

Chapter 5. Tables and Figures

Tables and figures are an integral part of a well-written scientific paper, not an adjunct. The bulk of the detailed information in a paper is typically presented in its tables. Many of the descriptions and basic concepts, key natural trends, key discoveries, and some of the conclusions are presented in figures. As you prepare your article, consider whether a figure or a table is more appropriate.

- If the text is crowded with detail, especially quantitative detail, consider creating a table. Do not overload the text with information that could be presented better in a table.
- Consolidate similar information into one table to let the reader compare easily. Do not make the reader search for related information.
- If a table has only a few rows and columns, try stating the findings in a few sentences. Do not use too many small tables for information that could be presented better in the text.
- In a difficult prose explanation, decide whether it could be better described with a figure.
- Does your figure show more than could be said in a few well-chosen words? A figure is not always better.

Tables, figures, and text all have a role to play. Deciding what best goes where is not always easy, but readers appreciate the effort.

Both tables and figures are used to support conclusions or illustrate concepts, but they have essential differences in purpose. Tables present numbers for comparison with other numbers or summarize or define concepts, terms, or other details of a study. Graphs reveal trends or delineate selected features. Sometimes the two purposes overlap, but they rarely substitute for one another. Data presented in tables should not be duplicated in graphs, and vice versa.

Readers typically study tables and figures before they read the text. Therefore, each table and figure should stand alone, complete and informative in itself.

TABLES

Tables are often used for reporting extensive numerical data in an organized manner. They should be self-explanatory. It is seldom necessary to use a table for fewer than eight items of data. Number the tables in the order in which they are cited in the text.

Guidelines for Preparing Tables

Following these guidelines can ensure that your tables will be prepared efficiently and accurately for typesetting, with almost no chance of introduced errors.

- Always use your word processor's (Microsoft Word is preferred) table feature. That is, the table that you create should have defined cells. DO NOT create tables by using the space bar and/or tab keys. Do not submit tables in Microsoft Excel.
- Do not use the enter key within the body of the table. Instead, separate data horizontally with a new row.
- Do not insert blank columns or rows.
- Asterisks or letters next to values indicating statistical significance should appear in the same cell as the value, not an adjacent cell (i.e., they should not have their own column).

- Spell out abbreviations on first mention in tables, even if they have already been defined in the text. The reader should be able to understand the table content without referring back to the text.
- To highlight individual values in tables you may use boldface type, italic type, or underlining. Any highlighting must have a supplemental note of explanation; attach the note symbol to the first value that is so highlighted.

Structure of a Table

The principal parts of a table are shown in Table 5–1. The remaining tables in this chapter show the basic structure as adapted for different types of information: a typical table (Table 5–2), a table with units varying row to row (Table 5–3), a table with both measured values and analysis of variance (Table 5–4), and a table without numeric data (Table 5–5). The examples are drawn from published papers; commentary for this manual is added in italics.

Keep table titles brief but sufficiently detailed to explain the data included. Typically, specify the crop or soil involved, the major variables presented, and the place and year. Do not include units of measurement; these belong in a row of their own, just beneath the column headings, or in row headings.

Each column should have a heading describing the material below it. Give units in the first row below the headings. When the same units apply to adjacent columns, state the unit only once and use em dashes on each side of the unit to indicate how many columns are included. (See examples.)

The column headings should reflect the type of data shown. That is, it is not enough to say “Yield of corn.” in the table title and then label columns only with 1994, 1995, and 1996, with a units row showing Mg ha⁻¹. Add a spanner heading, "Yield," above the year headings.

Table 5–1. Table titles should be written in words and sentences that are understandable to someone who has not read the text. The table below shows the main components of a typical table in ASA, CSSA, SSSA publications.

Column heading for stub†	Spanner head‡			
	Column heading	Subspanner head§		Column heading#
unit††	unit	Column heading¶	Column heading¶	unit
(Stub)		(Field)		
Stub heading	Independent line‡‡			
Row heading	value 1	value 2*	value 3***	value 4*
Row subheading§§	value 5	value 6**	value 7**	value 8*
Row heading	value 9	value 10*	value 11**	value 12*
Stub heading	Independent line¶¶			
Row heading	value 13	value 14	value 15**	value 16

* Significant at the 0.05 probability level.

** Significant at the 0.01 probability level.

*** Significant at the 0.001 probability level.

†, ‡, §, ¶, #, ††, ‡‡, §§, ¶¶, etc. Supplemental notes (each starting on a new line)

Table 5–2 is an example of a typical table that shows the consistent relation of the uppermost spanner heading to the units and the data values. Adapted from Saseendran et al. (1998; *Agron. J.* 90:185–190).

Table 5–2. Grain and straw yield in 1993 for ‘Jaya’ rice under rainfed conditions at Kerala Agricultural University in India, as measured and as calculated using CERES-Rice v3.0.

Date	Grain yield		Straw yield	
	Measured	Calculated	Measured	Calculated
	kg ha ⁻¹			
8 June	6100	5689	4,600	7,785
15 June	300	312	100	184
22 June	2300	2160	14,500	16,213
29 June	3200	3207	4,200	6,743

When the type of data varies row to row, put the units at the end of the stub entry describing the row. Separate the units from the row descriptor with a comma or parentheses. The column headings in this kind of table do not reflect the values shown but indicate some other grouping, such as time or place or experiment conditions.

Table Notes

As shown in Table 5–1, two types of notes are used with tables: those that show statistical significance and those that give supplementary information. The asterisks *, **, and *** are always used in this order to show statistical significance at the 0.05, 0.01, and 0.001 probability levels, respectively, and cannot be used for other notes. Significance at other levels is designated by a supplemental note (see also Table 4–1). Lack of significance

Table 5–3 is an example of a table with units varying row to row (unlike the usual pattern seen in Table 5–2). Adapted from Bordovsky et al. (1998; *Agron. J.* 90:638–643).

Table 5–3. Surface soil (0–15 cm) properties of Miles fine sandy loam soil at Munday, TX.

Property	Value	Qualifier
Physical		
Soil texture, g kg ⁻¹		
Sand	800	
Silt	130	
Clay	70	
Slope, %†	1	
Erosion factor <i>K</i>	0.24	medium
Mean permeability, m × 10 ⁻⁶ s ⁻¹	28	moderately rapid
Mean available water capacity, m ³ m ⁻³	0.12	very low
Mean liquid limit†	22	
Mean plasticity index	5	
Chemical		
Mean pH	7.8	mildly alkaline
Organic matter, g kg ⁻¹	3.3	low
Available N, mg kg ⁻¹	1	very low
Available P, mg kg ⁻¹	52	high high
Available K, mg kg ⁻¹	240	high
Available Ca, mg kg ⁻¹	1237	high
Available Mg, mg kg ⁻¹	500	high
Available Na, mg kg ⁻¹	111	low
Available S, mg kg ⁻¹		high

† Source: Soil Survey of Knox County, Texas. 1979. USDA Soil Conservation Service, Washington, DC, in cooperation with Texas Agric. Exp. Stn., College Station.

is usually indicated by "ns" and needs a note only if the lowest level of significance shown is higher than the nonsignificance level. EXAMPLE:

- ** Significant at the 0.01 probability level.
- *** Significant at the 0.001 probability level.
- † ns, nonsignificant at the 0.05 probability level.

For supplemental notes, use the following symbols in this order: †, ‡, §, ¶, #, ††, ‡‡, etc. Cite these symbols just as you would read a table—from left to right and from top to bottom, and reading across all spanner and subheadings for one column before moving on to the next. Regardless of where the asterisks first appear in a table, asterisked significance notes come before any supplemental notes keyed to the other symbols.

If individual values in a table are highlighted using italic or bold type or underlining, attach the note symbol to the first value that is so highlighted.

Table 5–4 shows how to incorporate ANOVA results. The centered independent heading is used, together with the new main entry line in the stub, to alert the reader to a change in the type of data for the rows that follow. Adapted from Porter et al. (1996; *Agron. J.* 88:750–757).

Table 5–4. Wheat N uptake (1988) as affected by fertilizer N and indigenous soil N.

Fertilizer N rate	df	Fertilizer N uptake	df	Soil N uptake
kg ha ⁻¹		kg ha ⁻¹		kg ha ⁻¹
0		–		85a†
56		28a		67ab
112		47b		63b
ANOVA				
Source of variation				
N rate (N)	1	***	2	*
Microplot (M)	3	NS‡	3	NS
N × M	3	NS	6	NS
CV, %		22		16

* Significant at the 0.05 probability level.

*** Significant at the 0.001 probability level.

† Within columns, means followed by the same letter are not significantly different according to LSD (0.05).

‡ NS, nonsignificant.

As shown in Table 5–5, sometimes a table is the best way to organize words. Adapted from Einhellig (1996; *Agron. J.* 88:886–893).

Table 5–5. Studies reporting stress enhancement of the action of allelopathic chemicals.

Stress	Bioassay†	Species	Allelochemical	Reference
High temperature	SG	soybean; grain sorghum	ferulic acid	Einhellig and Eckrich (1984)
High temperature	plantlets	barley	gramine	Hanson et al. (1983)
Low nutrients	RE	barley	phenolic acids	Glass (1976)
Low N or P	RE	barley	<i>p</i> -coumaric acid; vanillic acid	Stowe and Osborn (1980)
Low N or K	SG	<i>Schizachyrium scoparium</i>	hydrocinnamic acid	Williamson et al. (1992)
Moisture stress	G, SG	grain sorghum	ferulic acid	Einhellig (1987, 1989)

† G, germination; RE, root elongation; SG, seedling growth.

Further Resources

Additional information on tables is given in *Scientific Style and Format* (CSE, 2006).

FIGURES

Figures are often the best means of presenting scientific data. Poorly rendered figures or figures that merely repeat information given in the text, however, can confuse the reader or clutter the manuscript; thus, each figure should serve its purpose well or be omitted. Figures encompass at least four substantially different kinds of illustrations in black and white, shades of gray, color, or some combination:

- Graphs (line, bar, pie, etc.).
- Line drawings or maps.
- Photographs and micrographs.
- Animated illustrations, which are shown in stop-motion frames in printed journals and sometimes also in full animation in the electronic edition of the journal.

Line or bar graphs are the most common figures in ASA, CSSA, and SSSA journals, followed by line drawings, micrographs, and standard photographs. Color may be used at no extra charge for online publications. Consult the editor of the publication to which you are submitting for information on requirements and costs for color figures for print publications.

Graphs and charts improve the general presentation of a technical publication by reporting data in an easily comprehensible manner. They are generally used to show trends rather than the detailed information in a table.

The style of the graphs and charts and the size and appearance of letters and numbers should be consistent within a paper.

Whenever possible, figures should be horizontal in format, with the height two-thirds the width. This format takes up minimal space in the article. Do not draw a box around line-art figures. Multipanel figures should be labeled (lowercase a, b, c, etc.) and combined into one file.

File Formats

For ASA, CSSA, and SSSA publications, TIF, EPS, or PDF files are the preferred file types. Images should have a minimum resolution of 300 dpi. For EPS files, be sure all fonts are embedded; all lines must be at least 0.5 point. Figure art submitted as PDFs should be distilled using Adobe Acrobat Distiller's "Press Quality" setting. For photographs, use high-resolution TIFF or JPEG files.

Figure Quality

Because authors are the only ones working with the original graphics file, corrections are the sole responsibility of the author. Authors should not submit figures under the assumption that minor errors will be corrected by someone else at a later stage.

Clearly label all figures in the file name (e.g., Figure1.tif). (If the paper is submitted for double-blind review, be sure to omit the author's name within the file name.)

Figure Size

The final size of the published figure depends to some extent on where it will appear. For journals, a single column is approximately 8.5 cm (3.5 inches, or 20 picas) wide, and full-page width is approximately 17.8 cm (7 inches, or 42 picas). Books have

a single-column page width of approximately 11.4 cm (4.5 inches, or 27 picas). Figures occasionally are placed lengthwise on a page, but this is not the ideal layout.

Figures that fit within a single journal column's width are an economical use of space. Avoid creating figures that have unnecessary white space. Figures do not have to fill the allotted one or two columns; that is, reduction is based on content, not on a width of exactly one or two columns.

Font Size and Type

Use these recommended fonts where possible: Arial, Helvetica, Times New Roman, Symbol.

All figure elements, including letters, numbers, and symbols, must be legible at their final size. In general, authors should make the figure type size large enough so that it is at least 8 points after reduction. No type should be less than 6 points. As an example, for a 16-cm-wide figure, choose 16-point type, so that when the figure is reduced to fit in a single journal column, the type is reduced to 8-point size.

Style

Avoid labels in all capitals. Use either sentence-style capitalization (only the first word has an initial capital) or title capitalization (each major word has an initial capital). Use only lowercase for legends and for units of measure.

Position decimal points correctly, at the base of the numbers and in a size large enough to stand reduction. Decimal points should be in proportion to the numbers they accompany.

Be sure that the overall style in the figures follows journal standards. For example, if you use Mg ha^{-1} in the text, do not use Mg/ha in the figures.

In particular:

- Define all abbreviations in the caption, even if they appear in the overall abbreviations list.
- Italicize variables
- Check the spelling of all text in each figure.

The Graphic Elements

Axis scale. Do not crowd the interval marks on axis scales. Fewer may be better. Rarely, if ever, rule in the coordinates grid—not even in light lines or dots. (Light lines will break up, and light dotted lines may disappear entirely.)

Legend. Include a complete legend to identify symbols, lines, and patterns. (A legend is a miniature table of correspondence between the patterns and symbols and their meaning.) Put the legend inside the figure box, preferably above it or to the right.

Fill patterns and shading. If you need to shade parts of your figure, keep in mind that the spaces between the elements of that shading will be reduced when the figure is reduced. Many patterns built into computer programs become solid black when reduced to 50% of the original size. Search for patterns, or create your own, that will not condense to black.

For bar graph patterns, use solid black, solid white, black diagonal lines, sharp cross-hatching, a sharp dot screen, or a random dot pattern. Dot patterns must be fairly coarse to reproduce well. Light grays and fine, light dots are likely to become muddy or blotchy or

even disappear altogether in reproduction. Shades of gray may turn into indistinguishable muddy blacks.

Choose symbols and patterns of similar weight and tone to avoid making one set of data look inherently more important than another.

Lines. Every line in a figure should have meaning and purpose, so authors should avoid using decorative borders, shadows, and other three-dimensional effects. Lines should be of consistent weight and sufficiently heavy (at least 0.5 point) to ensure a high-quality reproduction.

Three-Dimensional Graphs. Use three-dimensional graphs only to represent three dimensions of data. If there are no data for the z axis, do not use three-dimensional formatting. This may require changing the default settings on your software.

Photographs

Submit photographs as high-resolution TIFF or JPEG files. Indicate the scale, or at least provide a reference point to indicate relative size. For micrographs, indicate the power at which the image was taken (either in the caption or on the figure itself).

If photographs are taken in a series, maintain the same height and angle of the camera, the same distance from the subject, and the same angle of the sun. (A picture taken 3 m from the subject at 0800 h will appear quite different from one taken of the same subject from 6 m at 1700 h.)

Selection

Make sure that the photograph shows something unique, interesting, and clearly identifiable. Use photographs only if they show something essential to your point.

Combinations

When two or more photographs are to be combined into one figure, each part of a composite figure should be clearly identified on the figure by large lowercase letters (a, b, c, etc.). Use the same letters to identify the parts in the caption.

Letters, numbers, arrows, scales, and other marks that appear in a light area of the photo should be black. If they appear in a dark area, they should be white, or placed on a white circular or square background. Sufficient contrast is also essential for size bars used in photomicrographs.

Releases

If a person or named product is shown in the photograph, it is the responsibility of the author to obtain written permission for use of the photograph from the person or the manufacturer of the product. A copy of the release must be forwarded to headquarters along with the accepted manuscript; ASA, CSSA, and SSSA are not responsible for any claims that may result from using the figure. For more information on permission and releases, see Chapter 12.

Captions

Type all figure captions double-spaced. Number figures in the order they are cited in the text. Place captions after the references and before any tables. It is good to repeat the caption with the actual figures so that reviewers do not have to hunt through the manuscript to understand the figures.

A figure caption should be brief but sufficiently detailed to stand on its own. Identify curves or symbols in a legend within the figure itself, not in the caption. Define abbreviations in the caption. Do not write separate captions for the parts of a compound figure

In both captions and text, refer to the figures with the abbreviation "Fig." Spell out the full word only when it appears alone (without a number) or as the first word of a sentence in the text.

In books that have both black-and-white and full-color figures, the full-color figures are sometimes grouped together and numbered as plates. Consult the editor of the publication for more information.

Do not be too brief in your caption. A caption that states only "Analysis of data" or "Results of Exp. 2," for example, is not sufficient.

Further Resources

Further information on preparing figures is available in the Council of Biology Editors' (now Council of Science Editors) *Illustrating Science* (CBE, 1988) and Seddigh and Jolliff (1988). A book-length analysis of graph design for scientific publications is available in Cleveland's (1994) *The Elements of Graphing Data*. Also worth consulting, although not always applicable to scientific publishing, is Tufte's (2001) book on visual presentation of quantitative data.