.* Colour contrasts are helpful in tables and graphs. Printing must be bold and clear. Avoid graphs with many lines—a better contrast may often be had with block layouts or diagrammatic presentations.
6. *Don't assume that you must use slides.* Consider other types of visual aids. It may be a relief to the audience not to sit in the dark. Many subjects

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don't need slides. "Live" exhibits such as weed specimens can be much more impressive if properly prepared.

In brief, use slides to *illustrate* your talk and not as an end in themselves.

EXPERIMENTAL DATA ON SLIDES

There is not enough room on slides for most tables and graphs in their printed form. Extracts from tables are more effective, with all non-essential material omitted. Restrict graphs to 1 or 2 lines at the most. Slides cluttered-up with Duncan's lettering can be confusing. *Select* the treatments that best illustrate the points you are trying to make, but take care not to present a biased picture.

Actual experimental data need not be shown on slides—for instance relative yields to a base of 100 (assuming they are appropriate) may be much more easily followed than actual yields. It is often helpful to convert tables to graphs or diagrams. Never put data on slides that you are not going to have sufficient time to discuss or explain adequately.

THE WRITTEN PAPER FOR PUBLICATION IN THE PROCEEDINGS

The "Circular to Authors" suggests the use of the standard format for papers, namely:

- Summary (not more than 100 words)
- Introduction
- Experimental methods
- Results
- Discussion and/or Conclusions
- Acknowledgements
- References

Such a form assumes, of course, that the papers are not going to be verbally presented—they are quite unsuitable for the spoken word in this form. This "mould", which has shaped the form of numerous scientific papers, is almost universally followed, but it is not necessarily the best or the only way of preparing research data. A more flexible and less stereotyped presentation would, in my view, improve the "readability" of a great many papers. Many subjects do not easily fit into this mould and authors should not hesitate to depart from it if they have good reason to do so. However, a study of recent "Proceedings" shows that most papers have followed the general pattern.

Papers in Conference Proceedings have a much more rigid limitation of *length* imposed upon them than is the case with most other scientific publications. This may require substantial modification to the standard pattern for scientific papers. For this, and for other reasons, quite a different layout may be necessary in some cases. For instance, where a paper is light on experimental results but has a well-reasoned and thoughtful discussion of the field under study, it may be better to depart completely from the standard format and discuss each aspect of the subject in its entirety, under subject headings. Another case might arise where the experimental methods used are standard and present no new ideas. Here the section on "methods" can be omitted, and dealt with in a few sentences when considering results. In general it is better to spend more time on describing how the conduct or background of the experiment differs from the "normal" situation, than to describe the "normal".

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There are two vital sections, namely "results" and "discussion of results". The rest are trimmings and can be reduced or, in some cases, omitted. The "introduction" is intended to be mainly a summary of previous work. Long-winded and detailed accounts, with numerous references, are out of place in a conference Proceedings. Stick to the really important papers that have a direct bearing on the subject under discussion.

Experimental materials and methods need be given in detail only where there is something new or original to write about; otherwise a few sentences are adequate and these may not need a separate heading.

"Results" can be very brief. In some cases it is sufficient just to give data tables.

The "discussion" section considers the results you have obtained in relation to previous work and should endeavour to show all the inferences that can fairly be drawn from these two sources.

If you are going to include "conclusions" these should be brief and to the point. They should not repeat the "summary" but bring out in a few sentences the important practical findings of your paper. The "summary" or abstract, on the other hand, is intended to show at a glance what is in the paper. It covers both the treatments and their effects, and is particularly useful for abstracting journals.

TABLES

In my view, conference Proceedings are not the place for complete detailed and complex tables showing all the measurements and observations that have been made. Many editors prefer very simple, condensed tables with a note to say where complete details may be available. Do not however, omit information used to draw inferences.

A few thoughts on the presentation and format of tables may be helpful.

1. *Only put essential data into tables.* Treatments that have failed or have given unreliable data for one reason or another should be omitted. Treatments whose results do not differ significantly from the standard may also be omitted in some cases and it may not be essential to quote all rates of all treatments. A footnote to the tables indicating such "non-significant" treatments may be adequate although they must always be mentioned somewhere.

Make sure that everything recorded is adding something worthwhile. Are the assessments really needed if yields are also quoted or can they be covered in a brief sentence or two? Do you need to show all those different assessments of the same thing at different times?

2. *Don't crowd too much into the one table.* Some tables in Weed and Pest Proceedings are very confusing and are cluttered-up with detail that is best given elsewhere or omitted. Some authors try to make composite tables of numbers of experiments with only a few common treatments. This can be confusing and very wasteful of space. Footnotes to the table can be used to cover atypical experiments.

3. *Be very very wary of making tables where no statistical analysis of results has been possible.* If it is necessary to make such tables, be especially careful to round-off figures so that you avoid giving false ideas of their accuracy. (This applies to all tables of results, whether statistically analysed or not.) "Rounding-off" should not be carried too far or all your treatment differences may disappear.

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4. *Presentation of statistical analyses.* Duncan's letters to show significant differences are now widely used but they can be hard to read and clutter-up tables. I suggest that letters showing 5% significance levels are adequate in many cases, possibly with a note to say what treatments differ at the 1% level of significance. Other methods of showing significance, such as "least significant differences" may make a tidier-looking table at times. When one or more treatments are omitted from a table a new set of Duncan's letters may be needed.

Where the experimental design is complex, such as with "split-plot" layouts or those with factorial series of treatments, the selection of treatment comparisons to include in tables must be made with care and with the help of a biometrician. Where no interactions are significant, tables can be simplified to show "main effects" only but "main effects" can be very misleading where significant interactions do occur.

These could arise, of example, where 2 crop varieties show differing tolerances to one or more of the weedkillers used in a trial. In such a situation a table of means showing weedkiller effects over the 2 varieties could be misleading. "Main effects" or other means over treatments can be misleading in many situations, especially in experiments which compare rates of application of treatments. The mean effect of chemical A (over rates) compared with chemical B may not be of much use if the minimum "effective" rate of chemical A is twice that of chemical B. In this situation the yields over mean rates of application of A and B are likewise meaningless.

5. *Levels of significance.* The conventional significance levels of 5% and 1% are not necessarily the most applicable ones to use in all circumstances. In some situations where variability is unavoidably high it may be worth quoting the 10% level of significance rather than dismiss all the trial results as not significant. A 0.1% level may be appropriate, but rarely in biological data. The Biometrics Section of the Ministry of Agriculture and Fisheries is currently considering ways of improving the presentation of statistical analyses and giving more information as to levels of significance.

GRAPHS AND DIAGRAMS

Graphical methods of presentation of experimental results will, in many instances, be more illustrative than tables. If graphs are used, however, there is no need to give the same data in tabular form.

Graphs usually show the relations between 2 variables such as the effect of rate of application of a chemical on yield. More complex relations, involving 3 or more factors, exist. Three variables and the concept of "response surfaces" can be very informative at times. If you have such data get expert advice to enable you to present it in the most effective manner.

Graphs are often much reduced in size by the time they appear in print. What seems to have been a definite trend in your drawing may not appear so in the Proceedings. Your printing may be too small when reduced in size, so make it bold. Your lines may disappear unless they are thick in the original. Far too many faint and unreadable graphs have appeared in recent years. Remember, also, that the grid of lines is not reproduced in the Proceedings and it may be difficult to "read across" big graphs. Draw lines boldly. Avoid large unused spaces on graphs by your choice of origins unless it is essential to show zero.

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The choice of scales is important with all graphs. Badly chosen scales can reduce marked trends to insignificant effects, but if you over-emphasise scales with variable data trends may be lost in jagged lines. Regression analysis and the fitting of lines of best fit to your data is undoubtedly the best answer to this problem.

Keep the number of lines on graphs to an absolute minimum. If the lines cross, 2 or 3 only can be shown, but if they do not intersect additional lines can be included. Only the essential treatment effects need be shown graphically.

Diagrams of various sorts, mainly block diagrams or histograms, may be used rather than graphs, but the examples in recent Proceedings are usually most unsatisfactory. The main fault has been to include too much detail, too many treatments and assessments of treatments. Resist the temptation to show everything in the one diagram. By the time your drawing is reduced to fit the printed page it may well be unreadable and impossible to follow.

SOME OTHER POINTS IN THE PRESENTATION OF DATA

1. *Other types of data analysis.* Very few instances of data analysis other than analysis of variance are to be found in the Weed and Pest Society Proceedings, especially with weed control papers. Studies of relations between measured weed content of plots and their yields would seem to be a type to which regression analyses might be applied. In rates of application experiments trend lines might be fitted in some circumstances. A biometrician should be consulted to get the maximum of information from your data and the best way of expressing any relations found.

2. *New chemicals and new treatments.* It is easy to be over-enthusiastic over a new chemical, but it is likewise easy to under-estimate it when knowledge is lacking as to the most effective rate or method of application. Care should be taken not to assume that a new material is inferior to a known standard when it may have been used at an ineffective rate of application, or applied at the wrong time or in the wrong way. Economic analysis comparing the new with the old should await the time when sufficient is known about both materials to enable each to be used in an equally efficient manner.

SOME CONCLUDING THOUGHTS

The best experiment is of little value until its data are properly analysed and the results are presented in a clear and unambiguous form to those who are going to use them. Research communication is an essential part of any research programme and deserves more attention than it has received. One of the many aspects of research communication is the presentation of results of field experiments, another is the continuing education of those to whom these results are presented.

One test of the effectiveness of the method of presentation might be an examination of the audience, concerning their comprehension of the papers they have heard presented and, presumably, have read. I wonder if our Society might undertake such an examination at some future conference. I am a little apprehensive as to the results!