

ASHS Publications Style Manual

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American Society for Horticultural Science
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Foreword

The ASHS Publications Style Manual is an online resource for authors, reviewers, and editors in preparing manuscripts for publication in ASHS journals HortScience, HortTechnology, and Journal of the American Society for Horticultural Science. This version of the Style Manual supersedes the 1997 ASHS Publications Style Manual as published by ASHS Press, Alexandria, VA, USA as well as all other preliminary drafts of this revised manual. This revision includes numerous updates as well as a hyperlinked Table of Contents and an alphabetical subject Index for easier navigation. At any time, readers may also search within the entire Manual by any term or phrase.

There are five main sections in this Publications Style Manual including:

- Part I. Journal Guidelines
- Part II. Author Guidelines
- Part III. Style Guidelines
- Part IV. Reviewer Guidelines
- Part V. Appendix

The decision to include several new sections (Part I - Journal Guidelines, Part II - Author Guidelines, and Part IV - Reviewer Guidelines) came about as a result of fielding questions from graduate students and young professionals about specific topics related to publishing. Readers may note that some blocks of text may have been repeated in multiple chapters; this was intentional to allow for certain sections to be independent and understood apart from the rest of the text. It is expected that at some future date, a condensed version of this Publications Style Manual may also become available for advanced professionals.

This ASHS Publications Style Manual is available for member access online as a pdf file at www.ashs.org by clicking on Publications> ASHS Publications Style Manual. Suggestions to improve this Publications Style Manual are welcome. Please forward any questions or comments to the Editor-in-Chief or Managing Editor for any of the ASHS journals.

With the application of proper scientific method, adherence to scientific writing criteria, and consideration of comments from reviewers and editors, most authors are expected to achieve successful publication of their manuscripts in ASHS journals.

Resource

American Society for Horticultural Science. 1997. ASHS publications style manual. ASHS Press, Alexandria, VA, USA.

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PART I.

JOURNAL GUIDELINES

Chapter 1. Horticulture

The following definitions are provided as a reference to establish the framework upon which other chapters are built. These key definitions are subsequently referenced when defining and delineating the mission and scope for each of the journals published by the American Society for Horticultural Science. In the interest of uniformity and consistency, certain phrases have been repeated in definitions for closely related words (e.g., “horticulture” and “horticulturist” to allow all definitions to stand on their own and be understood apart from surrounding text.

1.1 Horticulture

Horticulture is a branch of agriculture concerned with the art, economics, management, practice, science, and technology of producing non-commodity, labor-intensive, specialty plants cultivated for aesthetics, economics, food, medicine, or other benefit, generally with the purpose of enhancing the quality of life for humans.

1.2 Horticulturist

A horticulturist is a professional with expertise in the art, management, marketing, practice, production, science, or technology of growing non-commodity, labor-intensive, specialty plants used for aesthetics, economics, food, medicine, or other benefit, primarily for the purpose of enhancing the quality of life for humans.

The professional title “horticulturist” is a specialist designation like agronomist, botanist, or economist. Most specialist titles are based on nouns, not adjectives; for that reason, the term “horticulturalist”, which is based on an adjective, is not preferred as a professional designation.

1.3 Horticultural Crops

Horticultural crops include non-commodity, labor-intensive, specialty crops that are used for aesthetics, economics, food, medicine, or other benefit, primarily for the purpose of enhancing the quality of life for humans. Horticultural crops do not include commodity crops such as forages, grains, oilseeds, and pulses, especially those used for fiber, livestock feed, or industrial

purposes. Horticulture crops are often categorized into two broad groups: food crops and non-food crops.

Food Crops

Food crops include specialty crops such as: edible flowers, herbs, leafy greens, mushrooms, nuts, sea vegetables, small fruits, seeds, tree fruits, and vegetables, as well as other labor-intensive crops used to produce consumer products such as beverages, edible oils, and syrups.

Non-Food Crops

Non-food crops include crops used for aesthetic enrichment, environmental conservation, landscape design, or propagation, with many examples such as bedding plants, cut flowers, ground covers, landscape plants, ornamental plants, seeds, shrubs, transplants, trees, turfgrass, and vines.

1.4 Horticultural Research

Research is often categorized into three types. Early-stage research leading to the original discovery of a new analysis, experience, interpretation, observation, or perception is often referred to as basic or discovery research. This type of research involves exploring what is not yet known or understood. In contrast, development research focuses on using existing knowledge, often from discovery research to design and develop new products/processes, or improve products/processes, with the goal of solving problems. Typically, the third stage includes demonstration or technology transfer research, which involves utilizing products/processes from development research to determine best applications to enhance the efficiency, efficacy, or capability of practice (Table 1-1).

Discovery

Fundamental or discovery research is driven by a scientific question, rather than a specific problem to solve. The main motivation is to expand knowledge, to develop information or ideas, without a prerequisite to create a product/process or invent something of social benefit. As a rule, there may be no obvious or immediate application for this work, but there is value in the discovery of knowledge that results from it. Discovery research, also called basic research, provides the foundation for subsequent development and demonstration research to proceed.

Development

Development research is formulated to solve a specific problem, with the solution often based on applying knowledge derived from discovery research. The eventual outcome of development research is pragmatic rather than academic, with an empirical goal of designing or developing new or improved methods, products, systems, or technology. There is an obvious application for this work, or a recognized practical usefulness to the understanding that results from it, but additional work is needed to demonstrate value on a larger scale through demonstration research before direct application can be realized.

Evaluation

Evaluation or demonstration research is aimed at advancing progress made in research and development with the goal of enhancing the efficiency of current practice, transferring capability, or extending capacity of future practice. This type of work seeks to compare the standard or status quo with alternatives or new developments that have exhibited value on a small scale. Through the activities of education, extension, and research efforts, demonstration research seeks to introduce incremental improvements in practice. The results of this type of research are evidence-based and generally ready for direct application by practitioners and stakeholders.

1.5 Horticultural Science

Horticultural science is a professional discipline within the field of agriculture; it is most closely related to agronomy. However, horticultural science is differentiated from agronomy by the economic and social value of the species or crops considered.

Horticultural science is concerned with understanding the art, economics, management, practice, science, and technology of producing specialty crops that are generally cultivated for the benefit of humans. In contrast, agronomy is concerned with the production of commodity crops such as cereals or grains, forages, legumes or pulses, and oilseeds, which are primarily cultivated for fiber, livestock feed, or industrial purposes.

Table 1-1. Comparison of discovery, development, and demonstration research stages in horticultural science.

	Discovery	Development	Demonstration
Goal	Answer a question.	Solve a problem.	Select best practice.
Research stage	Discovery, observation, or generation of new knowledge.	Design or development of a new material, method, product, protocol, system, etc.	Evaluation of new material, method, product, protocol, system, etc. compared to a standard or status quo.
Research scope	Includes scientific explorations in pursuit of new knowledge or discoveries; seeks to answer a question.	Includes application of discovery knowledge to formulate a solution; seeks to solve a specific practical problem.	Includes evaluation of new development or compares improvement to existing standard; seeks to improve existing practice.
Research application	Value of new discovery or knowledge typically requires further efforts in development research before realization.	Effectiveness of results are generally assessed on a small-scale basis. Recommendations usually not yet ready for direct application by practitioners.	Efficacy of results usually assessed on a large enough scale to support recommendations for direct application by practitioners.

Resources

American Society for Horticultural Science. 1997. ASHS publications style manual. ASHS Press, Alexandria, VA, USA.

Chapter 2. ASHS Journals

The American Society for Horticultural Science publishes three peer-reviewed journals: Journal of the American Society for Horticultural Science (JASHS), HortScience, and HortTechnology. These journals are differentiated by their respective missions.

2.1 JASHS

Mission

The Journal of the American Society for Horticultural Science is a peer-reviewed open-access science journal published by ASHS. The primary mission is to publish accurate, clear, reproducible, and unbiased journal articles in the field of fundamental horticultural science. JASHS seeks to advance selected papers in horticultural science encompassing original discovery through analysis, compilation, formulation, and synthesis of concepts, data, ideas, observations, and theories formulated with the primary goal of answering a question.

Scope

Scientific queries published in JASHS are limited to advances in knowledge associated with high-value specialty crop species and their components or products. The research published in JASHS is usually undertaken without a specific product being considered, developed, or tested. The resulting contribution of knowledge is generally not yet ready for any practical application; however, it may be a prerequisite for subsequent problem solving or product development efforts.

2.2 HortScience

Mission

HortScience is a peer-reviewed open access specialty science journal published by ASHS. The primary mission is to publish accurate, clear, reproducible, and unbiased journal articles in the field of applied horticultural research. HortScience seeks to advance selected papers in

horticultural research derived from original efforts in design, engineering, exploration, and preliminary testing of new methods, processes, products, protocols, techniques, and technologies formulated with the primary goal of solving a problem.

Scope

The research studies published in HortScience are limited to advances in knowledge derived from high-value specialty crops and their components or products. HortScience seeks to publish the results of problem-solving research, typically conducted on a small-scale basis, in controlled environments or in limited trials. Generally, the results are not considered ready for direct utilization by practitioners, without additional evaluation efforts in larger-scale development trials. HortScience also publishes Cultivar and Germplasm Releases. See Chapter 15. Special Reports for additional information.

2.3 HortTechnology

Mission

HortTechnology is a peer-reviewed open-access science journal published by ASHS. The primary mission is to publish accurate, clear, reproducible, unbiased journal articles in the field of practical horticultural science. HortTechnology seeks to advance selected peer-reviewed papers derived from topics in practical horticultural investigations with the primary goal of improving capabilities of horticultural practitioners and students, or recommending best practices for horticultural operations, or advancing knowledge concerning the intrinsic social benefits associated with the intersection of humanity and horticulture.

Scope

The research investigations published in HortTechnology are limited to advances in knowledge derived from or associated with high-value specialty crops and their components or products. HortTechnology seeks to publish the results of comparative and evaluation research, typically conducted in real-world applications, and/or in classroom, field, or greenhouse environments on a large enough scale to support recommendations to practitioners. Generally, the results are ready for direct utilization by educators, growers, practitioners, and technical advisors.

2.4 Comparison of Journals

The following table (Table 2-1) is provided to delineate the scope of ASHS journals. It is intended to serve as a guideline to help authors, reviewers, and editors guide future manuscript submissions to the intended audiences.

Table 2-1. Comparison of JASHS, HortScience, and HortTechnology journals for research goal, stage, purpose, scope, focus, and application.

	JASHS	HortScience	HortTechnology
Goal	Answer a precise question.	Solve a specific problem.	Identify best practice.
Stage	Discovery, observation, or generation of new knowledge.	Design or development of a new material, method, product, protocol, system, etc.	Demonstration and evaluation of new material, method, product, protocol, system, etc. compared to a standard or status quo.
Purpose	Includes scientific explorations in pursuit of new knowledge or discoveries; seeks to answer a question.	Includes application of discovery knowledge to formulate a solution; seeks to solve a specific practical problem.	Includes evaluation of new development or compares improvement to existing standard; seeks to improve existing practice.
Scope	Includes scientific explorations in pursuit of new knowledge or discoveries; seeks to answer a question.	Includes application of discovery knowledge to formulate solutions; seeks to solve a specific practical problem on a small scale.	Includes evaluation of new development or compares an improvement to an existing standard; seeks to improve capability of practice.
Focus	Focus is on exploratory discovery and observation of new knowledge or enhancement in	Focus is on original design and development of new methods, products, processes, services, systems, techniques, tools, etc.	Focus is on comparative evaluation of new design or developments, relative to a standard to enhance capability, efficiency, or

	JASHS	HortScience	HortTechnology
	understanding of current knowledge.	usually through application of knowledge gained in discovery research.	efficacy of horticultural practices.
Application	Research includes investigations to reveal or discover what is true, or to answer a scientific question with the goal of expanding knowledge, developing theories, or compiling observations without an immediate need to create a useful product and with no apparent application by practitioners.	Research includes creative design and development of prototypes for new products, processes, prototypes, systems, tools, etc. These are generally assessed on a small-scale basis, or under controlled environmental conditions, yielding preliminary results that are not yet ready for application by practitioners without further evaluation work.	Research includes comparative evaluation, demonstration, and analysis of methods, products, processes, services, systems, techniques, tools, etc. These are generally assessed, relative to a standard, in real-world environments or on a sufficiently large enough scale to permit recommendations for immediate application by practitioners.

Resources

American Society for Horticultural Science. 1997. ASHS publications style manual. ASHS Press, Alexandria, VA, USA.

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PART II.

AUTHOR GUIDELINES

Chapter 3. Scientific Writing Criteria

Scientific writing requires a cogent presentation of multiple sections in a prescribed order so readers can understand why a study was undertaken; when, where, and how the study was done; what was learned from the study; and why the study matters.

Manuscripts are generally divided into seven key sections including Introduction, Materials and Methods, Results, Discussion, References Cited, Tables, Figures. Of these, four are frequently grouped together and collectively referred to as the IMRaD block (Introduction, Materials and Methods, Results, and Discussion). It should also be noted that there are four entities which carry special requirements for independence from all other sections. These include the Abstract, the IMRaD block, each Table, and each Figure. These self-contained autonomous entities must be able to stand alone and be understood apart from all other text.

In addition to the seven key sections covered above, each manuscript also contains three indexing components, namely the title, byline, and keywords. Each of aforementioned segments has a clearly delineated function, and it is a prerequisite of scientific writing that each achieves its designated purpose within specific criteria of science, structure, and style. The parameters of these criteria are outlined below.

3.1 Science

A primary objective of scientific writing is to achieve an objective presentation of facts, data, and knowledge. If key findings of research are to be effectively communicated, scientific reporting must be correct, logical, objective, precise, and valid. Such writing requires a prerequisite adherence to scientific method (Table 3-1). *Science is about coherence.*

Table 3-1. Descriptions of science criteria in scientific writing.

Science criteria	Description
Correct	<ul style="list-style-type: none"> Factual, free from error, and technically correct.

Science criteria	Description
Logical	<ul style="list-style-type: none"> • Claims based on clear thought process, logic, and reason. • Avoids incorrect arguments, errors in logic, or fallacies. • Consistent agreement of parts and free of contradictory statements. • Rational.
Objective	<ul style="list-style-type: none"> • Assumptions and methods are without bias or prejudice. • Interpretation of a concept, measurement, or conclusion is consistent with scientific method. • Conservative use of descriptive language to maintain neutrality. • Selection of subjects and treatments justified for inclusion in the study.
Precise	<ul style="list-style-type: none"> • Accurate. • Exact in descriptions, measurements, methods, or observations. Specific.
Valid	<ul style="list-style-type: none"> • Conclusions based on appropriate methods for data acquisition, categorization, compilation, and analysis. • Interpretation of results cogent, coherent, and reasoned.

3.2. Structure

A secondary goal of scientific writing is to accomplish a clear and comprehensible presentation of information. If key findings from studies are to be efficiently communicated, the writing structure needs to be complete, concise, ordered, structured, and understandable. *Structure is about clarity.*

Structure criteria	Description
Complete	<ul style="list-style-type: none"> • Provides sufficient information to allow for independent validation of assertions, arguments, or claims being made, particularly in methods of data collection and analysis. • All autonomous sections such as tables and figures are complete and able to stand alone, apart from the text or other tables or figures.

Structure criteria	Description
Concise	<ul style="list-style-type: none"> • A minimum of words is used to express ideas and all words are focused on the efficient communication of the arguments, assertions, or claims being made. • Not overly verbose or wordy. • Written in simple, direct, sentences. • Duplicate, extraneous, or irrelevant material that obscures the thesis of the document is eliminated.
Ordered	<ul style="list-style-type: none"> • Information is arranged in a systematic orderly way. • Subject matter is presented in a methodical, easy-to-follow line of thinking or outline, with each topic developed in support of the thesis.
Understandable	<ul style="list-style-type: none"> • Accessible. • Clear, without confusion. • Easy to read and understand. • All material necessary for comprehension is included. • Proper use of abbreviations, definitions, and terms where appropriate. • Information readily understood by the target audience with ordinary knowledge or skills in the field.

3.3 Style

A third goal of scientific writing is to attain a consistent format of presentation of information in compliance with scientific reporting standards. If key findings from research studies are to be communicated in a way that allows for validation by other researchers, then scientific writing needs to conform to uniform standards for reporting abbreviations, numbers, nomenclature, statistical reporting, terminology, and units of measurement. *Style is about consistency.*

Table 3-3. Descriptions of style criteria in scientific writing.

Style criteria	Description
Format	<ul style="list-style-type: none"> • Conforms to publication-specific instructions and format guidelines. • General format is consistent in overall appearance with other documents similarly published. • Information is presented in a consistent manner throughout the document.

Style criteria	Description
Nomenclature	<ul style="list-style-type: none"> • In compliance with accepted rules of communicating scientific information. • Conforms to established standards for abbreviations, labels, nomenclature, symbols, and terms consistent with commonly accepted international guidelines.
Statistics	<ul style="list-style-type: none"> • In accordance with ordinary rules for presentation of statistical data analysis. • In compliance with current standards of statistical reporting.
Syntax	<ul style="list-style-type: none"> • In accordance with ordinary rules of American English. • Follows standard guidelines with respect to capitalization, definitions, grammar, hyphenation, punctuation, spelling, sentence structure, and vocabulary.
Units of measure	<ul style="list-style-type: none"> • Conforms to international standards for reporting units of measurement in scientific journals.

Resources

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- Woodford, EP. How to teach scientific communication. Council of Biology Editors, Reston, VA, USA.

Chapter 4. Title

Criteria	Checklist	✓
Purpose	Does the Title achieve its designated purpose?	
Concise	Does the Title contain the fewest words possible to clearly identify the key subject and findings of the article?	
Independent	Is the Title capable of standing on its own when disconnected from the name of the journal in which it is published?	
Precise	Does the Title precisely describe the key subject and findings of the work?	

4.1 Purpose

The Title clearly identifies the key subject and findings of an article and permits easy and accurate indexing. Ideally, the core contribution of the work should be apparent from the Title before the Abstract is read.

4.2 Science

Accurate. Include a straightforward, accurate, objective description of the work, emphasizing results or conclusions.

Precise. Use standard precise terms from formal scientific, biological, or agricultural nomenclature instead of informal conversational terms.

4.3 Structure

Efficient. Use the most important keywords of the paper in the Title to facilitate accurate article indexing and retrieval. Avoid using broad terms when only narrow concepts are discussed.

Choose a concise descriptive Title; however, brevity may be sacrificed to include important keywords under which the article should be indexed.

Independent. The Title needs to be able to stand alone, apart from the name of the journal in which it is published. The reader should be able to understand the context of the work from the Title alone, without knowing where the article was published. A Title that leaves the audience in doubt about the nature of the study is unacceptable.

Length. The Title should include the fewest possible words that adequately describe the content of the paper. Titles that are too short are not helpful to the reader and titles that are too long are not meaningful. The Title should be no longer than three typeset lines (12-15 words maximum).

Stop words. Avoid using stop words; stop words are commonly used words that would overburden the system if they were searchable. Common stop words include a, an, are, be, if, in, into, of, on, the, and which.

Useless words. Avoid using useless words; useless words are those that can be eliminated without changing the meaning of the Title. Certain generic words or phrases (e.g., "a report of," "a study of," "effects of," "evaluation of," "factors involved in," "influence of," "new," "novel," "rapid," and other non-quantitative terms) are considered useless by indexing services. Other phrases (e.g., "regarding," "relies on," "results of," "tests on") as well as opening words ("A," "An," "The") and formulas with subscripts or superscripts are also of no value for indexing purposes.

Word combinations. Use simple word order and common word combinations in the Title to enhance efficiency of search and retrieval efforts. Online searches often use adjacency (i.e., a search for one word directly in front of another) as in common word combinations to retrieve more relevant results.

Word order. Begin the Title with a word or term that represents the most important aspect of the article, with the terms that follow reported in approximately descending order of importance.

4.4 Style

For general style guidelines, see Part III. Style Guidelines. For style guidelines specific to the Title, see below.

Abbreviations and acronyms. Avoid using acronyms and other abbreviations in the Title if there is any possibility of confusion. Certain letter strings (e.g., “Ca” for calcium and “CA” for controlled atmosphere) may not be indexed properly because database searches are not case specific.

Capitalization. Capitalize all words in the Title except 1) articles such as “a” and “the”; 2) prepositions such as “between”, “during”, “in”, “of”, and “on”; and 3) conjunctions such as “and” and “but”. The first word in a Title is always capitalized.

Chemicals. Use common or generic names of chemicals in the Title instead of formulas and numbers. Do not use full chemical names, trade names, or brand names. Spell out all abbreviations of chemicals in the Title (e.g., sodium chloride not NaCl). For agricultural chemicals, see Pesticides below.

Common names. Common names of well-known organisms and groups of organisms can be used—indeed, are often preferred—in manuscript Titles, except where their use is ambiguous (e.g., bean). If the common name of the subject organism or group of organisms is widely known, the common name should appear in the Title and authors should include the scientific name (without authority) in the Keywords. For two or more organisms within the same genus, spell out the genus name for each of the different species in the Keywords. If the common name of the subject organism or group of organisms is not widely known, then the scientific name (without authority) may be used in the Title of HortScience and JASHS papers, and one or more common names may be used as Keywords. HortTechnology requires the use of common names in the Title of manuscripts except when there is no useful common name (e.g., bacteria, fungi).

Cultivar name. Provide cultivar names in the manuscript Title only when they are important to understanding the primary goal of the study (e.g., if only one apple cultivar was used in the study, the Title could include the cultivar name, Gala).

Footnotes. Do not use footnotes in the Title.

Gene names. Use only the gene symbols that have been approved by the appropriate committee (e.g., Tomato Genetics Cooperative) in the Title. See Chapter 16. Nomenclature and Taxonomy for additional information.

Geography. Avoid ambiguous geographic terms (e.g., Deep South, Gulf Coast, Midwest) in the Title.

Organism. Identify the subject organism(s) in the Title by the complete common name(s). If an organism is not widely known or if the common name does not unambiguously identify the organism, report the scientific name in the Title. Do not report the common and scientific names of the same organism in the Title. Common names of well-known organisms (e.g., apple, petunia, tomato) can be used—indeed, are often preferred—except where their use is ambiguous (e.g., bean). If a scientific name is used in the Title, spell out the full genus and species (i.e., do not abbreviate the genus name with a single letter).

Numbers. Use Arabic numerals, rather than words, to express whole numbers of more than a single digit (i.e., greater than 9) or to report decimal numbers. Use words rather than numerals to express single-digit whole numbers (1-9); these should be spelled out (e.g., one, two, three, etc.) in the Title. See Chapter 17.

Pesticides. Use common or generic names of pesticides in the Title, instead of formulas and numbers. Do not use full chemical names, trade names, or brand names. See US Environmental Protection Agency (2022) to obtain a list of common names for pesticides.

Punctuation. Minimize punctuation in the Title. Commas are acceptable for separating elements of a series of related terms. Colons are acceptable for coupling main and subordinate elements in a Title. Semicolons and dashes should be avoided in the Title.

Terms. Use accurate, precise terms from formal scientific, agricultural, and biological nomenclature instead of informal conversational terms. See Chapter 16. Nomenclature and Taxonomy.

Trade names. Avoid use of trade names in the Title.

Unique. Construct a unique Title; the Title should not duplicate another title in use.

Verb tense. In cases where a complete sentence is appropriate, use the simple present tense to describe an evidence-based conclusion.

Resources

American Society for Horticultural Science. 1997. ASHS publications style manual. ASHS Press, Alexandria, VA, USA.

Day R, Gastel B. 2012. How to write and publish a scientific paper (7th ed). Cambridge University Press, Cambridge, UK.

- Tichy HJ. 1988. *Effective writing for engineers, managers, scientists* (2nd ed). John Wiley & Sons, New York, NY, USA.
- Trelease SF. 1947. *The scientific paper: How to prepare it, how to write it*. Williams & Wilkins, Baltimore, MD, USA.
- Trelease SF. 1958. *How to write scientific and technical papers*. MIT Press, Cambridge, MA, USA.
- US Environmental Protection Agency. 2022. PRN 97-5: Use of common names for active ingredients on pesticide labeling. <https://www.epa.gov/pesticide-registration/prn-97-5-use-common-names-active-ingredients-pesticide-labeling#naming>. [accessed 15 May 2022].

Chapter 5. Byline

Criteria	Checklist	✓
Purpose	Does the Byline achieve its designated purpose?	
Author affiliation	Are all author mailing addresses complete?	
Contributing author	Does the Byline include all contributing authors who meet the criteria for authorship of the work? Have all contributing authors reviewed the manuscript prior to submission?	
Corresponding author	Have the authors designated who will serve as post-publication corresponding author?	

5.1 Purpose

The purpose of the Byline is to identify the names of all authors who are qualified to take professional responsibility for the full contents of the manuscript. An author is defined as one who has contributed substantially to the research effort and participated in the intellectual synthesis of the ideas or research results being reported.

5.2 Science

The author names that appear on the Byline should include only those whose contributions meet the criteria for authorship. Criteria for authorship include substantial contribution to 1) overall design, execution, data analysis, and interpretation of results of a study and 2) initial writing phase or subsequent revisions of the original manuscript prior to submission. These criteria ensure that all persons credited as authors can accept full responsibility for the content of the publication. Individuals who do not satisfy the criteria for authorship should not be offered gift or courtesy authorships for the purpose of increasing collaboration or credibility. Individuals who do not meet the requirements for authorship, but have provided valuable assistance to the work, should be acknowledged as contributing non-authors in the Byline footnotes (see 5.4 Byline Footnotes, Unnumbered).

5.3 Structure

Author name. The name of each author is given according to the preference of the author; however, authors should report at least one given name (i.e., not just initials) in addition to the surname (family name).

Author address. To enable interested persons in the scientific community to communicate with the authors, complete author affiliations and mailing addresses should be provided. The institution(s) in which the author(s) carried out the reported research should be identified under the Byline. Affiliations not directly related to the reported research should not be included here.

Author sequence. The order of authors appearing on the Byline usually follows the order of decreasing degree of contribution to the research or project. The final determination of author sequence may be clarified by examining the author contributions in four phases of activity including: conception and design, data acquisition, analysis and interpretation, and manuscript preparation. Generally, the first author is the person who carries the highest level of professional responsibility for the work.

5.4 Style

Style and format issues that apply specifically to Bylines are provided here. Additional detail may be found in Part III. Style Guidelines on a topic basis.

Author address, domestic. The Byline address includes the name of the department (where appropriate) along with the name of a company, organization, research center, or university. For domestic authors, this information will be provided entirely in English. The affiliation address is the institution(s) where the research was conducted. For addresses in the United States, use two-letter abbreviations for states, followed by either five-digit or nine-digit zip codes. Whichever postal code format is chosen, it should be used consistently for all institution addresses. Do not report nine-digit zip codes for some authors and five-digit zip codes for others.

Author address, international. Just as with domestic authors, the Byline address includes the name of the department (where appropriate) along with the name of a company, organization, research center, or university. However, for international authors, this information may be

provided in English or in the native language, unless the native language is not based on alphanumeric characters. For international authors, whose native language is based on characters other than alphanumeric, the author affiliation information must be provided in English. The affiliation address is the institution(s) where the research was conducted. In all cases (alphanumeric- or character-based language) the affiliation address for city, county/province/state (where applicable), country, and postal code must be provided in English. For Canadian addresses, include city, province (two-letter abbreviations), postal code, and country name (Canada).

Author address, separate departments. When the authors are in separate departments at the same institution, this information should be provided in the numbered footnotes on the title page.

Author address, separate institutions. When authors are from separate institutions (or separate campuses of the same institution), this information should be provided in separate bylines, grouped by author seniority.

Author address, separate locations. When an author's current address is different from the affiliation where the research was conducted, this information should be indicated as the author's address within a numbered footnote on the title page.

Author name, international. The spelling of names of international authors is in the native spelling with diacritical marks (if present). If a diacritical mark cannot be made by the publisher, the vowel or consonant without the accent will be used.

Author title. Do not include professional titles (e.g., Associate Professor, Graduate Assistant), formal titles (e.g., Dr., Miss, Mr., Mrs., Ms., Prof.), or degree abbreviations (e.g., BS, MS, PhD) as part of the Byline; if desired, they may be added to the numbered block of footnotes.

Footnotes (Numbered block)

All other footnotes, after the unnumbered footnote block, are indicated by superscript Arabic numerals. Footnotes associated with the title page must be provided on the cover page(s) of the manuscript. They will appear as a group at the bottom of the first column of the first published page. Numbered footnotes may include the following:

Corresponding author, post-publication. The post-publication corresponding author is the author responsible for all communications with the public after publication. This author may be different from the pre-publication corresponding author, who is responsible for all communications with editors prior to publication.

First author affiliation. Elaboration on the first author's institutional department affiliation, followed by the current address, if it is not the mailing address listed in the Byline.

Coauthor(s) affiliation. Elaboration on the home institution(s) or affiliations of the coauthors, if different from the first author, when the authors participated in the research at the first author's institution.

Coauthor(s) affiliation, offsite. Elaboration on the institution or affiliation of the coauthor(s) who participated or cooperated on the project while based at their home institution(s) or affiliation(s), if different from the senior author.

Equivalent contribution. If contribution among certain authors was equivalent, the authors may report a statement to that effect in the numbered footnotes.

Deceased. An indication if an author is deceased.

Professional title. Elaboration on an author's professional title and/or institutional and department affiliation. Professional titles (e.g., Associate Professor, Graduate Assistant), formal titles (e.g., Dr., Miss, Mr., Mrs., Ms., Prof.), or degree abbreviations (e.g., BS, MS, PhD) may be added to the numbered block of footnotes.

Footnotes (Unnumbered block)

There are two parts to the Byline footnotes — an unnumbered section and a numbered section. The first footnote section is unnumbered and written as a block of copy, not as individual paragraphs. It may include the following information in the sequence indicated below:

Received. Received for publication date (date to be filled in by ASHS); this will indicate the calendar day, in the format Day Month Year (e.g., 1 Jan 2022) that ASHS received the manuscript.

Funding. Statement of sources of funding for the research project.

Identification. Identification of the paper with a project code and/or as part of the institution's publication series, if applicable. Add this entry (including the number of the journal series, paper, contribution, or publication) if required by the sponsor or host institution.

Thesis (if applicable). An example of this would be indicating the paper is a portion of a thesis submitted by one of the authors in fulfilling a degree requirement.

Author, acknowledgement (if applicable). Insert any credit, acknowledgement, or thanks for financial, material, or informational assistance. Do not include professional titles (e.g., Associate Professor, Graduate Assistant), address titles (e.g., Dr., Miss, Mr., Mrs., Ms., Prof.), or degree abbreviations (e.g., BS, MS, PhD) for acknowledged persons. Use of full names (given name followed by surname) is encouraged. Use first person singular or plural pronouns to acknowledge another's contribution (e.g., "We thank Gerald Grote for statistical advice.").

Disclaimer (if applicable). Trade or brand names generally should not be used in scientific literature. However, if their use is necessary, a general disclaimer is advisable in reference to commercial products or trade names. The following disclaimer, used by the US Department of Agriculture, may be used as a guide: "Mention of a trademark, proprietary product, or vendor does not constitute a guarantee of warranty of the product by the US Department of Agriculture and does not imply its approval to the exclusion of other products or vendors that may also be suitable." Many private institutions and state universities require their faculty or staff to use similar disclaimers; institutional statement style will be accepted.

Resources

American Society for Horticultural Science. 1997. ASHS publications style manual. ASHS Press, Alexandria, VA, USA.

Chapter 6. Keywords

Criteria	Checklist	✓
Purpose	Do the Keywords achieve their designated purpose?	
Duplication	Do the Keywords avoid duplicating words in the Title?	
Order	Are the Keywords arranged in alphabetical order?	
Precision	Have the authors avoided ambiguous abbreviations, jargon, and specialized terminology that may be lacking in precision for efficient retrieval by readers, indexing services, and search engines?	
Relevance	Are the Keywords specific and meaningful with respect to key findings? Have all extraneous words been removed?	

6.1 Purpose

Keywords facilitate the efficient categorization and retrieval of an article by characterizing the main topics of the article. Precise Keywords help readers locate articles of interest and assist indexing services to compile information about journal articles.

6.2 Science

Keywords should be specific and meaningful with respect to the key findings. Searches using a combination of the Keywords should retrieve other articles that are closely related to the subject of interest. Keywords should use recognized vocabularies related to the discipline discussed or field of study.

Content. Keywords should accurately reflect the content of the main text. Avoid including words that are used only once or twice in the main text, or not at all.

Jargon. Avoid using esoteric or vernacular terminology as Keywords (e.g., unusual abbreviations, colloquial words or jargon, cultivar names, trade or brand names, or newly coined names for a technique or material).

Precision. Words already included in the Title should not be repeated as Keywords. Avoid general or broad words such as “growth” or “yield” as well as extraneous, redundant, or unnecessary words or abbreviations with multiple meanings.

Relevance. Keywords should be useful terms for search engines, based on the terms used by the target audience to locate articles in each field of interest. To identify potentially effective Keywords, consider using Google Scholar (Google LLC, Mountain View, CA, USA) or another search engine to search for commonly used, yet specific, terms and then assess how relevant the results are to your own work.

6.3 Structure

Keywords are five to seven words or phrases, reported in alphabetical order. Do not attach footnotes to any Keywords.

6.4 Style

Style and format issues that apply specifically to Keywords are provided here. Additional detail may be found in Part III. Style Guidelines on a topic basis.

Chemicals. Use common names of chemicals (not full chemical names) as Keywords unless the full chemical name is required to accurately index the results. Do not use trade names, brand names, or trademarked names for chemicals. For agricultural chemicals, see Pesticides below.

Organisms. If the common name of the subject organism is widely known, the common name should appear in the Title and authors should include the scientific name (genus and species without the name of the authority) of the subject organism in the Keywords. If the common name of the subject organism is not widely known, then the scientific name of the organism may be used in the Title and one or more common names may be used as Keywords. For two or more organisms within the same genus, spell out the genus name for each of the different species in the Keywords.

Pesticides. Use common or generic names of pesticides in the Keywords, instead of formulas and numbers. Do not use full chemical names, trade names, or brand names. See US Environmental Protection Agency (USEPA, 2022) to obtain a list of common names, approved by The American National Standards Institute and/or USEPA.

Resources

American Society for Horticultural Science. 1997. ASHS publications style manual. ASHS Press, Alexandria, VA, USA.

US Environmental Protection Agency. 2022. PRN 97-5: Use of common names for active ingredients on pesticide labeling. <https://www.epa.gov/pesticide-registration/prn-97-5-use-common-names-active-ingredients-pesticide-labeling#naming>. [accessed 15 May 2022].

Chapter 7. Abstract

Criteria	Checklist	✓
Purpose	Does the Abstract achieve its designated purpose?	
Complete	Does the Abstract state the principal objectives and scope of the study, briefly describe the methods employed, summarize the results, and state the conclusions?	
Concise	Is the Abstract concise – not too detailed or too long? Does it exceed 5% of the length of the entire paper?	
Understandable	Can the Abstract stand on its own and be understandable without having first read the paper?	
(HortTechnology only)	For HortTechnology manuscripts, does the Abstract include a clear message indicating how the results can be used by practitioners?	

7.1 Purpose

The Abstract states the principal objectives and scope of the study, briefly describes the methods employed, summarizes the results, and states the conclusions. A good abstract helps readers assess the value of a paper relative to their research interests and helps them decide whether they should read the full article. In addition, abstracts assist researchers to stay abreast of current work relating to their specific field of study.

7.2 Science

Abstracts are concise, self-explanatory, one-paragraph summations of the article. It should reflect the content of the article as closely as possible and provide a summary of all the essential

sections of the paper including objectives, methods, results, and conclusions. The Abstract should not present any information that is not stated elsewhere in the paper.

7.3 Structure

The Abstract contain the elements of purpose, materials, methodology, results, and major conclusions in a single paragraph with no subheadings. For reviews and other broad-scope articles, the Abstract need only outline the topics of the article without summarizing evidence and conclusions. Because abstracts also appear in abstracting journals and online databases separated from the articles, the Abstract needs to be able to stand alone and be understandable to readers without access to the details of the study.

Conclusions. State the principal conclusions in terms of the effects of these results on the applicable field of study.

Data. If data are included in the Abstract, they should be presented in text format. Abstracts should not contain any tables or figures.

Exhibits. Do not refer to any exhibits (tables or figures) in the Abstract.

Footnotes. Do not use footnotes in the Abstract.

In-text citations. Do not include in-text citations in the Abstract.

Length. The Abstract should be one continuous paragraph and should not exceed 5% of the length of the article.

Methodology. The Abstract should provide a concise description of the research methods employed including type of study, hypothesis, variables, and experimental design.

Objectives. Do not duplicate the title in the Abstract. Briefly identify the principal objectives and scope of the investigation. Why is this study important?

Results. Summarize the effects of major treatments relative to the hypothesis.

Subheadings. The Abstract should be one continuous paragraph and carry no subheadings.

7.4 Style

Style issues that apply specifically to the Abstract are provided here. Additional details may be found in Part III. Style Guidelines on a topic basis.

Abbreviations. Abbreviations should not be used in the Abstract unless they are clearly understood to the potential reader (e.g., DNA, pH). If a lengthy term is used only once within an Abstract, it is best to wait and introduce the abbreviation for the term upon first use in the Introduction, Materials and Methods, Results, and Discussion (IMRaD block).

Abbreviations, first use. In cases where it is appropriate to define an abbreviation in the Abstract, do so on first use of the abbreviation by placing a parenthetical immediately after the word or phrase to be abbreviated. Once an abbreviation is defined in the Abstract, use the abbreviation throughout the Abstract thereafter; avoid using the unabbreviated form. Define each abbreviation only once in the Abstract.

Chemicals. Use common or generic names of chemicals in the Abstract, not full chemical names, trade names, or brand names. Indicate common compounds by their chemical symbols (e.g., NaCl). Report chemical elements by their symbols, except when it may cause confusion with other words [e.g., arsenic (As), helium (He), iodine (I)]. In HortTechnology, symbols for all chemical compounds and elements should be defined on first use in the Abstract [e.g., nitrate (NO₃), potassium (K)].

Diseases, biotic. All biotic diseases should be identified upon first use in the Abstract with the common name of the disease and the scientific name of the causal organism [e.g., crown gall (*Agrobacterium tumefaciens*)] or group of causal organisms [e.g., Verticillium wilt (*Verticillium* sp.)]. Thereafter in the Abstract, use the common name when referring to the disease (e.g., crown gall, Verticillium wilt); use the abbreviated binomial (e.g., *A. tumefaciens*) or scientific name (e.g., *Verticillium* sp.) when referring to the causal organism(s).

Gene name. In the Abstract, enclose well-known synonyms for genes in parentheses after the approved symbol or name; to avoid ambiguity, separate two synonyms with “and”, and three or more with commas, not slashes. See Chapter 16. Nomenclature and Taxonomy for additional information.

Organism. All organisms should be identified upon first use in the Abstract with the complete common name and binomial scientific name in italics [e.g., tomato (*Solanum lycopersicum*), two-spotted spider mite (*Tetranychus urticae*)]. Thereafter in the Abstract, use a shortened version such as complete common name only (e.g., tomato, two-spotted spider mite) or abbreviated

binomial only (e.g., *S. lycopersicum*, *T. urticae*). In HortTechnology, the complete common name (e.g., tomato, two-spotted spider mite) should always be used to refer to an organism in the Abstract after it has been reported with its binomial scientific name upon first use.

Organisms, group. All groups of organisms should be identified upon first use in the Abstract with the common name and scientific name [e.g., blueberry (*Vaccinium* sp.), crucifers (Brassicaceae)]. Thereafter in the Abstract, use a shortened version such as common name only (e.g., blueberry, crucifers) or scientific name only (e.g., *Vaccinium* sp., Brassicaceae). In HortTechnology, the common name (e.g., blueberry, crucifers) should always be used to refer to a group of organisms in the Abstract after it has been reported with its scientific name upon first use.

Trade names. Avoid use of brand names, trade names, or trademarked names in the Abstract.

Resources

American Society for Horticultural Science. 1997. ASHS publications style manual. ASHS Press, Alexandria, VA, USA.

Day R, Gastel B. 2012. How to write and publish a scientific paper (7th ed). Cambridge University Press, Cambridge, UK.

Tichy HJ. 1988. Effective writing for engineers, managers, scientists (2nd ed). John Wiley & Sons, New York, NY, USA.

Trelease SF. 1947. The scientific paper: How to prepare it, how to write it. Williams & Wilkins, Baltimore, MD, USA.

Trelease SF. 1958. How to write scientific and technical papers. MIT Press, Cambridge, MA, USA.

Chapter 8. Introduction

Criteria	Checklist	✓
Purpose	Does the Introduction achieve its purpose? Does it answer clearly and concisely the question “ <i>Why</i> was this research conducted?” Is there mention of the new information the researchers hope to acquire?	
Question	Does the Introduction include a statement of the research question to be answered, problem to be solved, relationship to be examined or association not yet explained, or the socioeconomic benefit to be derived from the work that justifies doing the research?	
Hypothesis	For experimental research, has the hypothesis to be tested been clearly stated? Is it new? Is it worthy of consideration?	
Prior Work	Does the Introduction include mention of (and in-text citations to) key results of prior work relevant to the subject that this research plans to challenge, confirm, or develop?	
References	Have all the in-text citations in the Introduction been checked against the end references in the References Cited to make sure there is a one-to-one match?	

Articles reporting original research are traditionally divided into four sections: Introduction, Materials and Methods, Results, and Discussion (IMRaD block). The IMRaD structure is not an arbitrary publication format—it reflects adherence to scientific method. Each section answers different questions. The Introduction answers questions about *why* the research was conducted. In contrast, the Materials and Methods answers questions about *how* the research was done; the Results answer questions about *what* was learned; and the Discussion answers questions about *who* will be impacted by the results of the study by the clarifying significance of the results.

8.1 Purpose

The Introduction delineates the focus of the research and states unequivocally the rationale for conducting the study. It includes mention of (and in-text citations to) key results of prior work

relevant to the subject that this research plans to challenge, confirm, or develop as well as the new information the researchers hope to acquire. The Introduction clearly and concisely answers the question “*Why* was this research conducted?”

8.2 Science

The Introduction needs to describe the research question and clarify how it explores uncertainty in a specific area of concern (e.g., classification, composition, comparison, causality, correlation, description, effect, relationship). In addition, the Introduction sets the parameters for a study by providing a summary of prior work, constructing the hypothesis, describing precise data fields, and suggesting the appropriate statistically valid approach for analysis of data.

8.3 Structure

Question. Describe the research topic being addressed first in terms of the biological question and then the statistical question (e.g., null hypothesis). Clarify the goal of the paper by explaining the rationale for the study. Describe the nature and extent of the problem being investigated.

Prior Work. Orient the reader by summarizing the most relevant literature about the research question. Cite only key references—more general ones first, followed by studies more closely aligned with the subject work. The Introduction should not include a comprehensive literature review, as most readers are likely to be familiar with key papers in the general field of study. Extensive literature reviews are appropriate for some papers (e.g., dissertations) but that is not the case for most research articles. Rather, focus on key references that support the rationality of the scientific hypothesis or argument to follow. It is important to mention and provide references to key results of prior work relevant to the subject study, which the current research plans to challenge, confirm, or develop. In addition, the Introduction should clarify the special contribution, which the subject study aims to accomplish, relative to those of prior researchers. **Methods.** Present a general description of the methods of investigation.

Hypothesis. Describe either the hypothesis to be investigated or the purpose of the study. Provide a summary of specific data fields that will be collected and analyzed. Describe the general method to be employed for statistical analysis of data.

8.4 Style

Style issues that apply specifically to the Introduction are provided here. Additional details may be found in Part III. Style Guidelines on a topic basis.

Diseases, biotic. All biotic diseases should be identified upon first use within the IMRAD block with the common name of the disease and the scientific name of the causal organism [e.g., crown gall (*Agrobacterium tumefaciens*)] or group of causal organisms [e.g., Verticillium wilt (*Verticillium* sp.)]. Thereafter in the IMRAD block, use only the common name when referring to the disease (e.g., crown gall, Verticillium wilt) and use the abbreviated binomial (e.g., *A. tumefaciens*) or scientific name (e.g., *Verticillium* sp.) when referring to the causal organism(s).

Organisms. All organisms should be identified upon first use within the IMRAD block with the complete common name and binomial scientific name in italics [e.g., tomato (*Solanum lycopersicum*), two-spotted spider mite (*Tetranychus urticae*)]. Thereafter in the IMRAD block, use a shortened version such as complete common name only (e.g., tomato, two-spotted spider mite) or abbreviated binomial only (e.g., *S. lycopersicum*, *T. urticae*). In HortTechnology, the complete common name (e.g., tomato, two-spotted spider mite) should always be used to refer to an organism in the IMRAD block after it has been reported with its binomial scientific name upon first use.

Organisms, groups. All groups of organisms should be identified upon first use in the IMRAD block with the common name and scientific name [e.g., blueberry (*Vaccinium* sp.), crucifers (Brassicaceae)]. Thereafter in the IMRAD block, use a shortened version such as common name only (e.g., blueberry, crucifers) or scientific name only (e.g., *Vaccinium* sp., Brassicaceae). In HortTechnology, the common name (e.g., blueberry, crucifers) should always be used to refer to a group of organisms after it has been reported with its scientific name upon first use in the IMRAD block.

Resources

American Society for Horticultural Science. 1997. ASHS publications style manual. ASHS Press, Alexandria, VA, USA.

Day R, Gastel B. 2012. How to write and publish a scientific paper (7th ed). Cambridge University Press,

Cambridge, UK.

Tichy HJ. 1988. *Effective writing for engineers, managers, scientists* (2nd ed). John Wiley & Sons, New York, NY, USA.

Trelease SF. 1947. *The scientific paper: How to prepare it, how to write it*. Williams & Wilkins, Baltimore, MD, USA.

Trelease SF. 1958. *How to write scientific and technical papers*. MIT Press, Cambridge, MA, USA.

Chapter 9. Materials and Methods

Criteria	Checklist	✓
Purpose	Have the Materials and Methods achieved the designated purpose? Do they answer the question " <i>How</i> was this research conducted?"	
Hypothesis	For experimental studies, have the authors translated a research question into a hypothesis?	
Experimental Design	Do the Materials and Methods clearly identify the type of study (e.g., exploratory, observational, or experimental)? If experimental, have the experimental subject(s), experimental unit(s), and treatment(s) been clearly and accurately identified?	
Experimental Methods	Do the Materials and Methods include enough information on all equipment, materials, and procedures so that the study can be reproduced?	

Articles reporting original research are traditionally divided into four sections: Introduction, Materials and Methods, Results, and Discussion (IMRaD). The IMRaD structure is not an arbitrary publication format—it reflects adherence to scientific method. Each section answers different questions.

The Materials and Methods answers questions about *how* the research was conducted. In contrast, the Introduction answers questions about *why* the research was done; the Results answer questions about *what* was learned; and the Discussion answers questions about *who* will be impacted by the results of the study, by clarifying the significance of the results.

Reporting Materials and Methods can be vastly improved by the consistent use of precise terms. Brief definitions of terms that may pertain to this section are provided at the end of this chapter.

9.1 Purpose

The Materials and Methods provides a useful context for assessing scientific method by describing important environments, equipment, materials, methods, treatments, and procedures

which may influence results. The Materials and Methods clearly and concisely answer the question “*How* was this research conducted?”

9.2 Science

The credibility of a study can be compromised if there are concerns about the Materials and Methods, especially those that relate to the validity of a controlled research study such as experimental design, data collection, and data analysis. Therefore, the advice and counsel of a qualified statistician is recommended prior to initiating research studies, where appropriate. The following issues are of particular importance to controlled experimental studies.

1. **assumptions, not met.** Failure to assess whether the data met the assumptions required of a particular statistical test may lead to doubts about whether the correct statistical test was employed to analyze the data.
2. **data analysis, improper.** Evidence of data exclusion, addition, or manipulation, which risk affecting the truthful nature of a conclusion or outcome may be interpreted as unethical. Certain data manipulations may be justified (e.g., transformation); however, any changes to original data should be clearly stated and explained.
3. **descriptions, inadequate.** Failure to precisely describe or cite experimental materials or methods may hinder efforts to repeat a study.
4. **experimental design, imprecise.** Failure to correctly identify and precisely define experimental treatments, experimental units, sampling units, replications, and repetitions (if applicable) may affect the validity of conclusions or inferences from the statistical analysis. For example, the use of inferential statistics to test for treatment effects with data from experiments where treatments are not replicated, or replicates are not statistically independent has been called “pseudo-replication” by Hurlbert (1984). If data are analyzed from such experiments, treatment effects will be confounded or there will be no way to assess error associated with the treatment effect. Without an estimate of error, standard errors cannot be computed, and no hypothesis tests can be conducted.
5. **scientific method, improper.** Failure to define a question to investigate, failure to define a hypothesis (where appropriate), failure to properly design an experiment, failure to accurately collect/organize/analyze/report data.
6. **variables, confounded.** Failure to account for important confounding variables (i.e., any factor other than the one being studied that is associated with both the independent and

dependent variables) raises concerns that erroneous conclusions may be drawn from the data analysis.

9.3 Structure

The Materials and Methods requires careful adherence to an organized structure if it is to maintain readability. If the text involves lengthy descriptions of several topics, subheadings may be used to break the text into blocks, each with its own subheading.

Methods should be presented in a logical order, one that corresponds as closely as possible to the order in which the authors plan to discuss the results. Include only those procedures directly pertaining to the results that will be discussed. Do not refer to any data or interpretation of data that will be presented later in either the Results or Discussion sections.

Part of the Materials and Methods section may be essentially derived or repeated from previously published papers. In those cases, authors should refer readers to the previous publication rather than reiterate the complete step-by-step descriptions of procedures. However, if any portions of the prior published materials or methods were modified, that should be stated.

The guiding principle of the Materials and Methods section should be *transparency* about how a study was conducted. The Materials and Methods section should aim to be sufficiently detailed so that readers will be able to evaluate the scientific merit of the investigation and data analysis.

Environments

Controlled environment. For studies involving controlled-environment experiments, see guidelines for measuring and reporting environmental conditions (Tibbetts et al. 2000).

Field study. For studies involving field work, report the specific location (e.g., New Mexico State University Leyendecker Plant Science Center at Las Cruces, NM, USA (lat. 32.196920°N, long. 106.743960°W, elevation 1173 m); South China Agricultural University, Guangzhou, Guangdong, China (lat. 23°9'28.80"N, long. 113°20'52.80"E). Include important characteristics and features of study sites relevant to the research study, including gradients in time and/or space. Include maps, drawings, or photographs where appropriate. If published information already exists concerning the subject location, cite the source.

Equipment

Include a complete generic description of all equipment followed by appropriate technical specifications such as product model/name/number and the manufacturer name and location in parentheses [e.g., product name and/or number; manufacturer name, city, county/province/state (if applicable), country]. Report information for the manufacturer, not a distributor or retail supplier. See Trade Names for examples.

Materials

Include sufficient information on all materials for proper identification and sourcing. Include appropriate technical specifications such as product model/name/number and the manufacturer name and location in parentheses [e.g., product name and/or number; manufacturer name, city, county/province/state (if applicable), country]. Report information for the manufacturer, not a distributor or retail supplier. Use care in reporting information on proprietary materials. See also Trade Names.

Methods

Describe how the independent variable(s) will be manipulated, how the dependent variable(s) will be measured or evaluated, and how the confounding variables will be considered or controlled. Begin with a description of the independent variable(s) (e.g., condition, environment, test material), followed by a description of the dependent variable(s) to be measured.

Experiment Design

Hypothesis

Restate the research question and hypothesis for the study (where appropriate), as previously reported in the Introduction.

1. State the null hypothesis.
2. Identify the test statistic that will be used to assess the validity of the null hypothesis.
3. Formulate a decision rule that will be used to decide whether to reject the null hypothesis.

Type of Study

Describe the type of study (e.g., exploratory, observational, or experimental). For experimental studies, identify important parameters related to experimental design, data analysis, and interpretation of results such as appropriate. Examples listed in alphabetical order include:

1. Experimental material (i.e., subject of interest)
2. Experimental unit
3. Factor levels (i.e., categories or values of each factor to be studied)
4. Factor(s) of interest (independent variable)
5. Response unit of measurement
6. Replications
7. Response(s) to be measured (i.e., dependent variable)
8. Sampling unit [subsample of experimental unit (if appropriate)]
9. Treatments (i.e., all possible combinations of factor levels)

Randomization/Replications

Describe how experimental units were assigned to a treatment group. Describe the number of replications in the study and provide a description of the experimental design (e.g., diagram) of the study showing the arrangement of the experimental units.

Subjects

Diseases, biotic. All biotic diseases should be identified upon first use in the IMRAD block with the common name of the disease and the scientific name of the causal organism [e.g., crown gall (*Agrobacterium tumefaciens*)] or group of causal organisms [e.g., Verticillium wilt (*Verticillium* sp.)]. Thereafter in the IMRAD block, use the common name when referring to the disease (e.g., crown gall, Verticillium wilt); use the abbreviated binomial (e.g., *A. tumefaciens*) or scientific name (e.g., *Verticillium* sp.) when referring to the causal organism(s).

Organisms. All organisms should be identified upon first use in the IMRAD block with the complete common name and binomial scientific name in italics [e.g., tomato (*Solanum lycopersicum*), two-spotted spider mite (*Tetranychus urticae*)]. Thereafter in the IMRAD block, use a shortened version such as complete common name only (e.g., tomato, two-spotted spider mite) or abbreviated binomial only (e.g., *S. lycopersicum*, *T. urticae*). In *HortTechnology*, the complete common name (e.g., tomato, two-spotted spider mite) should always be used to refer to an organism in the IMRAD block after it has been reported with its binomial scientific

name upon first use. The guiding principle is to be scientifically precise in the first occurrence, then to shift to a shorter version for ease of reading thereafter.

Organisms, groups. All groups of organisms should be identified upon first use in the IMRaD block with the common name and scientific name [e.g., blueberry (*Vaccinium* sp.), crucifers (Brassicaceae)]. Thereafter in the IMRaD block, use a shortened version such as common name only (e.g., blueberry, crucifers) or scientific name only (e.g., *Vaccinium* sp., Brassicaceae). In HortTechnology, the common name (e.g., blueberry, crucifers) should always be used to refer to a group of organisms in the IMRaD block after it has been reported with its scientific name upon first use.

Organisms, strains (e.g., cultivars). In addition to the scientific name of an organism, report the strain (e.g., accession number, cell line, cultivar) of all subject organisms, where appropriate, and the source of any organisms (e.g., commercial nursery, research institution, seed company, university). A strain is a genetic variant within a biological species. In plants, a strain is a designated group of offspring that are descended from a modified plant produced by conventional breeding, biotechnology, or a genetic mutation.

Persons. For survey studies involving human subjects, include pertinent details about methods of recruitment. Include only those characteristics of subjects that are relevant to the subject study, as appropriate.

Data Collection

Report data collection methods for the dependent variable including any test equipment used to collect data, any modifications made to test equipment, criteria for data inclusion/exclusion, and where appropriate, any procedures for data quality control.

Data Analysis

Descriptive

Descriptive data analysis is used to summarize data, visually inspect data for patterns, identify outliers, or verify that data meet assumptions of statistical tests.

Data modification. Report any statistical procedures used to modify raw data. Examples include mathematically transforming continuous measurements to make distributions closer to

a normal distribution, creating ratios or other derived variables, and collapsing continuous data into categorical data or combining categories.

Data outliers. If relevant, report any outlying data and how they were treated in the analysis.

Data patterns. Summarize patterns in data that indicate associations or relationships.

Inferential

Inferential data analysis is used to assess the probability that the null hypothesis is true. The number and type of predictor and outcome variables determines the appropriate statistical test(s) to be utilized in the analysis and interpretation of results.

Statistical model. Determine an appropriate statistical model consistent with the research question and null hypothesis, the study design (i.e., number and types of predictor and outcome variables), the distribution of the data, and assumptions underlying a given statistical model. Verify that the data conformed to assumptions of the test(s) used to analyze the data. Specify that: 1) skewed data were analyzed with non-parametric tests; 2) paired data were analyzed with paired tests; and 3) relationships analyzed with linear regression models were linear.

Statistical methods. Report statistical methods, procedures, and statistical software employed in the analysis of data as they relate to the primary objectives of the study. Define statistical terms, abbreviations, and symbols employed in statistical analyses. Statistical analysis methods should be described with enough detail to enable a knowledgeable reader with access to the original data to be able to verify whether the correct statistical analysis procedures were employed. Report the outcome of the analysis in the Results section.

Statistical tests. The names of all statistical tests to be applied to the data must be clearly stated and identified unambiguously. See 9.4 Computer Software for examples.

9.4 Style

Style issues that apply specifically to the Materials and Methods are provided here. Additional details may be found in Part III. Style Guidelines on a topic basis.

Computer software, commercial. All software package(s), procedure(s), and options(s) used should be identified. When specific software is first mentioned in the IMRAD block, include a generic description of the software, followed by the version name/number (where applicable), name of the manufacturer, and location [city, county/province/state (where applicable), country] of the manufacturer's headquarters. See Trade Names for first and subsequent use.

Examples:

- statistical software (SAS ver. 9.4; SAS Institute Inc., Cary, NC, USA)
- statistical software (IBM SPSS Statistics ver. 18.0.2; IBM Corp., Armonk, NY, USA)

Computer software, online. All software package(s), procedure(s), and options(s) used should be identified. When specific software is first mentioned in the IMRAD block, include a generic description of the software, followed by the version name/number (where applicable) and a reference to the References Cited. Do not report the web address or URL.

Example:

- statistical software [R ver. 3.6.2 (R Core Team 2019)]

Computer software, published. All software package(s), procedure(s), and options(s) used should be identified. When specific software is first mentioned in the IMRAD block, include a generic description of the software, followed by the version name/number (where applicable) and a reference to the References Cited. Do not report the web address or URL.

Example:

- data-handling software [TBtools (Chen et al. 2017)]

Database. All databases used should be identified. When a specific database is first mentioned in the IMRAD block, include a generic description of the database, followed by the version name/number (where applicable) and an in-text citation linked to the References Cited. Do not report the web address or URL.

Example:

- Rosaceae database [Genome Database for Rosaceae (Washington State University; Clemson University 2015)]

Trade names, first mention. When reporting a trade or brand name for the first time in the IMRAD block, include a complete generic description of the product immediately preceding the trade name. Trade names should be used only for clarification as needed. Generic descriptions

should be used as the primary form when referring to commercial products throughout the manuscript (e.g., report “facial tissue” instead of “Kleenex”). When useful for clarification, refer to each trade name parenthetically immediately after reporting the generic description of the product.

The trade name should be followed with the name and location of the current manufacturer. Include the city, county/ province/state (where applicable), and country of the headquarters of the company that produces the product, not a distributor or retail supplier. Each corporate location should be reported only once in the text; therefore, second and subsequent uses of trade names need not include location information. Trade names should not be used if the source of the trade name cannot be identified.

Examples:

- gibberellic acid (GA₃) plant growth regulator (ProGibb® 40SG; Valent BioSciences LLC, Libertyville, IL, USA)
- imidacloprid systemic insecticide (Admire® Pro, Bayer Crop Science, Research Triangle Park, NC, USA)
- portable leaf area meter (LI-3000C; LI-COR, Inc., Lincoln, NE, USA)
- sequencing instrument (Applied Biosystems 3500 Genetic Analyzer; Thermo Fisher Scientific Inc., Waltham, MA, USA)
- social networking service (Twitter; Twitter, Inc., San Francisco, CA, USA)
- statistical software (IBM SPSS Statistics ver. 18.0.2; IBM Corp., Armonk, NY, USA)

Trade names, second and subsequent mention. When reporting a trade or brand name after it has already been reported in the IMRAD block, include a generic description of the product immediately preceding the trade name. Trade names should be used only for clarification as needed. Refer to each trade name parenthetically immediately after reporting the generic description of the product.

Examples:

- GA₃ (ProGibb® 40SG)
- imidacloprid (Admire® Pro)
- leaf area meter (LI-3000C)
- sequencing instrument (Applied Biosystems 3500)
- social networking service (Twitter)
- statistical software (IBM SPSS Statistics ver. 18.0.2)

Units of measurement. Report units of measurement in HortScience and JASHS in the International System of Units (SI). In HortTechnology, authors should report all data in original units. Original units refer to the unit in which the data were originally collected or reported.

Many studies conducted in agriculture use United States customary (US) units of measurement (e.g., 4 mils, 6 inches, 200 ppm, 50 lb/acre) rather than SI units. Reporting in original units of measurement is required in HortTechnology to reduce errors in recommendations made to practitioners.

In HortTechnology, when the original data are in US units, authors should report US units (i.e., not US units converted to SI). It is expected and acceptable that HortTechnology manuscripts may contain a mixture of US and SI units. For additional information, see Chapter 18. Units of Measurement. Reporting Materials and Methods can be vastly improved by the consistent use of precise terms. Brief definitions of terms referenced in these guidelines are provided herein.

Terms

alpha. Alpha refers to the likelihood that the true population parameter lies outside the confidence interval.

assumption, statistical test. Use of statistical tests requires that certain assumptions about the data are met. Examples of assumptions include: 1) observations are independent (i.e., the value of one observation does not affect the value of other observations); 2) data for the dependent variable are normally distributed; or 3) data from different groups are homoscedastic (i.e., different groups have the same standard deviation).

confounding variable. A confounding variable is an unmeasured factor which influences both the independent variable and the dependent variable. A confounding variable has two conditions: 1) it must be correlated with an independent variable; and 2) it must be causally related to the dependent variable. In practice, a confounding variable may distort or mask the nature of the true relationship between the independent variable and the dependent variable. Randomization is the best way to reduce impact of confounding factors.

control. A control is any standard or treatment against which one or more treatments are compared.

error variables. Numerous variables, in addition to the independent variable, may influence the dependent variable. Variables that are unknown or unmeasured are called error variables. Error variables account for all the individual differences in response measurements that are not accounted for by the independent variable. Error variables are controlled by randomization.

experiment. An experiment is a controlled study that is designed to understand cause-and-effect

relationships.

experimental design (experimental layout). The experimental design refers to the physical arrangement of experimental units, including replications and the interspersions of experimental treatments among the experimental units.

experimental material (study subject). The experimental material is the primary subject of interest in a study. It is the individual entity or physical matter that is analyzed, examined, investigated, observed, or treated during a particular study (e.g., plant species, organism, material, etc.) and is the target entity for inferences calculated from the data.

experimental unit. The experimental unit is the smallest unit of experimental material upon which a single treatment is assigned in an act of randomization (i.e., each experimental unit is randomly assigned to receive a single treatment). A single experimental unit cannot receive two different treatments. Two experimental units within a single replicate containing all treatments cannot receive the same treatment. An experimental unit may be comprised of multiple sampling units.

factor. A factor (also called independent variable or predictor variable) is a variable manipulated by the experimenter. Each factor has two or more levels (i.e., different levels of the factor). Combinations of factor levels are called treatments. If there is only one factor with x levels, there would be x treatments.

hypothesis, alternative. In experimental research, the alternative hypothesis is usually the hypothesis that sample observations are not influenced by chance (i.e., observations are influenced by some non-random cause or event) rather than by chance.

hypothesis, null. In experimental research, the null hypothesis is usually the hypothesis that sample observations are influenced by chance (i.e., observations are influenced by some random cause or event) rather than a non-random event.

hypothesis. A research hypothesis is a tentative conjecture that introduces a research question, variables of interest, and proposes a relationship among variables which can be tested by further observation or experimentation.

measurement. A measurement is an observation or quantification of an attribute for a single variable obtained from a single sampling unit or a single experimental unit. Measurements may be made by unaided human senses (estimates) but are more commonly obtained using instruments to detect and measure quantities.

power analysis. Power analysis is a mathematical calculation used to estimate sample sizes needed to detect a significant difference between two means.

randomization. The purpose of randomization is to guarantee the validity of the test results by ensuring that errors are independently distributed. A lack of independence of errors prohibits knowing the probability of a Type I error (rejection of a null hypothesis that is true). In practice, there is often a conflict between using complete randomization procedures and the desirability of having treatments

interspersed among homogeneous blocks (e.g., systematic designs). Common sense combined with knowledge of biological or production systems should be utilized to address this conflict.

repetition. Repetition refers to the number of times that a complete experiment was repeated. In field studies, this may refer to a duplication of the entire experiment in either time (e.g., multiple years) or space (i.e., multiple locations). Repetition is especially important for field studies where it is difficult to control confounding variables and where the risk/outcome of making a Type I error needs to be minimized (e.g., recommendations).

replication. A single replicate refers to one complete set of experimental units that contains all treatments; a replicate includes one experimental unit per treatment. Replication refers to the assignment of more than one experimental unit to the same treatment. The main purpose of replication is to provide an estimate of experimental error so comparisons among treatments can be made. Each replication must be independent of every other replication. Multiple replicates (duplicates of all treatments) are necessary to calculate standard error of the mean, which is required to estimate confidence intervals. In practice, replication reduces the effects of “noise” or random variation or error, thereby increasing the precision of a treatment effect estimate.

reproducibility. Reproducibility (repeatability) refers to the ability to be copied or reproduced (e.g., results); it is a major principle underpinning scientific method. In practice, a reproducible study is documented in such a way that deduction of scientific results is fully transparent.

research, experimental. Experimental research seeks to assess the nature of a relationship among variables by manipulation of some variables. Experiments have three characteristics: 1) the researcher randomly assigns experimental units to treatments; 2) the researcher actively manipulates an independent variable; and 3) the researcher maintains a high degree of experimental control over environmental conditions and other confounding variables (Hatcher 2018, p 15). Experimental studies can show that variables are related or correlated, and they can estimate the probability of cause-and-effect relationships among variables.

research, exploratory. Exploratory research involves collecting data to explain a phenomenon more completely; it provides objectivity of knowledge relating to a fact, issue, problem, or situation in question. Whereas, observational and experimental research both typically use hypothesis testing, exploratory research does not.

research, observational. Observational studies seek to assess the nature of a relationship among variables without manipulation of any variables. In contrast to experimental research: 1) the researcher does not actively manipulate an independent variable; and 2) the researcher does not maintain a high degree of experimental control over environmental conditions and other confounding variables. Observational studies can show that variables are related or correlated – but they cannot estimate the probability of cause-and-effect relationships among variables. Any inferences about causality would be inappropriate.

sample size. Sample size is the number of sampling units that are observed or measured [e.g., 100 individual plants in an experimental unit (e.g., field plot)].

sampling unit. A sampling unit is the smallest entity within an experimental unit on which observations or measurements are recorded (e.g., a single plant on which height is recorded).

treatment. A treatment is a particular combination of one or more factors applied to an experimental unit. The total number of experimental units needed to randomly assign all treatments to can be found by multiplying together the total number of levels for each factor. If there is only one factor with x levels, then there would be x treatments.

variable, dependent (outcome variable). A dependent variable is an outcome or response variable that is influenced by the manipulation of an independent or predictor variable.

variable, independent (predictor variable). An independent variable is a treatment variable that is changed or manipulated to measure a response in a dependent variable.

variable. A variable is any characteristic, number, or quantity that can be measured, counted, or manipulated.

Resources

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Chapter 10. Results

Criteria	Checklist	✓
Purpose	Has the Results section achieved its designated purpose? Does this section clearly and concisely answer the question " <i>What</i> was learned from this research?"	
Experimental Design	Was the sample size appropriate for the study? Have potential sources of bias (e.g., confounding variables) been considered and accounted for in the analysis?	
Data Analysis	Have the data been summarized, emphasizing important patterns and trends? Have all data exclusions been stated and explained?	
Significance	Has the threshold for accepting significance been stated and does this threshold match the information provided in the Materials and Methods as part of the original experimental design?	
Generalizations	Have adequate explanations, examples, or referrals to tables and figures been provided to support key generalizations made about the data or research study?	

Articles reporting original research are traditionally divided into four sections: Introduction, Materials and Methods, Results, and Discussion (IMRAD). The IMRAD structure is not an arbitrary publication format—it reflects adherence to scientific method. Each section answers different questions.

The Results answer questions about *what* was learned from the research. In contrast, the Introduction answers questions about *why* the research was done; the Materials and Methods answers questions about *how* the research was conducted; and the Discussion answers questions about *who* will be impacted by the results of the study, by clarifying the significance of the Results.

Reporting of results can be vastly improved by the consistent use of precise terms. Brief definitions of terms referenced in these guidelines are provided at the end of this chapter.

10.1 Purpose

The Results section needs to 1) summarize the data, emphasizing important patterns and trends; 2) support generalizations with explanatory text and examples derived from analysis of data; and 3) illustrate generalizations with tables and/or figures. The Results section clearly and concisely answers the question “*What* was learned from this research study?”

10.2 Science

The credibility of a study can be compromised if there are concerns about the reporting of results, especially those that relate to the commentary about methods and interpretation of data analysis. Therefore, the advice and counsel of a qualified statistician is recommended prior to initiating research studies. The following issues are of particular concern in reporting results.

1. **Analysis.** Evidence of errors in collecting, organizing, analyzing, or reporting data. Failure to analyze data using the appropriate statistical procedure.
2. **Errors.** Errors in data or in converting data to alternate units of measurement [e.g., calculating equivalents in International System of Units (SI) units from data obtained in other unit systems]. Any conversion from one unit system to another must be done using an exact conversion factor, usually with a minimum of four decimal places; otherwise, unacceptable rounding errors may occur.
3. **Exhibits.** Failure to provide complete tables and figures. Incomplete exhibits especially those are difficult to understand, are improperly labeled, or are lacking in adequate descriptions, headers, footnotes, or statistics detract from plausibility.
4. **Experimental design.** Evidence of insufficient sample size, meaning the sample is too small to detect meaningful effects and is likely to produce unreliable answers to questions.
5. **Misinformation.** Embellishment, exaggeration, or misstatements of fact that convey misinformation. Failure to quantify uncertainty about the true value of a population parameter (e.g., mean) by reporting confidence intervals. Failure to distinguish between fact and opinion.
6. **Precision.** Failure to report each observation, measurement, and statistic with the appropriate precision relevant to the data being reported. The number of significant digits in the reported results needs to be commensurate with the precision of the

experimental method, mathematical calculations, and scientific instruments. Failure to report a precise P value unless the P value is less than 0.001 (then report $P < 0.001$).

7. **References.** Failure to identify statistical procedures employed during the analysis of data and include appropriate corresponding in-text citations and end references.
8. **Scientific method.** Failure to define a question to investigate, failure to define a hypothesis (where appropriate), failure to properly design an experiment, or failure to accurately collect/organize/analyze/report data. Failure to confirm that all assumptions necessary for correct interpretation of inferential statistical tests (e.g., independence of observations from each other, independence of observational error from confounding effects, approximate normality of observations) are met; if not met, then relative impact on results discussed.

10.3 Structure

Begin the Results by restating the central question or hypothesis for the research. Briefly state the key findings in one or two sentences. Utilize the key findings as topic sentences for subsequent paragraphs. In the subsequent paragraphs, present evidence in support of the key result or generalizations made. Refer readers to specific information summarized in tables and figures in support of key findings. Within the text, discuss results of descriptive statistical analysis first, followed by results of inferential statistical analysis (e.g., confidence intervals, correlations, and hypothesis tests). In most case, the Results section should be focused on presenting new facts relevant to objective of the research. These statements of fact are supported by referral to data, evidence, and observations without interpretation.

10.4 Style

Style issues that apply specifically to the Results section are provided here. Additional details may be found in Part III. Style Guidelines on a topic basis. Most aspects of statistical reporting in ASHS journals follow the Publication Manual of the American Psychological Association (APA, 2020). A useful guide to APA statistical reporting ormat may be found in Hatcher (2018).

Confidence intervals. Report confidence intervals using the general form of “95% CI [lower limit, upper limit) as in 95% CI [0.36, 3.69].

Decimals. In most cases, numbers that need decimal places should be reported to just two or three decimal places. Place a leading zero before a decimal fraction.

Decimals, leading zeroes. You should place a leading zero before a decimal fraction (e.g., 0.01).

Decimal places, probability. Precise probability levels should be reported to two or three decimal places (e.g., $P = 0.02$) unless the probability is less than 0.001, then report it as $P < 0.001$. Avoid using the conventional reporting (i.e., $P < 0.05$ or $P > 0.05$); report exact P values instead.

Error bars. There are three options that are used to overlay error bars on a line plot of the mean. They include a) the standard deviation of the data (SD), b) the standard error of the mean (SE or SEM), or c) a confidence interval for the mean (CI). All are based on sample standard deviation. The SE equals the SD divided by the square root of the sample size. The width of the CI is a multiple of the SE . State which option was used to create error bars.

Greek letters. Population parameters are often represented by Greek letters [e.g., chi (χ), delta (δ), sigma (σ)]. Greek letters may also be used to represent sample statistics, [e.g., eta (η), lambda (λ), and theta (θ)]. Greek letters are not italicized because they are easy to distinguish from normal text.

Latin letters, used as abbreviations. In cases where Latin letters are used as abbreviations for data analysis procedures [e.g., analysis of variance (ANOVA)], they should not be placed in italics.

Latin letters, used as symbols. Sample statistics are often represented by Latin letters. When Latin letters are used as abbreviations or symbols to represent statistics they should be placed in italics [e.g., standard deviation (SD)]. Latin letters used to represent variables (e.g., X , Y) should also be italicized. Latin letters are italicized to help distinguish them from normal text.

Probability. Report probability with the italicized capital Latin letter P .

Statistic. A statistic may be represented by a word or a symbol. When referring to a statistic within the IMRAD block, the statistic should be represented by words. The symbol may be included within parentheses or following a comma. Statistical symbols, following a definition, are preferred in tables and figures.

Statistical procedures. Latin-letter abbreviations for statistical procedures are not italicized (e.g., ANOVA).

Statistical symbols. Abbreviations that do not represent characteristics of a sample but are statistical symbols should be italicized. Examples of these include degrees of freedom (*df*), *F* statistic (*F*), probability (*P*), and *t* statistic (*t*).

Statistical variables. Latin letters that are used to represent variables, such as *X* and *Y*, are italicized.

Statistics, descriptive. Within a sentence, report descriptive statistics (e.g., mean, standard deviation) prior to reporting inferential statistics (e.g., *F* value, *P* value, or *t* value).

Statistics. Statistics are typically represented using words rather than symbols when the statistic is referred to within the text. When symbols do appear in the text, they are enclosed within parentheses or appear at the end of a sentence, preceded by a comma.

Subscripts, sample statistics. Do not italicize sample statistic subscripts [e.g., critical value of *F* (F_{crit})].

Table 10-1. Examples of common symbols and abbreviations used in reporting statistical analyses and their results.

Term	Abbreviation	Accepted usage
analysis of variance	ANOVA	Abbreviation allowed with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table, and each figure) [i.e., analysis of variance (ANOVA)]; abbreviation to be used thereafter.
asterisk	*	Abbreviation allowed with definition only in tables and figures. Use for levels of significance.
average	avg	Abbreviation allowed without definition only in tables and figures.
chi-square value	χ^2	Abbreviation allowed without definition. Use for statistical reporting.

Term	Abbreviation	Accepted usage
coefficient of determination	R^2, r^2	Abbreviation allowed without definition. Use for statistical reporting. Use R^2 for three or more variables, r^2 for two or more variables. Italicize the statistic, but not the superscript.
coefficient of linear correlation	r	Abbreviation allowed without definition. Use for statistical reporting. Use abbreviation only with numerals; format in italics.
coefficient of variation	CV	Abbreviation allowed with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, tables, and figures) [i.e., coefficient of variation (CV)]; abbreviation to be used thereafter; format in italics.
equation	Eq., Eqs.	Abbreviation allowed without definition. Use abbreviation only with numerals; enclose numerals in brackets, e.g., Eq. [1], Eqs. [2] to [4].
honestly significant difference	HSD	Abbreviation allowed with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table, and each figure) [i.e., honestly significant difference (HSD)]; abbreviation to be used thereafter.
interquartile range	<i>IQR</i>	Abbreviation allowed with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table, and each figure) [i.e., interquartile range (<i>IQR</i>)]; abbreviation to be used thereafter; format in italics.
least significant difference	LSD	Abbreviation allowed with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table, and each figure) [i.e., least significant difference (LSD)]; abbreviation to be used thereafter.
logarithm, common (to base 10)	log	Abbreviation allowed without definition. Use abbreviation only with numerals.
logarithm, natural	ln	Abbreviation allowed without definition. Use abbreviation only with numerals.

Term	Abbreviation	Accepted usage
nonsignificant	NS	Abbreviation allowed without definition. Use only in tables and figures.
number	no.	Abbreviation allowed without definition. Use only in tables and figures; do not use number sign (#).
number of observations in a population	<i>N</i>	Abbreviation allowed without definition. Use abbreviation only with numerals; format in italics.
number of observations in a sample	<i>n</i>	Abbreviation allowed without definition. Use abbreviation only with numerals; format in italics.
probability	<i>P</i>	Abbreviation allowed without definition. Use abbreviation only with numerals; format in italics.
standard deviation	<i>SD</i>	Abbreviation allowed with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table, and each figure) [i.e., sample standard deviation (<i>SD</i>)]. Use abbreviation; thereafter, format in italics.
standard error	<i>SE</i>	Abbreviation allowed, with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table, and each figure) [i.e., standard error (<i>SE</i>)]. Use abbreviation thereafter; format in italics.
standard error of the mean	<i>SEM</i>	Abbreviation allowed, with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table, and each figure) [i.e., standard error of the mean (<i>SEM</i>)]. Use abbreviation thereafter; format in italics.
variance	<i>s</i> ²	Abbreviation allowed without definition, for statistical reporting. Italicize the statistic, but not the superscript.

Terms

alpha. Alpha (α) refers to the likelihood that the true population parameter lies outside the confidence interval.

error variables. Numerous variables, in addition to the independent variable, may influence the dependent variable. Variables that are unknown or unmeasured are called error variables. Error variables for all the individual differences in response measurements that are not accounted for by the independent variable. Error variables are controlled by randomization.

error. The imprecise term “error” has been applied to many different concepts including Type I and Type II error; random errors, systematic errors; variation among replicates, discrepancy between sample mean and population mean, etc.

null hypothesis. The null hypothesis is usually the hypothesis that sample observations are influenced by chance (i.e., observations are influenced by some random cause or event) rather than a non-random event.

parameter. A parameter is a characteristic of a population.

probability value. The probability (P) value is the probability of getting the observed result, or a more extreme result, if the null hypothesis is true. A large P value is interpreted as stronger evidence that the null hypothesis is true. A small P value suggests there is stronger evidence in favor of the alternative hypothesis.

probability, statistical. In statistical reporting, probability refers to the probability of a Type I error (mistaken rejection of a null hypothesis when it is true).

random error. A random error is an *inconsistent* difference between an observed value and the true value of a measurement. Random errors are considered unavoidable because control of all unpredictable events in an experiment is not realistic. In practice, random errors result in variable fluctuations around the true value of a measurement.

reproducibility. (synonym: repeatability) Reproducibility refers to the ability to be copied or reproduced (e.g., results); it is a major principle underpinning scientific method. In practice, a reproducible study is documented in such a way that deduction of scientific results is fully transparent.

standard deviation. Standard deviation (SD) is a measure of dispersion or spread of data. It estimates how close observations are to the mean.

standard error. Standard error (SE) is a measure of the variability of a statistic (e.g., correlation coefficient, mean, regression coefficient). It is an estimate of the standard deviation of a sampling distribution.

statistic. A statistic is a characteristic of a sample. It may be used to estimate a population parameter.

systematic error. A systemic error is a *consistent* predictable difference between an observed value and the true value of a measurement (e.g., equipment calibration, observer bias, measurement bias). In practice, this type of error results in a directional shift around the true value of a measurement

Type I error. A Type I error is the mistaken rejection of the null hypothesis when it is true (false positive).

Type II error. A Type II error is the mistaken acceptance of a null hypothesis when it is false (false negative).

Resources

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Chapter 11. Discussion

Criteria	Checklist	✓
Purpose	Has the Discussion section achieved its designated purpose? Does it tell the reader what the key findings mean, as they related to the research question?	
Conclusions	Have the results been interpreted in a manner that supports the conclusions and generalizations with evidence?	
Exceptions	Have any exceptions to the generalizations, patterns, principles, or relationships been pointed out with adequate discussion of possible reasons for these outcomes?	
Prior Work	Have the results and interpretations been compared to previously published work (including work that agrees or does not agree) as well as with the hypothesis of the study?	
Significance	Has a brief statement regarding the significance of the work been included? Does the statement refrain from extrapolating implications beyond the scope of the study?	

Articles reporting original research are traditionally divided into four sections: Introduction, Materials and Methods, Results, and Discussion (IMRAD). The IMRAD structure is not an arbitrary publication format—it reflects adherence to scientific method. Each section answers different questions. The Discussion section answers questions about *who* will be impacted by the results of the study, by clarifying the significance of the results. In contrast, the Introduction answers questions about *why* the research was done; the Materials and Methods answers questions about *how* the research was conducted; and the Results answer questions about *what* was learned.

11.1 Purpose

The primary function of the Discussion section is to tell the reader what the key findings mean as they relate to the research question, hypothesis, or thesis of the study. The Discussion should include a summary of how the results compare to the work of prior researchers previously noted in the Introduction, and it should discuss the significance and benefits of the new knowledge obtained from the current study. Finally, the Discussion should clearly and concisely provide: 1) *what* was learned from this study; 2) *why* this study is important; and 3) *who* will be impacted from these results.

11.2 Science

The Discussion should tie together how all the elements of the article fit together, from the Introduction, Materials and Methods, and Results. The Discussion should seek to clarify the relationships among observed facts without exaggeration, inappropriate extrapolation, or unsupported generalizations. Only those results that are relevant to the study should be interpreted or discussed.

11.3 Structure

The Discussion can be combined with the Results, or they can be separate; however, the latter is preferred for more complex studies. The topics below are listed in order of appearance in the Discussion, rather than in alphabetical order.

Generalizations. Include discussion of results for each of the main generalizations.

Patterns. Include discussion of the main relationships (e.g., causal relationships, correlations, generalizations, patterns) from specific data reported in the results.

Exceptions. Compare and explain any differences in the obtained results versus the expected results.

Comparisons. Compare results with those of prior published research. Discuss differences with respect to opposing theories. Do not use a comparative without stating the standard for comparison. For example, “treatment A produced larger fruit” is obscure—larger than what? While some comparisons are inferred by context or a previous statement, many can be vague and need to be qualified.

Conclusions. Close the Discussion with brief, pertinent conclusions, or an interpretive statement. Avoid indicating “future work is necessary” or “further work is underway.”

11.4 Style

Style issues that apply specifically to the Discussion are provided here. Additional details may be found in Part III. Style Guidelines on a topic basis.

Diseases, biotic. All biotic diseases should be identified upon first use in the IMRAD block with the common name of the disease and the scientific name of the causal organism [e.g., crown gall (*Agrobacterium tumefaciens*)] or group of causal organisms [e.g., Verticillium wilt (*Verticillium* sp.)]. Thereafter in the IMRAD block, use the common name when referring to the disease (e.g., crown gall, Verticillium wilt); use the abbreviated binomial (e.g., *A. tumefaciens*) or scientific name (e.g., *Verticillium* sp.) when referring to the causal organism(s).

Organisms. All organisms should be identified upon first use in the IMRAD block with the complete common name and binomial scientific name in italics [e.g., tomato (*Solanum lycopersicum*), two-spotted spider mite (*Tetranychus urticae*)]. Thereafter in the IMRAD block, use a shortened version such as complete common name only (e.g., tomato, two-spotted spider mite) or abbreviated binomial only (e.g., *S. lycopersicum*, *T. urticae*). In HortTechnology, the complete common name (e.g., tomato, two-spotted spider mite) should always be used to refer to an organism in the IMRAD block after it has been reported with its binomial scientific name upon first use.

Organisms, groups. All groups of organisms should be identified upon first use in the IMRAD block with the common name and scientific name [e.g., blueberry (*Vaccinium* sp.), crucifers (Brassicaceae)]. Thereafter in the IMRAD block, use a shortened version such as common name only (e.g., blueberry, crucifers) or scientific name only (e.g., *Vaccinium* sp., Brassicaceae). In HortTechnology, the common name (e.g., blueberry, crucifers) should always be used to refer to a group of organisms in the IMRAD block after it has been reported with its scientific name upon first use.

Resources

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Chapter 12. Tables

Criteria	Checklist	✓
Purpose	Has each table achieved its designated purpose? Does each table augment, clarify, or illustrate related text?	
Elements	Are all the necessary parts or elements of each table present [e.g., column heads, column spanners (optional), footnotes, row titles, stubs, table cells, table title]?	
Independent	Are all tables constructed to be independent from the text (i.e., functional, and able to be understood without reference to any other part of the manuscript)? Do they meet the requirement of being able to “stand alone”?	
Numbers	Are the tables numbered in the same order in which they are referenced in the text?	

A table is a visual exhibit of data, arranged in rows and columns, organized in a manner that allows for accurate, efficient retrieval of information. Tables are concise conveyors of data; they may present a significant amount of information but do not generally reveal relationships, trends, or patterns. In publications, tables are near the text where they are first cited. They are not embedded in the text and do not rely on surrounding text to be understood; in contrast, lists and tabulations are embedded in the text and usually do rely on preceding text to explain their meaning.

12.1 Purpose

The primary objective of a table is to present information in a manner that enables efficient retrieval. Tables should augment, clarify, or illustrate related text; at the same time, each table needs to be complete enough to function as an independent, autonomous entity, able to be understood without reference to any other part of the manuscript.

12.2 Science

All table elements [column heads, column spanners (optional), footnotes, row titles, row stubs, table cells, table numbers, and table titles] need to be complete so each table can stand alone, without reference to any other part of the manuscript.

The inclusion of inaccurate, incomplete, or irrelevant information in tables is unacceptable; at the same time, any intentional exclusion of material data that may change the meaning of information also is unacceptable. Concerns about the accuracy or precision of data reported in tables can compromise the credibility of a study. Examples include:

Imprecise or erroneous data conversions. Data that is converted from one standard of measurement to another [e.g., conversions from US customary units to International System of Units (SI) units] should be calculated using an exact conversion factor, usually with a minimum of four decimal places; otherwise, unacceptable rounding errors may occur.

Inappropriate precision. The number of reported decimal places needs to be commensurate with the precision of the experimental method. Whereas exact numbers are required for calculations and conversions, more than three decimal places are seldom justified for data reported in the cells of tables.

Incomplete tables. Incomplete tables include those that are difficult to understand for any reason. Common examples of incomplete tables include: 1) tables with inadequate or missing descriptions for table titles, column heads, stub heads, row titles, or footnotes; 2) tables with missing or erroneous data [e.g., abbreviations not defined, subject organism(s) not identified].

Missing credit. If information provided in a table is not original, then a credit or source line identifying the source of information must be provided as a footnote. The credit line should take one of three forms: 1) "Reprinted from (for an exact reproduction), 2) "Adapted from" (for a modified version of an original); or 3) "Based on" (where information comes from a particular source, but the table is not reproduced or adapted). When a table is reproduced or adapted from a published source, permission to reuse the table must be obtained from the copyright holder.

Nomenclature, missing. Organisms are not identified by genus and species at first mention or in footnotes. Groups of organisms are not identified by genus or a higher taxonomic category at first mention or in footnotes.

12.3 Structure

Choosing the optimal format for the presentation of information (i.e., tables, text, or figures) will depend on the complexity of the data. Tables are often the best means for organizing descriptive information or presenting data that includes derived statistics. Very simple tables requiring only one or two columns, or two or three rows may often be converted to text without loss of comprehensibility; in contrast, certain other information describing complex relationships such as correlations, trends, or patterns may be best represented in a figure.

Organization

The table arrangement should be orderly, logical, and as simple as possible, without compromising comprehensibility. Determining what data should be in columns and rows is not always obvious. In general, numbers are more easily compared when presented side-by-side. This suggests that the dependent (outcome or response) variables should be identified in row titles and the independent (predictor) variables in column heads. However, the final choice may depend on constraints of page size, width of cell entries, number of rows and columns, and the number of properties being compared.

Elements

A table may have eight key elements (listed here in alphabetical order). They include column heads, column spanners (optional), footnotes, row titles, row stubs, table cells, table number, and table titles.

Column Heads

Each column of a table must have a column head (column heading). Column heads identify the data in the columns of the table. Position column heads flush left or centered over their respective columns. Capitalize only the first letter of the first word of each column head, except for proper nouns. The column heads should be self-explanatory and include units of measurement within parentheses whenever applicable.

Abbreviations. Abbreviations may be used to keep column heads as brief as possible; they should be defined in the footnotes as needed. See Tables 15-1 and 15-2 for lists of common terms, abbreviations, and symbols with guidelines for approved use in ASHS journals.

Capitalization. Capitalize only the first letter of the first word of each column head except for proper nouns. Use sentence-style capitalization (i.e., capitalize first word only).

Units of measurement. A common column head format is to name the variable and give the units of measurement [e.g., “Root dry wt (g)”]. Avoid column heads consisting solely of units of measurement (e.g., “kg”). To conserve space, use abbreviations, symbols, and other short forms in column headings. See Tables 15-1 and 15-2 for lists of common terms, abbreviations, and symbols with guidelines for approved use in ASHS journals. Otherwise, define these elements in the table title or footnotes as needed.

Column Spanners

Headings that span two or more column heads are called “spanners”. Whenever a spanner is used, every column under the spanner must have its own column head.

Footnotes

Table footnotes may be used to explain abbreviations, phrases, symbols, words, etc. that appears in any table element. Use superscript lowercase Roman numerals (e.g., i, ii, iii) to direct readers to the corresponding footnote located below the table. Use of lowercase Roman numerals is preferred over the use of either Arabic numerals (e.g., 1, 2, 3) or lowercase letters (e.g., a, b, c) to prevent confusion when table cells contain numerical superscripts denoting mathematical operands or alphabetical superscripts denoting mean separation. [*Note: This format replaces the prior ASHS style of using lowercase Roman letters in reverse alphabetical order (e.g., z, y, x) because there is no current word processing program that offers that option for designating footnotes.*]

Assign footnote reference numerals from left to right and from top to bottom starting with the table title, and then progressing through the column heads and then finally ending with the data in the rows of the table, including the row titles. Locate reference numerals to the immediate right of the rightmost character in column heads, row titles [e.g., Root dry wt (g)^{iv}, Treatmentⁱ], and within cells (e.g., 10.9 a^{vii}, ND^{ix}).

Each footnote numeral in the list of footnotes is placed flush with the left margin of the table and is separated from the footnote by one space. Carryover lines in the footnote should be aligned with the first letter of the first line of the note with a hanging indent so footnote letters are clearly visible.

See Tables 15-1 and 15-2 for a list of approved abbreviations that may be used without definition in ASHS journals.

Row Titles

Row titles (row headings) identify the data appearing in a single row (i.e., in the cells to the right of the row title). Place information that identifies the contents of a row in the leftmost column of the table. Capitalize only the first letter of the first word of each row title. Use sentence-style capitalization unless there is justification to so otherwise.

The row title should be self-explanatory. Unlike a column head, a row title may consist solely of a unit designation. To conserve space, use abbreviations, symbols, and other short forms in row titles. Define these elements in a footnote, if necessary. See Tables 15-1 and 15-2 for lists of common terms, abbreviations, and symbols with guidelines for approved use in ASHS journals.

Row Titles Stub

The leftmost column of the table, the “stub”, consists of a stub head at the top and row titles below. The stub head should identify the row titles beneath it. A row title identifies the data appearing in rows (i.e., the cells to the right of the row title). Stub heads are left justified and capitalized sentence style.

Table Cells

The body of the table may contain numbers, text, or symbols. Data contained in tables should include numeric results not only as derivatives (e.g., percentages), but also as the absolute numbers from which the derivatives were calculated. In addition to numeric results, tables should include measures of uncertainty, such as standard error or confidence intervals. Data presented in the text should not be unnecessarily repeated in tables.

Alignment. Align numbers within a column on the decimal point, actual or implied. Otherwise align the columns as appropriate on another common element such as parentheses or a multiplier. Align text as either flush left or centered, but entries requiring several lines should be flush left. Symbols should always be centered in the cell.

Empty cells. Empty cells cause uncertainty for readers. Do not leave a cell blank; instead, use a consistent alphanumeric string of text to explain the missing data (e.g., “No data”, “ND”). The meaning of all acronyms such as “ND” should be reported in the footnotes.

Order. The data field can be organized in two basic ways, depending on the nature of the research. If the intent is to aid in evaluating data, the data field should be ordered (i.e., sorted) by some characteristic of the data. However, if the purpose of the table is to help readers find specific values, then the data should be ordered by some characteristic of the column heads or row titles.

Parallel. Make sure that all entries in a table that are grouped together are equivalent in structure (i.e., all the items of the same type are parallel with similar format or precision).

Precision. Related quantities or values in a table should have the same degree of precision. Similarly, data in a table should report the same level of precision in the text. Numbers presented in the manuscript should always be rounded to the nearest meaningful digit.

Table Number

Start each table on a new page and number each table with consecutive Arabic numerals (e.g., Table 1, Table 2). The text and tables should discuss the topics in the same sequence. All tables must be cited in the manuscript and numbered in the order that they are cited. Do not number multiple tables with the same numeral (e.g., Table 1A, Table 1B, Table 1C).

Table Title

Table titles should be detailed enough that readers can understand the table without reference to any other part of the manuscript. The table title and any associated footnotes must be self-explanatory, clear, and sufficient to allow the reader to grasp the fundamental aspects of the table. Abbreviations may be used in the table title; however, units of measurement are best introduced in the column heads or row titles. Abbreviations used in the table title that are not recognized by ASHS need to be defined in the table title. See Tables 15-1 and 15-2 for lists of common terms, abbreviations, and symbols with guidelines for use in ASHS journals.

12.4 Style

Style issues that apply specifically to tables are provided here. Additional detail may be found in Part III. Style Guidelines on a topic basis.

Tables must be provided as editable files only (i.e., do not provide any tables as image files). In the manuscript, place tables immediately after References Cited. Each table should be presented on a separate page with its title and footnotes. No other text should appear on the separate page. Make a separate table for each data set ; do not design a table that includes multiple tables. Each table must be compiled to fit the page of the publication. If the width of the table is too large to fit within the width of the page, it may be possible to set it lengthwise on the page. Otherwise, excessively large tables should be included in supplementary materials.

Punctuation. For the text reported in cells, use periods or other end punctuation only if the cells contain complete sentences or a mixture of fragments and sentences.

References. References to tables that appear in the IMRAD (Introduction, Materials and Methods, Results, and Discussion) text should be parenthetical to the text, usually at the end of a sentence, although in some cases a table may be used as the subject of a sentence [e.g., (Table 5), (Tables 1-3), (Tables 2 and 6), or Table 1].

Significant differences. If letters are used to indicate mean separation, use either lowercase letters (e.g., a, b, c) or uppercase letters (e.g., A, B, C) from the beginning of the alphabet and include a footnote to define level of significance. Mean separation letters are not presented as superscripts. The following footnote is suitable when letters are used to designate the results of mean separation tests.

Example: ^{iv} Mean separation in columns by Duncan's multiple range test at $P \leq 0.05$.

Statistical significance. If symbols are used to report statistical significance, use a single asterisk (*) for $P \leq 0.05$, or a double asterisk (**) for $P \leq 0.01$, and a triple asterisk (***) for $P \leq 0.001$; otherwise report exact P values.

The following footnote is suitable when symbols are used to designate significance:

Example: ^{vii} NS, *, **, *** non-significant or significant at $P \leq 0.05$, 0.01, or 0.001, respectively.

Software. Prepare tables using the table function in word-processing software programs. Place each entry into a unique cell; do not position the entries with line breaks and tab stops as these word processing commands are easily lost in file transfers and conversions.

Table citation. Cite tables in text in the following manner:

Examples: (Table 1), (Tables 3 and 5), (Tables 2-4), (Tables 2-3 and 5-7)

Resources

American Society for Horticultural Science. 1997. ASHS publications style manual. ASHS Press, Alexandria, VA, USA.

Council of Science Editors. 2014. Scientific style and format: The CSE manual for authors, editors, and publishers (8th ed). University of Chicago Press, Chicago, IL, USA.

Chapter 13. Figures

Criteria	Checklist	✓
Purpose	Have all figures achieved their designated purpose? Do they reveal trends or patterns in the data or help illustrate the results of the study?	
Independent	Are all figures capable of standing alone (i.e., clearly understood without reference to any other part of the manuscript)?	
Complete	Are all elements necessary for understanding a figure included (e.g., axes, caption, labels, legends)?	
Numbered	Are the figures numbered in the same order in which they are referenced in the text?	
Quality	Have all figures been submitted with appropriate resolution to yield high-quality print output (i.e., minimum of 300 dots per inch)?	

A figure is any visual exhibit of non-tabular data [e.g., graph (bar, line, pie); line drawing (chart, diagram, illustration, map, sketch); image (photograph, micrograph), or digital recording (animation, video)]. Figures are often the best means for conveying information that cannot be adequately described in tables or text. Figures improve the general presentation of a technical publication by reporting data in an easily comprehensible manner.

13.1 Purpose

Figures play a key role in clarifying, highlighting, and summarizing information. Figures are concise conveyors of information; they reveal trends or patterns that may not be obvious in the original data. Figures help us assess relationships among data and interpret the meaning of the results of a study. For example, bar graphs compare magnitudes; flow charts show relationships; illustrations clarify concepts; line graphs show trends; photographs document observations; and pie charts show relative proportions of a whole.

The primary objective of a figure is to present data in a manner that enables discussion of key characteristics of the data (e.g., changes over time, contrasts, correlations, descriptive statistics,

differences, means, patterns, ranges, relationships, sampling biases, trends, variations). Figures should clarify, illustrate, or augment the written text; they are not a replacement for written text. High-quality figures are a critical component of achieving accessibility and understanding of results.

13.2 Science

The credibility of a study can be compromised if there are concerns about the accuracy, objectiveness, or quality of figures. Examples of concerns listed in alphabetical order are provided below:

1. **Inaccurate figures.** Figures contain inaccurate, imprecise, or misleading information.
2. **Incomplete figures.** Figure captions, data, labels, or legends are missing information [e.g., definition of abbreviations, identity of subject organism(s)].
3. **Indecipherable figures.** Figures are poorly constructed, indecipherable, or unreadable.
4. **Low quality figures.** Figures are hard to read (e.g., low-resolution files).
5. **Manipulated images.** Images are modified in a way that may alter or distort the results of the study.
6. **Misleading axes.** Figures are constructed with misleading axes [e.g., 1) maximum value on the y-axis exaggerates or minimizes effects; 2) y-axis does not start at zero or lacks a label for the point of origin; or 3) ratio of graph dimensions (i.e., height to width) affects the appearance of the graph and its interpretation].
7. **Misleading trend lines.** Trend lines have been drawn through uncorrelated data (e.g., in a scatterplot) suggesting there is a trend when none exists.

13.3 Structure

Each figure contains numerous elements; not all figures contain all these elements. However, each element that is included in a figure needs to be sufficiently detailed and complete so that the figure can stand alone and be understood, independent from and without reference to any other part of the manuscript.

Figure axes. Figure axes include: 1) x-axis (horizontal axis) and 2) y-axis (vertical axis). Interval marks on axis scales should be minimal.

Figure caption. A figure caption is the descriptive title of a figure. Information in figure captions should be clear and concise, capable of being understood without reference to any other part of the manuscript. Unlike tables, footnotes are not used in figures. Thus, all information necessary to understand a figure should be presented either within the figure or in the caption. Figure captions are not enclosed within the boundaries of a figure. Rather, they are reported all together on a separate page entitled “List of Figures.” Only the abbreviated figure number appears on the page where the figure is presented. All acronyms and other abbreviations used in the figure caption should be defined in the caption unless abbreviations are so commonly used as to be approved for use without definition. See Tables 15-1 and 15-2 for lists of abbreviations with approved use in ASHS journals.

Figure labels. Figure labels include: 1) x-axis labels (text or numerals used to label the categories or increments of the x-axis); 2) x-axis title (single word or phrase, located below the x-axis labels which describes the set of labels [(e.g., Time after planting (d))]; 3) y-axis label (text or numerals used to label the categories or increments on the y-axis); 4) y-axis title (single word or phrase, located to the left of the y-axis labels, which describes the set of labels on the y-axis [e.g., Yield ($\text{kg}\cdot\text{ha}^{-1}$)]).

Figure legend. A legend is the key to the symbols, patterns, and color codes utilized in a figure; it is presented within the boundaries of a figure. A figure legend is not the figure caption (i.e., title).

Figure number. The figure number is the Arabic numeral used to identify a chart, drawing, graph, line drawing, map, or photograph (e.g., Fig. 1, Fig. 2). The identification “Fig.” in the figure caption is not formatted as bold text. Figures are numbered in the sequence in which they are cited in the text. Multiple independent figures are not numbered using the same numeral (e.g., Fig. 1A, Fig. 1C). Uppercase letters may only be used to identify different sub-figures within a compound figure.

Composite figures

For graphs or photographs that are grouped as one composite figure, place letters on each frame that reference a corresponding description in the caption. Assign capital letters in alphabetical order (A, B, C) from left to right, then top to bottom. Be sure that letters are of uniform height

and density and that they will be legible when reproduced (e.g., seek to maximize contrast by using white letters on a black background and black letters on a white background).

In-text Referrals

The text should discuss the figures in the same sequence as they are numbered in the document. In-text referrals to figures should provide the figure number(s) in parentheses. References to figures that appear in the IMRAD (Introduction, Materials and Methods, Results, and Discussion) text should be parenthetical to the text, usually at the end of a sentence, although in some cases a figure may be used as the subject of a sentence.

Example: (Fig. 1)

Example: (Fig. 3A)

Example: (Fig. 1A-B) or (Fig. 1A, 1B) or (Fig. 1A and 1B)

Example: (Fig. 2C-E)

Example: (Fig. 2D-F, 2H) or (Fig. 2D-F and 2H)

Example: (Figs. 1, 3) or (Figs. 1 and 3)

Example: (Figs. 2-5)

Example: (Figs. 1E-G, 4A-C) or (Figs. 1E-G and 4A-C)

List of Figures

The List of Figures is a compilation of all figure captions arranged in order of their mention in the text. The List should appear on the page(s) immediately following the tables but preceding the first figure.

Non-original figures

Charts, graphs, and photographs which are created by someone other than the author(s) may be useful in a publication but must be cited by page number referencing the original source.

Figures that are not original may require permission to use or publish the work. The credit line for a figure should take one of three forms: 1) "Reprinted from (for an exact reproduction), 2) "Adapted from" (for a modified version of an original); or 3) "Based on" (where information comes from a particular source, but the figure is not reprinted or adapted). When a figure is reprinted or adapted from a published source, permission to reuse the figure must be obtained from the copyright holder. Provide complete in-text citations and end references for any figures that are not original.

Non-original photographs

Digital images or photographs that are not original may require permission to use or publish the work. The credit line for a photograph should be prefaced with 1) “Image courtesy of” or 2) “Permission to reuse image obtained from”. When a photograph is reprinted or adapted from a published source, permission to reuse the image must be obtained from the copyright holder. Provide complete in-text citations and end references for any images that are not original. It is not necessary to report a credit line for original photographs.

13.4 Style

Style issues that apply specifically to figures are provided here. Additional detail may be found in Part III. Style Guidelines on a topic basis.

Abbreviations

Abbreviations and symbols used in figures must conform to the style used in the text. All acronyms and other abbreviations used in the figure caption should be defined in the caption unless abbreviations are so commonly used as to be approved for use without definition. See Tables 15-1 and 15-2 for lists of abbreviations with approved use in ASHS journals.

Cultivar names

Use single quotation marks for cultivar names within figure captions unless preceded by the words cultivar or cultivars. Names of cultivars are not punctuated with single quotes when they are reported within figures unless the single quotes are needed to differentiate cultivars from other types of accessions reported in the same figure.

File Format

Each figure should be submitted as a separate file. Any data visualization software can be used to create original artwork. Original artwork should be exported to a universal file format (e.g., JPG, PDF, PNG) to preserve formatting.

The most common file formats for figures submitted to ASHS journals include JPEG, PDF, and TIFF. For photographs, ASHS recommends TIFF or JPEG files. Files that are initially exported as

a PDF file from data visualization software may be subsequently opened and converted to other file formats (e.g., JPEG, PNG, or TIFF) using PDF management software such as Adobe Acrobat (Adobe, San Jose, CA, USA).

Fonts

Use the following fonts in figures where possible: Arial, Baskerville, Calibri, Cason, Garamond, Helvetica, Palatino Linotype, Symbol, and Times New Roman. Arial is especially good for figure labels and legends. Helvetica offers high quality on both print and screen. As a rule, sans serif fonts are better than serif fonts for print documents.

All figure elements including letters, numbers, and symbols must be legible at their final size, (i.e., readable after it is reduced to fit in a journal column). No font within a figure should be less than 8 points after reduction. Use a minimum font size of 12 points for all text in the figure captions. Decimal points, subscripts, and superscripts should be large enough to be clearly visible after reduction for printing.

Photographs

Photographs must be clear, with sharp focus and high resolution. For micrographs, indicate the power at which the image was taken. When two or more photographs are combined into one figure, each part of a composite figure should be clearly labeled on the figure (See 14.3 Composite Figures).

If an individual person or a named product is shown in a photograph, it is the responsibility of the author to obtain written permission (i.e., signed release form) for use of the photograph from either the individual or the manufacturer of the product.

Photographs should be converted from RAW to either JPEG or TIFF files prior to submission and resized for appropriate resolution to yield a high-quality image at final printing size [minimum 300 dots per inch (dpi)].

There are eight file formats available for images. The most common file formats used for publishing images include JPEG or TIFF (for images) or PDF (for documents). See Resolution below.

- EPS files are used for vector-based images which need to be expanded without losing quality (e.g., large print graphics). This file format is seldom used in online publications.

- GIF files may be used for short animations. However, JPEGs and PNGs are a better option for high-quality print.
- HEIC files are used for images captured on certain smartphones. These need to be converted to JPEG prior to submission.
- JPEG or JPG. files are used for uploading photographs to the web as well as storing images at a smaller size. They are commonly used for submitting images for figures but may yield grainy low-quality results if the original image lacks adequate resolution.
- PDF files are used for preparing electronic versions of figures as originally formatted for printing. PDF files may be converted to JPEG, PNG, or TIFF files.
- PNG files are used for storing graphics and line drawings without losing quality. However, the larger and more complex the image, the larger the file size.
- RAW files are the best format for original photographs as they do not compress, manipulate or alter the images. RAW photos tend to be larger than JPEGs but smaller than TIFFs. Prior to publication, RAW photos are generally converted to a more universal file management format such as JPEG or TIFF.
- TIFF files are excellent for printing and storing high resolution images. They do not degrade with editing and are routinely used for publication submissions.

Symbols

Symbols used in graphs and charts should be defined. If symbols are necessary, then choose standard symbols, such as triangle, box, or circle. Complex symbols do not translate well and cannot be replicated easily. Make all symbols and scatter-plot dots large enough to reproduce clearly without blurring.

Resources

American Society for Horticultural Science. 1997. ASHS publications style manual. ASHS Press, Alexandria, VA, USA.

Cleveland WS. 1984a. Graphs in scientific publications. *Am Stat.* 38(4):261-269. <https://doi.org/10.2307/2683400>.

Cleveland WS. 1984b. Graphical methods for data presentation. Full scale breaks, dot charts, and multibased logging. *Am Stat.* 38(4):270-280. <https://doi.org/10.2307/2683401>.

Council of Science Editors. 2014. *Scientific style and format: The CSE manual for authors, editors, and publishers* (8th ed). University of Chicago Press, Chicago, IL, USA.

Chapter 14. References Cited

Criteria	Checklist	✓
Purpose	Has the References Cited section achieved its designated purpose? Is it a compilation of all references mentioned in the text?	
Complete	Have all end references been verified to be complete (i.e., containing all required elements of an end reference)? Do all end references derived from an internet site include a date of access? For end references that have been assigned a DOI number, has that number been included?	
Correct	Have all end references been verified to be accurate and traceable to a reliable published source?	
Complementary	Do all in-text citations refer to a complete end reference in the References Cited and vice versa?	
Relevant	Are all in-text citations relevant to a specific argument or thesis of the study?	
Purpose	Has the References Cited section achieved its designated purpose? Is it a compilation of all references mentioned in the text?	

14.1 Purpose

The References Cited is a compilation of the complete bibliographic descriptions of all references mentioned in the text. In-text citations and their corresponding end references serve three purposes: 1) to support an argument or thesis by providing readers with referrals to the appropriate original authority, precedent, or relevant supporting document, with the goal of improving comprehension of a concept or enhancing the critical evaluation of current work in relation to prior work; 2) to acknowledge or give credit to original sources of important ideas, viewpoints, or technology (e.g., software) discussed within the body of the text; and 3) to provide readers with sufficient information to uniquely identify, locate, and corroborate a citation mentioned within the manuscript.

There are three components of cited references: 1) the complete end reference, which is the full bibliographic description of a single published (or unpublished but accepted for publication) work; 2) the abbreviated in-text citation, which refers the reader to a complete end reference; and 3) the compilation of all complete end references, sorted alphabetically, which appears in the References Cited.

14.2 Science

Scientists build on the work of others to discover or create knowledge. The primary purpose of including citations in publications is to enhance the coherence of an argument by providing evidence of prior research or interpretation of relevant research. As such, citations also serve to acknowledge or credit original sources of important concepts or viewpoints discussed within the body of the text. Citations should not be used to promote self-interests. The minimum requirements of citations are as follows:

Accurate. Each end reference needs to be accurate, complete, and traceable if it is to serve the intended purposes of an end reference. References for publications that erroneously lead readers to inaccessible resources or publications have no value. Authors are responsible for checking the original source of each end reference. References should not be copied from a previous list of cited references, because any errors will then be repeated. Complete references should appear as published in the original work with misspellings included and followed by “[sic]”.

Complementary. All in-text citations mentioned in the manuscript must refer to a corresponding complete end reference in the References Cited and vice versa. In other words, there must be a complementary one-to-one match for both in-text citations and corresponding end references in the References Cited.

Relevant. Citations should be relevant and lend credence to an argument or thesis of an article by providing evidence of prior research or interpretation of relevant concepts. Inclusion of irrelevant citations is inappropriate.

The References Cited should not include unpublished work, personal communications, privileged data, or any other information that cannot be corroborated by a third party. Authors may cite personal communications with other researchers as in-text citations; however, they should not cite their own or a coauthor’s unpublished data as personal communications.

14.3 Structure

References are comprised of numerous elements. In-text citations include only two elements—author name(s) and year. End references include all essential reference elements needed to locate or retrieve a reference.

Elements

Author Name(s)

Begin with the surname (family name) followed by initials without punctuation and without spaces. Separate successive names from each other by a comma and a space. Capitalize surnames and enter spaces within surnames as they appear in the document being cited. Place family designations of rank (e.g., Jr) after the initials, without punctuation.

Author, editor. Names of an editor or editors should be followed by “(ed)” or “(eds),” respectively.

Author, organization. When an organization (e.g., agency, committee, company, university) serves as the author, group all items written by the same organization together. An organization, without any indication of subsidiary components, is considered one author; a component of an organization is considered another author. Use a comma to separate an organization and its components and a semicolon to separate two organizations as authors. When a component of an organization is an author, place components in descending hierarchical order (e.g., US Department of Agriculture, Agricultural Research Service). Drop the leading “The” in an organization name for the purpose of alphabetizing. In the name-year system, when an acronym or initialization has been used by an organization as the in-text citation, order the reference by the full name, not the acronym or initialization.

Author, unknown. If no author is known, credit the work to the editor(s) or publisher, not to “Anonymous”.

Surname, apostrophes. Ignore apostrophes within surnames.

Surname, foreign. See Chapter 15.10 Surnames.

Surname, multiple citations. If an author is cited more than once, repeat the author’s name—do not substitute an underline for the author’s name. For multiple items by the same author, order the items by year in ascending order. If there are several items with the same first author and/or

with coauthors, present items written by a single author before items with coauthors. Give the multi-author publications in alphabetical order letter-by-letter.

Surname, order. Authors are listed first by senior author (surname first, followed by initials) and then additional authors (surname first, followed by initials). All authors of a reference must be listed. All single-authored articles of a given individual precede multiple-authored articles when that author is the senior author of multiple articles. List citations alphabetically (letter-by-letter, not word-by-word) by surnames of authors (then initials if surnames are the same) and chronologically if duplicate author names appear.

Surname, particles Treat particles within an author's name such as "de", "la", "van", "van de", and "von" as part of the surname. Alphabetize according to particle, regardless of nationality, unless contradictory author preference is stated in the publication.

Surname, suffix. If a name is followed by "Jr" or a Roman numeral, the correct form is "Little RP Jr" or "Posey GD III". Do not include professional and honorary titles.

Examples:

Davies FT Jr, Geneve RL, Wilson SB. 2017. Hartmann and Kester's plant propagation: Principles and practices (9th ed). Pearson Education, New York, NY, USA.

Stover E, Stange RR Jr, McCollum TG, Jaynes J, Irely M, Mirkov E. 2013. Screening antimicrobial peptides in vitro for use in developing transgenic citrus resistant to Huanglongbing and citrus canker. *J Am Soc Hortic Sci.* 138(2):142–148. <https://doi.org/10.21273/JASHS.138.2.142>.

Date of Publication

The year of publication is required for all references, following the name(s) of the author(s). If no date of publication can be found, but can be reasonably inferred from within the publication, enclose it in square brackets [2021]. If no date of publication can be found or inferred, use [date unknown].

Title

Titles should be lowercase except for the first word, proper nouns, or certain foreign-language conventions. Do not italicize titles except for words or phrases italicized in the original title of the published work and names of genera, species, and lesser taxonomic categories (e.g., botanical variety, subspecies). Do not underline or use quotation marks around titles. If an

article, book, or chapter title has a subtitle (indicated by a colon, dash, different typeface, semicolon, or smaller type), place a colon (or the dash or semicolon used in the original title) before the subtitle and capitalize the first letter of the first word. Do not abbreviate title.

Journal

Journal names are capitalized and abbreviated according to ISO 4 international standards as detailed in the “List of Word Abbreviations” (International Standard Serial Number International Centre 2021). Capitalize the first letter of all words, but delete extraneous prepositions, articles, symbols, and punctuation. Do not italicize or underline journal names. Journal names are abbreviated, except for single-word journal names (e.g., *Euphytica*, *HortScience*, *Phytopathology*). Journal subtitles are not considered part of the journal title, so are not included in the abbreviation. See Table 12-2 for additional information.

Titles of foreign language publications retain their native spelling and diacritical marks, except titles that do not use the Roman alphabet. Words with capital nouns (such as German) retain their capitalization, but the rest of the title should follow style in lowercase. Do not translate foreign titles into English unless a translated copy was used. Titles transliterated into Roman characters should carry a parenthetical note [e.g., “(in Chinese)”] before the period ending the title.

Volume(Issue):Page Numbers

Give the volume number in Arabic (i.e., not Roman) numerals, followed by the issue number (if appropriate) in Arabic numerals within parentheses. Issue numbers are required for journals that do not use continuous page numbers within a volume/year (i.e., the publication’s pages are renumbered from 1 in each issue). Issue numbers are optional for journals that use continuous page numbers (i.e., only the first issue of each volume/year begins with page number 1). The pagination of the publication follows the volume or issue number after a colon, with no blank spaces. Give full pagination (e.g., use “1101–1102” not “1101–02” or “1101–2”); use the en dash to separate the first and last pages.

Examples: 42(4):22–26; 96:645–648.

Digital Object Identifier

A digital object identifier (DOI) is a permanent address for an article or other electronic source that will continue to lead a reader to the source even if the source’s web address has changed

multiple times. For this reason, DOIs are the preferred retrieval information for online sources whenever they are available. DOIs should terminate without punctuation.

All DOIs begin with the prefix “<https://doi.org/>”. Most publications will include the DOI with the citation information. If needed, a DOI may be obtained from “https://www.crossref.org” by clicking on “Search metadata” and entering the title of the publication into the search box. If the publication has a DOI, it will appear on the results page. Not every publication will have a DOI. If no DOI has been assigned, do not substitute a web address or Uniform Resource Locator (URL) unless the source of the publication (e.g., journal) specifically recommends the use of URLs when citing their resources. Wherever a DOI is applicable and available, include the text “DOI” followed by the DOI metadata at the end of each listing in the References Cited.

Example:

Li L, Tong Y-X, Lu J-L, Li Y-M, Yang Q-C. 2020. Lettuce growth, nutritional quality, and energy use efficiency as affected by red–blue light combined with different monochromatic wavelengths. *HortScience*. 55(5):613-620. <https://doi.org/10.21273/HORTSCI14671-19>.

End References

End references include the full bibliographic information for an in-text citation. The compilation of end references (i.e., References Cited) lists all references in alphabetical order by the surname (i.e., family name) of the first author and then chronologically by the year of publication, if an author is cited more than once. Alphabetical sequencing is determined by the author’s surname and then, if necessary, via letter-by-letter sequencing.

Examples:

Miller L, Vellidis G, Coolong T. 2018. Comparing a smartphone irrigation scheduling application to water-balance and soil moisture-based irrigation methods: Part II – Plasticulture-grown watermelon. *HortTechnology*. 28(3):362-369. <https://doi.org/10.21273/HORTTECH04014-18> .

Miller L, Vellidis G, Mohawesh O, Coolong T. 2018. Comparing a smartphone irrigation scheduling application to water-balance and soil moisture-based irrigation methods: Part I – Plasticulture-grown tomato. *HortTechnology*. 28(3):354-361. <https://doi.org/10.21273/HORTTECH04010-18>.

In-text Citations

In-text citations are alphanumeric expressions that refer to a complete bibliographic reference found in the References Cited. Citations attached to a block of text allow the reader to associate

that text with a specific reference in support of the premise or thesis of that text. Citations should not be included if they are irrelevant to the associated text.

ASHS uses parenthetical citations within the text for in-text citations which include the name of the author(s) and the year of publication [e.g., (Wooster 2019)]. Note that the “author” of a reference may be an organization such as an agency, committee, company, or university, e.g., (US Department of Agriculture, National Agricultural Statistics Service 2019). All in-text citations that appear in the text must refer to complete end references in the References Cited.

The format for in-text citations is the same for one or two authors [e.g., (Li 2020), (Prosser and Widgeon 1999)]; however, for three authors or more, the phrase “et al.” is inserted after the name of the senior author, but before the year of publication [e.g., (Huang et al. 2020)]. When two or more citations are listed in the text at the same time, the citations are listed alphabetically first, then chronologically [e.g., (Fittleworth 2019, 2020; Zhang and Yue 2018; Zhang et al. 2009a, 2009b)]. When multiple references published in the same year have different first authors who share the same surname, include the first author’s initials as part of the in-text citation [e.g., (Liu H-F et al. 2019; Liu J 2019)]. Unlike in the References Cited, all authors of a reference are not always listed with in-text citations.

14.4 Style

Elements

References are composed of numerous elements such as author(s), year, title, source, etc. Indexing services extract reference elements to populate various databases. Authors are responsible for providing all required elements for each reference.

The final format of a published citation is governed by three characteristics: 1) the order in which the reference elements are arranged; 2) the punctuation between reference elements (e.g., period); and 3) the placement of delimiters within a reference element (e.g., parentheses, colon, en dash, brackets). Different citation management programs yield slightly different formats depending on how proprietary algorithms code for these three characteristics.

These seven simple rules for punctuating the elements of end references will provide adequate delimiters for reference elements.

1. Use CSE citation format (Name. Year) to arrange reference elements.

2. Use periods to separate all reference elements, e.g., Name. Year. Title. Source., etc.
3. Use commas to separate serial items within a reference element, e.g., Name AA, Name BB, etc.
4. Use parentheses to attach a descriptor to a reference element, e.g., (abstr) describes a title.
5. Use delimiters (parentheses, colons, en dashes) to separate components of a numerical reference element, e.g., 346(17):1319-1320.
6. Use square brackets to enclose notes or impermanent information not needed to source a reference, e.g., [accessed 5 Jan 2022].
7. Terminate each end reference with a period.

Format

ASHS journals use the “Name. Year” or “CSE citation style” (Council of Scientific Editors 2014, p 551) for References Cited. The CSE citation style is used broadly across the sciences—especially in biology, where it originated. In addition, there are numerous CSE citation generators available online or as downloadable software (e.g., EndNote; Clarivate, Philadelphia, PA, USA).

See Table 14-1 below for examples. Also see Appendix Table 14-2 for a list of commonly used words and abbreviations for use in preparing the References Cited, Appendix Table 14-3 for a list of journal names and abbreviations (sorted by journal abbreviation) and Appendix Table 14-4 for a list of journal names and abbreviations (sorted by journal name).

Table 14-1. Guidelines for preparing end references and in-text citations for publishing in ASHS journals with examples sorted by type of reference.

Reference	Abstract
General format	Author(s). Year. Title (abstr). Journal. Volume(Issue):Page(s). DOI.
End reference	Bhasin A, Davenport JR, Hoheisel G, DeVetter LW. 2019. Exploring the potential of postharvest nitrogen applications in northern highbush blueberry (abstr). HortScience. 54(9S):S164.
In-text citation	(Bhasin et al. 2019)

Reference	Blog
General format	Author(s). Year. Title (blog post). URL. [access date].

End reference	Becker, D. 2014. When to include retrieval dates for online sources (blog post). http://blogapastyle.org/apastyle/2014/08/when-to-include-retrieval-dates-for-online-sources.html . [accessed 29 Jan 2022].
In-text citation	(Becker 2014)

Reference	Book
General format	Author(s). Year. Title (edition). Publisher, City, County/Province/State, Country. DOI.
End reference	Taiz L, Zeiger E, Møller IM, Murphy AS. 2018. Fundamentals of plant physiology (1st ed). Oxford University Press, New York, NY, USA.
In-text citation	(Taiz et al. 2018)

Reference	Book chapter
General format	Author(s). Year. Chapter Title, Page(s). In: Editors (eds). Book Title. Publisher, City, County/Province/State, Country. DOI.
End reference	Fletcher SJ. 2014. qPCR for quantification of transgene expression and determination of transgene copy number, p 213–237. In: Fleury D, Whitford R (eds). Crop breeding methods and protocols. Humana Press, New York, NY, USA. https://doi.org/10.1007/978-1-4939-0446-4_17 .
In-text citation	(Fletcher 2014)
Notes	Page number ranges are preceded by “p” and a space and are linked with an en dash. Page number ranges are not abridged.

Reference	Bulletin
General format	Author(s). Year. Title. Bulletin Name and Number.
End reference	Rollins HA, Howlett FS, Emmert EH. 2002. Factors affecting apple hardiness and methods of measuring resistance of tissue to low temperature injury. Mich Agric Exp Stn Res Bull 901.
In-text citation	(Rollins et al. 2002)

Reference	Computer software, commercial
General format	None
End reference	None
In-text citation	None
Note	Commercial software (e.g., IBM SPSS Statistics, JMP, Microsoft Excel, Minitab, Qualtrics, SAS, SigmaPlot, Statistix, SYSTAT) should not be listed in the

	References Cited. Report trade name information in the text, tables, and figures using the same format as for other commercial products (see Chapter 9. Materials and Methods).
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Reference	Computer software, online
General format	Author(s). Year. Title of program. Source, City, County/Province/State, Country. URL. [access date].
End reference	R Core Team. 2019. R-3.6.2 for Windows. R Foundation for Statistical Computing, Vienna, Austria. https://cran.r-project.org/bin/windows/base/old/3.6.2/ . [accessed 4 Feb 2022].
In-text citation	(R Core Team 2019)

Reference	Computer software, published
General format	Author(s). Year. Title. Journal. Volume:Page(s). DOI.
End reference	Chen C, Chen H, Zhang Y, Thomas HR, Frank MH, He Y, Xia R. 2020. TBtools: An integrative toolkit developed for interactive analyses of big biological data. <i>Mol Plant</i> . 13:1194-1202. https://doi.org/10.1016/j.molp.2020.06.009 .
In-text citation	(Chen et al. 2020)

Reference	Conference proceedings paper
General format	Author(s). Year. Title. Proceedings Name. Volume:Page(s).
End reference	Locascio SJ, Fiskell JGA, Everett PE. 2000. Advances in watermelon fertility. <i>Proc Trop Reg Am Soc Hortic Sci</i> . 14:223–231.
In-text citation	(Locascio et al. 2000)

Reference	Congressional bills
General format	Congressional Body. Year. Congressional Bill Number: Congressional Bill Title. URL. [access date].
End reference	US House of Representatives. 2018. HR 2: Agriculture Improvement Act of 2018. https://www.congress.gov/bill/115th-congress/house-bill/2/text . [accessed 24 Sep 2021].
In-text citation	(US House of Representatives 2018)

Reference	Database
General format	(See Journal article or Online resource)

Reference	Dissertation
General format	(See Thesis)

Reference	Dissertation Abstract
General format	Author. Year. Title (Degree Diss). University Name, City, County/Province/State, Country. Diss Abstr. Number.
End reference	Reeder JD. 1981. Nitrogen transformations in revegetated coal spoils (PhD Diss). Colorado State University, Fort Collins, CO, USA. Diss Abstr. 81-26447.
In-text citation	(Reeder 1981)
Note	Use only as a reference to the abstract in Dissertation Abstracts, not as a reference to the complete dissertation or thesis.

Reference	Horticultural Abstract
General format	Author(s). Year. Title. Source. Volume:pages (Hortic Abstr. Volume:Abstract Number, Year).
End reference	Gherghi A, Bwrza I, Millim K, Tudosescu O. 1978. The behavior in controlled atmosphere storage of 'Jonathan' apples grown on different rootstocks (in Romanian). Lucr Stün Inst Cerc Val Leg Fruct. 9:71-75. (Hortic Abstr. 48:10310, 1978).
In-text citation	(Gherghi et al. 1978)
Note	Use only as a reference to the abstract in Horticultural Abstracts, not as a reference to the complete article.

Reference	Internet
General format	(See Online Resource)

Reference	Journal article, advance online publication
General format	Author(s). Year. Title. Journal. [advance online publication]. DOI.
End reference	Havey MJ, Sunggil K. 2021. Molecular marker characterization of commercially used cytoplasmic male sterilities in onion. J Am Soc Hortic Sci. [advance online publication]. https://doi.org/10.21273/JASHS05083-21 .
In-text citation	(Havey and Sunggil 2021)

Reference	Journal article, article number reported
General format	Author(s). Year. Title. Journal. Volume:Article Number. DOI.
End reference	Lima REM, Fariasa LFL, Ferreira JFS, Suarez DL, Bezerrac MA. 2020. Translocation of photoassimilates in melon vines and fruits under salinity using ¹³ C isotope. Sci Hortic. 274:109659. https://doi.org/10.1016/j.scienta.2020.109659 .
In-text citation	(Lima et al. 2020)

Reference	Journal article, issue number reported
General format	Author(s). Year. Title. Journal. Volume(Issue):Page(s). DOI.
End reference	Chung H-Y, Chang M-Y, Wu C-C, Fang W. 2018. Quantitative evaluation of electric light recipes for red leaf lettuce cultivation in plant factories. HortTechnology. 28(6):755-763. https://doi.org/10.21273/HORTTECH04024-18 .
In-text citation	(Chung et al. 2018)

Reference	Journal article, issue number not reported
General format	Author(s). Year. Title. Journal. Volume:Page(s). DOI.
End reference	Haynes KG, Zotarelli L, Christensen CT, Walker S. 2019. Early generation selection within a diploid hybrid <i>Solanum tuberosum</i> Groups Phureja and Stenotomum population for the intense yellow-flesh creamer potato market. HortScience. 54:2118-2124. https://doi.org/10.21273/HORTSCI13576-18 .
In-text citation	(Haynes et al. 2019)
Notes	Issue numbers are optional for journals that use continuous page numbers (i.e., only the first issue of each volume/year begins with page number 1).

Reference	Journal article, issue number required
General format	Author(s). Year. Title. Journal. Volume(Issue):Page(s). DOI.
End reference	Jackson LE, Ramirez IR, Yokota R, Fennimore SA, Koike ST, Henderson DM, Chaney WE, Klonsky KM. 2003. Scientists, growers assess trade-offs in use of tillage, cover crops and compost. Calif Agric (Berkeley). 57(2):48-54. https://doi.org/10.3733/ca.v057n02p48 .
In-text citation	(Jackson et al. 2003)
Notes	Issue numbers are required for journals that do not use continuous page numbers within a volume/year (i.e., the publication's pages are renumbered from 1 in each issue).

Reference	Journal article, unpublished, accepted for publication
General format	Author(s). Year. Title. Journal. [in press].
End reference	Li L, Tong Y-X, Lu J-L, Li Y-M, Yang Q-C. 2020. Lettuce growth, nutritional quality, and energy use efficiency as affected by red-blue light combined with different monochromatic wavelengths HortScience. [in press].
In-text citation	(Li et al. 2020)
Note	Unpublished papers or manuscripts submitted for publication may not be used in the References Cited unless the work has been accepted for publication, in which case the work may be cited as "[in press]" at the end of the reference.

Reference	Journal article, unpublished, not accepted for publication
General format	None
End reference	None
In-text citation	(Posey GD III and Crawford BM, unpublished)
Note	The References Cited should not include journal articles submitted for publication that have not been accepted for publication. Where appropriate, unpublished articles can be noted parenthetically in the text. Identify each contributor to the unpublished article by surname and initial(s) (i.e., do not report et al.).

Reference	Journal article, URL reported
General format	Author(s). Year. Title. Source. URL. [access date].
End reference	Kelly K, Wehry R. 2006. Consumer interest in gardening topics and preferred information sources. J Ext. 44(2):2RIB7. https://www.joe.org/joe/2006april/rb7.php . [accessed 1 Aug 2021].
In-text citation	(Kelly and Wehry 2006)

Reference	Online resource
General format	Author(s). Year. Title. URL. [access date].
End reference	US Department of Agriculture, National Agricultural Statistics Service. 2019. Floriculture crops 2018 summary. https://www.nassusda.gov/Publications/Todays_Reports/reports/floran19.pdf . [accessed 3 Mar 2020].
In-text citation	(US Department of Agriculture, National Agricultural Statistics Service 2019)

Reference	Patent, plant
General format	Patent inventor (inventor). Year. Title of patent. Patent holder (assignee). Patent Number. (file date, grant date).
End reference	Shaw DV, Larson KD (inventors). 2006. Strawberry plant named 'Albion'. University of California (assignee). US Plant Patent 16,228. (Filed 29 Jan 2004, granted 31 Jan 2006).
In-text citation	(Shaw and Larson 2006)

Reference	Patent, utility
General format	Patent inventor (inventor). Year. Title of patent. Patent holder (assignee). Patent Number. (File date, grant date).
End reference	Williams D (inventor). 2005. Screwless clip mounted computer drive. Cargill Inc (assignee). US Patent 6,885,550. (Filed 24 Aug 2000, granted 26 Apr 2005).
In-text citation	(Williams 2005)

Reference	Report
General format	Author(s). Year. Title. Report Name and Number.
End reference	Domoto PA, Nonnecke GR, Tabor P, Riesselman LB. 2013. Cold hardy wine grape cultivar trial. Iowa State Res Farm Prog Rep 1915.
In-text citation	(Domoto et al. 2013)

Reference	Software
General format	(See Computer software)

Reference	Thesis
General format	Author. Year. Title (Degree Diss). University, City, County/Province/State, Country.
End reference	Li Q. 2010. Effects of light quality on growth and phytochemical accumulation of lettuce and <i>Salvia miltiorrhiza</i> Bunge (PhD Diss). Northwest A&F University, Xianyang, Shaanxi, China.
In-text citation	(Li 2010)

Reference	Unpublished information
General format	None
End reference	None
In-text citation	(Purkiss HC, unpublished data); (Longwood Gardens, unpublished information); (Huang B, personal communication)
Note	The References Cited should not include unpublished work, personal communications, privileged data, or any other information that cannot be corroborated by a third party. Where appropriate, unpublished information can be noted parenthetically in the text. Identify each contributor to the unpublished information by surname and initial(s) (i.e., do not report et al.). Authors should not cite their own or a coauthor's unpublished information as personal communications.

Reference	Website
General format	(See Online resource)

Resources

American Society for Horticultural Science. 1997. ASHS publications style manual. ASHS Press, Alexandria, VA, USA.

Council of Science Editors. 2014. Scientific style and format: The CSE manual for authors, editors, and publishers (8th ed). University of Chicago Press, Chicago, IL, USA.

University of Chicago Press. 2017. The Chicago manual of style: The essential guide for writers, editors, and publishers (17th ed). University of Chicago Press Editorial Staff, Chicago, IL, USA.

University of California, Berkeley Library. 2019. Bioscience journal abbreviations.
<https://guides.lib.berkeley.edu/bioscience-journal-abbreviations>. [accessed 4 Feb 2022].

PART III. STYLE GUIDELINES

Chapter 15. Abbreviations and Terms

Manuscripts must comply with current standards of English grammar, syntax, style, and usage. ASHS, in general, conforms to *The Chicago Manual of Style* (University of Chicago Press 2017).

Abbreviations

Abbreviations are shortened forms of a word or phrase. Acronyms are a type of abbreviation constructed of words formed from the first letter of each of the successive parts or major parts of a compound term. Abbreviations and acronyms when used appropriately should either enhance readability or clarity. Otherwise, use of the complete word or phrase is preferred. Abbreviations are reported within parentheses, following the definition, not vice versa. For example, United States Department of Agriculture (USDA) is correct; USDA (United States Department of Agriculture) is not.

See Appendix Table 15-1 for a list of abbreviations, symbols, and definitions with guidelines for use in ASHS journals. For abbreviations that involve units of measurement (including time), see Chapter 18.

First use. Abbreviations are defined on first use. The concept of “first use” can be confusing; it does not mean upon first appearance in the entire manuscript. Upon first use means upon first appearance in any autonomous entity (see definition below) of a document. The term “first use” implies that the abbreviation will be used more than once in any autonomous entity of a document. If that is not the case, there is no need to use an abbreviation. Abbreviations defined upon first use in any autonomous entity should be used consistently throughout that section thereafter. For consistency, once an abbreviation has been defined in a section, avoid using the unabbreviated form again in the same section. Similarly, once an abbreviation has been defined, it should not be defined again later in the same section. Avoid using abbreviations in the manuscript title.

Autonomous entity. There are four entities in a manuscript that are required to be independent (i.e., able to be understood apart from the rest of the manuscript). The autonomous entities include: 1) Abstract, 2) IMRAD block (i.e., Introduction, Materials and Methods, Results, and Discussion combined as one block), 3) each table, and 4) each figure. Each autonomous entity must be able to stand alone and be understood without reference to any other part of the manuscript. Thus, each abbreviation defined upon first use in any one of the four autonomous

entities (Abstract, IMRAD block, each table, and each figure) must be defined again on first use in any other autonomous entity.

Units of measurement. Use an abbreviation or symbol for a standard measurement in the text only if the unit is preceded by a number (see Appendix Table 18-1 for accepted uses of abbreviations of units of measurement). Do not abbreviate units of measurement when they appear by themselves in the text.

Correct “expressed as milligrams of catechin equivalents per kilogram”

Incorrect “expressed as mg of catechin equivalents per kg”

Upper case abbreviations. Upper case acronyms and other abbreviations for chemical expressions, government agencies, organizations, etc. should be written as a string of letters without spaces or periods (i.e., ARS, ASHS, IAA, and USDA are correct abbreviations; A R S, A.S.H.S, I A A, and U.S.D.A. are not).

American English

All papers must use American English. Use American spelling of terms, rather than the British spelling (e.g., “color,” not “colour”; “center,” not “centre”; “program,” not “programme”; “rationalize,” not “rationalise”; and “gasoline,” not “petrol.” However, retain the original spelling of words in quotations, when part of proper nouns (e.g., Wageningen Centre for Development Innovation), and in the References Cited.

Colloquial Jargon

Avoid slang, jargon, local vernacular, and coined terms. Special words or expressions that are used by a particular profession or group or region or which may be difficult for others to understand should be avoided.

Compound Terms

A compound term is a combination of two or more words which when used together have acquired a new meaning. Use a hyphen for a compound term when it adds clarity or when each part of the compound term cannot serve as a modifier on their own. In most cases, a two-part compound adjective is hyphenated when it is placed before the noun it modifies,

but it is not hyphenated if the adjective is a single word before a noun. Examples are provided below.

Example: “split-plot design,” but “each split plot” (i.e., the compound term “split-plot” is the modifier for “design” in the first case; “split” is the single term modifier for “plot” in the second case).

Example: “a winter-hardy plant,” but “it is winter hardy”

Example: “a 5-mL drench,” but “5 mL of drench”

Example: “a 12-h cycle,” but “every 12 h.”

A compound modifier containing numerals or alphabetized fractions usually are hyphenated (e.g., “a 4-min exposure,” “5-year-old orchard,” or “a two-thirds majority”). Compound modifiers are not hyphenated when the first word ends in “ly.”

Foreign Terms

Foreign characters. All foreign languages that use alphabet characters other than Roman characters and their diacritical marks must be transliterated to English. Such languages include Arabic, Chinese, Hebrew, Japanese, Korean, and Slavic (including Russian). Although Greek characters are available (because Greek is used extensively in mathematics), it is preferred that modern Greek also be transliterated to English.

Foreign places. Capitalize the names of foreign places when they occur as part of a proper noun.

Foreign words. Certain foreign terms that have become part of modern English such as media, data, bureau, in vitro, in vivo, and in situ are not italicized.

Latin Terms

Whenever Latin or foreign words or phrases are used, they should be italicized if they have not been naturalized in English, but their abbreviations are not italicized. For example, spell out in italics *id est* (that is) and *nomen novam* (new name), but abbreviate without italics “i.e.” (*id est*) and “nom. nov.” (*nomen novam*).

Location Names

Always spell out the names of countries, provinces, and states when they stand alone (i.e., there is no city cited). Use two-letter Canadian postal abbreviations for provinces and territories (e.g., Rivière-Ouelle, QC, Canada) when they are given with the city. Use AB for Alberta, BC for British Columbia, MB for Manitoba, NB for New Brunswick, NL for Newfoundland and Labrador, NS for Nova Scotia, NT for Northwest Territories, NU for Nunavut, ON for Ontario, PE for Prince Edward Island, QC for Quebec, SK for Saskatchewan, and YT for Yukon. Use two-letter United States Postal Service abbreviations for US states when they are given with the city. Use DC for District of Columbia, PR for Puerto Rico, and VI for US Virgin Islands.

Pronouns

First- and third-person pronouns are accepted and preferred for clarity. Use the active voice whenever possible.

Weak: The plants were watered by the experimenters once a week.

Strong: We watered the plants weekly.

Quotation Marks

Use double quotation marks to set off a direct (word-for-word) quotation. Periods and commas always go inside quotation marks. Quotation marks are often used with technical terms, terms used in an unusual way, or other expressions that vary from standard usage. Use single quotation marks only for cultivar names and quotations within quotations. When quoted material runs more than one paragraph, start each new paragraph with opening quotation marks, but do not use closing quotation marks until the end of the passage.

Surnames

Chinese. The family name precedes the given name (usually hyphenated) when written in Chinese (e.g., Chiang Ching-kuo). However, in ASHS journals a Chinese name usually is Anglicized and transposed (e.g., Ching-kuo Chiang), and cited as Chiang C-K.

Dutch or Belgian. When alphabetizing, the particle that precedes the family name remains lowercase, e.g., J van Zanten becomes van Zanten J; however, some American authors of Belgian or Dutch extraction capitalize the particle, e.g., De Hertogh AA.

Egyptian. Arabic names without prefixes or variants place the family name after the given name. Shawki A. Moustafa, therefore would be cited as Moustafa SA. When the particle “el” alone or a prefix or its variant (el, ibn, abdel, abdoul, abu, about, or aboul) precedes a name, it is hyphenated to the word it precedes in the citation, e.g., Mahoud el Barkooki is cited as el-Barkooki M. The particle or prefix remains lower case.

French. The definitive articles (le, la, or les) alone or combined with prepositions (de, du, or des) precede the name in the citation and remain either capitalized or lowercase as they were in the original (e.g., Charles de Gaulle becomes de Gaulle C and Maurice LeBeau becomes LeBeau M.).

German. Names containing particles or their abbreviations precede the family name in a citation and remain lowercase (e.g., Klaus von Krupp becomes von Krupp K).

Indian. Modern Indian names place the given name before the family name. If the family name is preceded by Sen or Das, it should remain capitalized and lead the citation (e.g., Natoobhai D. Sen Dhur becomes Sen Dhur ND).

Indonesian. Family names are written last. However, some Indonesians have only one name (e.g., Soetono).

Japanese or Korean. The family name always comes first when written in Japanese or Korean. Western form usually places the given name first (e.g., Yashiro Kosaka is cited as Kosaka Y).

Portuguese. Citations should carry the participle (do, da, das, dos) in lowercase before the family name (e.g., Alberto Alvares do Santos becomes do Santos AA).

Spanish. Some Spanish names and names of Spanish origin include the maternal after the paternal name. In the transposed name, the paternal name precedes the maternal name [e.g., Jose Manuel Hernandez Gonzales becomes Hernandez Gonzales JM (Gonzales is the maternal name); or Carlos Pérez y Martínez becomes Pérez y Martínez C (Martínez is the maternal name)]. Note that the maternal name is not separated from the paternal name by a comma in the citation.

Vietnamese. The family name precedes the given name, but the first name, which is the last element, must be transposed with the middle name (e.g., Ngo Van Hai becomes Ngo HV).

Resources

American Society for Horticultural Science. 1997. ASHS publications style manual. ASHS Press, Alexandria, VA, USA.

International Standard Serial Number. 2020. List of title word abbreviations.

<https://www.issn.org/services/online-services/access-to-the-ltwa/?lettre=a#lettres> [accessed 4 Feb 2022].

University of British Columbia. 2020. Science and engineering journal abbreviations.

<https://woodward.library.ubc.ca/research-help/journal-abbreviations/> [accessed 4 Feb 2022].

University of Chicago Press. 2017. The Chicago manual of style: The essential guide for writers, editors, and publishers (17th ed). University of Chicago Press Editorial Staff, Chicago, IL, USA.

Chapter 16. Nomenclature

The term "nomenclature" refers to the set of standardized naming rules used to systematically generate unique, distinct, and consistently configured designations for entities, which are broadly understood by the scientific community. Consistent reporting of proper nomenclature is important in scientific writing to maintain precision and adherence to scientific method.

In scientific writing, the most frequent problems relating to nomenclature issues are:

1. Failure to report precise nomenclature upon first mention of all common names.
2. Failure to repeat #1 above in all subsequent autonomous entities of a manuscript. The autonomous entities of a manuscript include the Abstract, the IMRAD block (Introduction, Materials and Methods, Results, and Discussion), and each Table and Figure.

It is beyond the scope of these Guidelines to serve as a comprehensive reference for nomenclature; therefore, authors are advised to seek advice from published sources and databases for specific questions about nomenclature of specific items. A partial list of online resources is included in Tables 16-1 through 16-4.

In this chapter, scientific nomenclature for entities of particular relevance to horticulture, namely chemicals, diseases, genes, and organisms, will be briefly covered. In addition, the proper use of common names and trade names will be discussed.

16.1 Chemicals

Common names of chemicals are the names that are used locally but may vary by region or country. Thus, a chemical may have many common names and numerous other vernacular or local names in different languages. Although the same common name may be informally applied to two or more different chemicals, in scientific writing, each reported common name of a chemical must be clearly associated with the scientific name of only one distinct chemical if it is to be universally understood.

Nomenclature rules and publication styles for biochemical, inorganic, and organic compounds are established by Commissions of the International Union of Pure and Applied Chemistry (IUPAC) and the International Union of Biochemistry and Molecular Biology (IUB). In addition, the Chemical Abstracts Service (CAS) compiles a database of information on naturally occurring and synthetic substances called the CAS Registry in which each substance has a unique identification number (American Chemical Society 2022).

Numerous chemicals are important in horticultural research including biochemical, inorganic, and organic compounds; pesticides (e.g., fungicides, herbicides, insecticides), fertilizers, and plant growth regulators (e.g., growth promoters, growth retardants, hormones). See Table 16-1 for a list of online resources relevant to chemicals in horticulture.

Table 16-1. Online resources for nomenclature databases relevant to chemicals in horticultural research.

Index	Description	Resource
Chemicals	Database of chemicals.	https://www.cas.org/cas-data/cas-registry . [accessed 13 Jun 2022].
Chemicals	Database of chemicals.	https://pubchem.ncbi.nlm.nih.gov . [accessed 13 Jun 2022].
Chemicals	Database of chemicals.	https://www.lookchem.com/Chempedia/Chemical-Resource/Chemical-DataBase/13857.html . [accessed 13 Jun 2022].
Chemicals	International Union of Pure and Applied Chemistry: Agrochemicals.	https://agrochemicals.iupac.org . [accessed 5 Jan 2022].
Pesticides	Compendium of pesticide common names.	https://pesticidecompendium.bcpc.org/index.html . [accessed 13 Jun 2022].

Chemicals have numerous names; guidelines governing which chemical name is most appropriate for use in scientific publications depend on balancing readability with relevance for the intended audience. Simple names (abbreviations or common names) may be appropriate for one audience; in other cases, scientific names (the compound name, molecular formula, IUPAC name, or CAS number) may be a better option; finally, the inclusion of trade names may be useful in some cases.

For example, a common use herbicide, mecoprop, may be referred to by any of the following names.

Simple names

abbreviation	MCPP
common name	mecoprop

Scientific names

compound name	methylchlorophenoxypropionic acid
molecular formula	$C_{10}H_{11}ClO_3$
IUPAC name	(RS)-2-(4-chloro-2-methylphenoxy)propanoic acid]
CAS number	93-65-2

Trade names

trade name	MCPP-p 4 Amine (Nufarm Americas Inc., Alsip, IL, USA)
trade name	Acme MCPP Herbicide (PBI/Gordon Corp., Kansas City, MO, USA)

ASHS recommends that authors provide at least two names for all chemicals (at least three names if trade names are included) on first mention. Provide one simple, generic name (e.g., abbreviation or common name) and one scientific name (e.g., compound name, molecular formula, or IUPAC name) in parentheses (see Examples 1-4). Thereafter, in the interest of readability, use of the simpler or more readable version of the chemical name is recommended.

Example 1: "methylchlorophenoxypropionic acid (MCPP)"

Example 2: "indole-3-acetic acid (IAA)"

Example 3: "polyethylene glycol (PEG) or $C_{2n}H_{4n+2}O_{n+1}$ "

Example 4: "(E,2S)-2-amino-4-(2-aminoethoxy)but-3-enoic acid, aminoethoxyvinylglycine (AVG), or $C_6H_{12}N_2O_2$ "

Example 5: "methylchlorophenoxypropionic acid [MCPP (MCPP-p 4 Amine; Nufarm Americas Inc., Alsip, IL, USA)]"

Inclusion of a specific trade name may add important detail to the description of a material or product. If a trade name is provided, list it as the tertiary name. As a rule, trade names lack permanence; thus, the requirement for additional designations. Follow the trade name with the name of the manufacturer and the manufacturer address (see Example 5).

Title. Use common or generic names of pesticides and other chemicals in the Title instead of formulas and numbers. Do not use full chemical names, trade names, or brand names. See US Environmental Protection Agency (2022) to obtain a list of common names for pesticides. Spell out all abbreviations of chemical elements in the Title (e.g., nitrogen not N).

Keywords. Use common names of pesticides and other chemicals (not full chemical names) as Keywords unless the full chemical name is required to accurately index the results. Do not use trade names, brand names, or trademarked names for chemicals as Keywords. See US Environmental Protection Agency (2022) to obtain a list of common names for pesticides.

Abstract. Use common or generic names of chemicals in the Abstract, not full chemical names, trade names, or brand names. Indicate common compounds by their chemical symbols (e.g., NaCl). Report chemical elements by their symbols, except when it may cause confusion with other words [e.g., arsenic (As), helium (He), iodine (I)]. In HortTechnology, symbols for all chemical compounds and elements should be defined on first use in the Abstract [e.g., nitrate (NO₃), potassium (K)].

IMRAD block. Provide at least two terms for all chemicals on first mention in the IMRAD block (at least three names if trade names are included). Provide one simple, generic name (e.g., abbreviation or common name) followed by the more complex, standardized nomenclature (e.g., compound name, molecular formula, or IUPAC name) in parentheses. Thereafter, in the interest of readability, use of the simpler or more-readable version of the chemical name is recommended.

Indicate ion charges with superscripts (e.g., H⁺, Cl⁻); use Ca²⁺, not Ca⁺⁺ or Ca⁺². Indicate isotopes different from the normal with superscript numbers preceding the element symbol [e.g., ¹⁴C(2-chloroethyl)phosphonic acid].

Report chemical elements by their symbols, except when it may cause confusion with other words [e.g., arsenic (As), helium (He), iodine (I)]. However, do not begin sentences with a chemical symbol (e.g., “P is necessary for growth”).

Indicate common compounds by their chemical symbols (e.g., NaCl). General mention of a salt or its concentration in solution may be given as the simplest formula (e.g., Na₂SO₄). Give full molecular formulas for hydrated salts [e.g., BaCl₂·H₂O (use the raised period, with no space before or after the period for water of hydration)].

In HortTechnology, symbols for all chemical compounds and elements should be defined on first use in the IMRAD block [e.g., nitrate (NO₃), potassium (K)].

Tables and Figures. Use common or generic names of pesticides and other chemicals in the tables and figures, not full chemical names, trade names, or brand names. See US Environmental Protection Agency (2022) to obtain a list of common names for pesticides.

16.2 Diseases

Common names of plant diseases are the names that are used locally but may vary by region or country. Thus, a disease may have many common names and numerous other vernacular or local names in different languages. Common names of diseases often reflect local symptoms without identifying either the physiological factor or causal organism associated with that disease. Although the same common name may be informally applied to two or more different diseases, in scientific writing, each reported common name of a disease or disorder must be clearly associated with only one physiological factor or causal organism for the concept of disease to be universally understood.

Plant diseases are generally categorized as either abiotic (non-infectious, associated with a physiological factor) or biotic (infectious, associated with a causal organism). Abiotic diseases are caused by conditions external to the plant, not living agents. Examples of abiotic diseases include environmental stress, nutritional deficiencies, salt injury, and sun scorch. Biotic diseases are caused by living organisms such as bacteria, fungi, fungal-like organisms, nematodes, parasitic plants, phytoplasmas, viruses, and viroids. Since local symptoms vary by geography, proper nomenclature of diseases relies on utilizing databases of approved disease names, which also provide associated causal organisms or physiological factors for both abiotic and biotic diseases. See Table 16-2 for a list of online resources.

For reporting on biotic or infectious diseases, identification of the disease by both common name and by scientific name of the causal organism is required. The common name of a disease is reported without italics; however, reporting of the causal organism follows the rules of nomenclature for organisms and is reported in italics. The reporting of authorities is optional.

The person who first published the scientific name of a disease causal organism is its author (authority). Reporting authorities for genera, species, and subtaxa (e.g., *forma specialis*, pathovar) of causal organisms is optional. If authors choose to include authority information, it

must be supplied consistently the first time in the Abstract and IMRAD block that any genus [when reported without a specific epithet (e.g., *Phytophthora* de Bary)], species (e.g., *Botrytis cinerea* Pers. ex Fr.), or subtaxon (e.g., *Fusarium oxysporum* Schlecht. f. sp. *phaseoli* Kendrick & Snyder) is mentioned in any context. The currently recognized authority should not be separated from the genus, species, or subtaxon name by parentheses. Authorities listed in parentheses are understood to be the original author in cases when the name of the organism was changed from that given by the original author [e.g., *Pseudomonas syringae* van Hall pv. *tomato* (Okabe) Young et al.].

Title. Diseases should be identified in the manuscript Title using the common name only. Common names of diseases are not italicized, even when they include the names of genera (e.g., Colletotrichum leaf spot). When common names of diseases include proper nouns like the names of people or places, capitalize the proper noun only (e.g., Pierce's disease). In studies where the subject organism(s) are causal organisms of diseases and/or groups of causal organisms, identify the subject organism(s) in the Title by scientific name without the authority (e.g., *Botrytis cinerea*, *Fusarium oxysporum* f. sp. *phaseoli*, *Phytophthora*).

Keywords. Include the scientific name of the causal organism or group of causal organisms (without authority information) in the Keywords (e.g., *Erwinia amylovora*, *Pseudomonas syringae* pv. *tomato*, *Rhizoctonia*) unless it appears in the Title

Manuscript. All biotic diseases should be identified on first use in all independent manuscript components (i.e., Abstract section, IMRAD block, each table, each figure) with the common name of the disease and the scientific name of the causal organism [e.g., crown gall (*Agrobacterium tumefaciens*)] or group of causal organisms [e.g., Verticillium wilt (*Verticillium* sp.)]. Thereafter within each manuscript section, use the common name when referring to the disease (e.g., crown gall, Verticillium wilt) or the abbreviated binomial (e.g., *A. tumefaciens*) or scientific name (e.g., *Verticillium* sp.) when referring to the causal organism(s).

Table 16-2. Online resources for nomenclature databases relevant to diseases in horticultural research.

Index	Description	Resource
Bacteria	Lists of prokaryotic names and nomenclature of all bacteria and archaea.	https://www.dsmz.de/services/online-tools/prokaryotic-nomenclature-up-to-date . [accessed 13 Jun 2022].

Index	Description	Resource
Plant bacteria	List of common names of plant bacteria diseases along with associated pathogens or causes.	https://www.apsnet.org/edcenter/resources/commonnames/Pages/default.aspx . [accessed 13 Jun 2022].
Plant diseases	Database of common names of plant diseases.	https://www.apsnet.org/edcenter/resources/commonnames/Pages/default.aspx . [accessed 5 Jan 2022].
Plant fungi	US National Fungus Collections fungal database.	https://nt.ars-grin.gov/fungaldatabases/ . [accessed 13 Jun 2022].
Plant fungi	List of common names of plant fungal diseases along with associated pathogens or causes.	https://www.apsnet.org/edcenter/resources/commonnames/Pages/default.aspx . [accessed 13 Jun 2022].
Plant viruses	International Committee on Taxonomy of Viruses (ICTV).	https://talk.ictvonline.org . [accessed 13 Jun 2022].
Plant viruses	List of common names of plant viral diseases along with associated pathogens or causes.	https://www.apsnet.org/edcenter/resources/commonnames/Pages/default.aspx . [accessed 13 Jun 2022].
Plants	International Plant Names Index for scientific names of vascular plants.	https://www.ipni.org . [accessed 13 Jun 2022].
Plants	USDA National Plant Germplasm System.	https://www.ars-grin.gov . [accessed 13 Jun 2022].
Plants	USDA PLANTS database, plant list of accepted nomenclature, taxonomy, and symbols.	https://plants.usda.gov/home . [accessed 13 Jun 2022].
Soil	USDA Official Soil Series Descriptions.	https://soilseries.sc.egov.usda.gov/osdname.aspx [accessed 13 Jun 2022].

16.3 Genes

Gene nomenclature is the scientific naming of genes, the units of heredity in living organisms. Genes are DNA segments that contribute to phenotype, function, or process. Each gene is assigned a descriptive name and a unique symbol.

The following general guidelines are based on published rules for reporting genes and chromosomes. Most are adaptations of the rules proposed by the International Committee on Genetic Symbols and Nomenclature (ICGSM) and the Commission on Plant Gene

Nomenclature (CPGN), an organization of the International Society for Plant Molecular Biology (ISPMB). The identification of individual gene families and the criteria for distinguishing related families are the responsibility of working groups.

Genes are named according to established conventions, which vary by crop. Many of these are summarized in *Scientific Style and Format* [Council of Science Editors 2014 (p 298-312)]; see also entries for gene and genotype in the *New Oxford Dictionary for Scientific Writers and Editors* (Martin 2009).

Gene, alleles. Use gene symbol with superscript plus sign, or a plus sign with the gene symbol as a superscript for standard, wild-type alleles. Identify multiple alleles by the symbol, followed by a letter or letters as superscript(s) (e.g., Redspotted, *Rs*; Red-tinged, *Rt*).

Gene, description. Describe a gene in the text according to its phenotype, sufficiently to describe its effect(s), but as briefly as possible.

Gene, linkage. Linkage information should include the names and symbols of the linked genes, the linkage detection chi-square (χ^2) value and probability, the recombination value and standard error, the phase (coupling or repulsion), the heterogeneity χ^2 value (if more than one population was studied), and the type of population(s) studied (F_2 or backcross).

For additional assistance, see *Scientific Style and Format* (Council of Science Editors 2014) for specialized terms and usages in cell biology and molecular biology or the *New Oxford Dictionary for Scientific Writers and Editors* (Martin 2009).

Gene, name. Identify genes by name. Accepted names of genes are set in italics and may be modified with letters or numbers (with or without superscripts, with or without italics). The name should be short (one to three words) and describe the mutant form, if identifiable as such. Otherwise, it should identify the non-primitive form unless it has been identified previously by long usage of the primitive form. If one or more mimics exist and the same basic name is used, identify the gene further with a number following a hyphen (e.g., chlorophyll deficient-2). Write the names of genes in italics in Latin or English (e.g., male sterile). Capitalize the first word only if the mutant form is dominant (e.g., Early flowering).

Gene, symbol. Gene symbols contain only Latin letters, Arabic numerals, and punctuation is avoided, except for hyphens. When possible, related genes are named using a common root symbol to enable grouping, typically based on shared function. Start the gene symbol with the first letter of the gene name, capitalized if dominant, followed by one or two letters to distinguish it from other symbols (e.g., Red, *R*; green flesh, *gf*; and green petal, *gp*). The gene name and gene symbol begin with a capital letter for dominant traits; the gene name and gene

symbol begin with a lowercase letter for recessive traits. In the title of an article and in the tables, use only the gene symbols that have been approved by the appropriate committee (e.g., Tomato Genetics Cooperative). Avoid beginning manuscript titles or sentences with gene symbols or names that begin with a lowercase letter.

Gene, synonyms. In the Abstract and IMRAD block, enclose well-known synonyms for those same genes in parentheses after the approved symbol or name; to avoid ambiguity, separate two synonyms with “and”, and three or more with commas, not slashes. Use the approved name throughout the rest of the Abstract and IMRAD block. When referencing genes and alleles from different organisms, use the appropriate symbols for each organism, including case and type style. In the Introduction, enclose well-known synonyms for those same genes in parentheses after the approved symbol or name; to avoid ambiguity, separate two synonyms with “and”, and three or more with commas, not slashes. Use the approved name throughout the rest of the text.

16.4 Organisms

An organism is any living structure such as an animal, bacterium, fungus, insect, plant, etc. capable of growth and reproduction.

Common names of organisms are the names that are used locally but may vary by region or country. Thus, an organism may have many common names and numerous other vernacular or local names in different languages. Although the same common name may be informally applied to two or more organisms, in scientific writing, each reported common name of an organism must be clearly associated with only one organism if the concept of an organism is to be universally understood.

In order to have a standard system of naming organisms, international codes of nomenclature have been adopted. There are four such codes, namely: 1) International Code of Nomenclature for Cultivated Plants (International Society for Horticultural Science 2016), 2) International Code of Nomenclature for Algae, Fungi, and Plants (Turland et al. 2018), 3) International Code of Nomenclature of Prokaryotes (Parker et al. 2019), and 4) International Code of Zoological Nomenclature (International Commission on Zoological Nomenclature 1999). A practical guide to these codes and to the standards for viruses is published by the Council of Science Editors [2014 (Chapters 21-24)]. See Table 16-4 for a list of online resources for nomenclature databases relevant to organisms in horticultural research.

Table 16-4. Online resources for nomenclature databases relevant to organisms in horticultural research.

Index	Description	Resource
Animal	Index of animals by common and scientific name in alphabetical order	http://www.animalinfo.org/spec_ind.htm . [accessed 13 Jun 2022].
Bacteria	Lists of prokaryotic names and nomenclature of all bacteria and archaea.	https://www.dsmz.de/services/online-tools/prokaryotic-nomenclature-up-to-date . [accessed 13 Jun 2022].
Insects	Database of common names of insects by common name, scientific name, author, order, family, genus, and species.	https://www.entsoc.org/publications/common-names . [accessed 13 Jun 2022].
Insects	Entomological taxa and field guide.	https://texasinsects.tamu.edu/ . [accessed 13 Jun 2022].
Plant bacteria	List of common names of plant bacteria diseases along with associated pathogens or causes.	https://www.apsnet.org/edcenter/resources/commonnames/Pages/default.aspx . [accessed 13 Jun 2022].
Plant diseases	Database of common names of plant diseases.	https://www.apsnet.org/edcenter/resources/commonnames/Pages/default.aspx . [accessed 5 Jan 2022].
Plant fungi	US National Fungus Collections fungal database.	https://nt.ars-grin.gov/fungal-databases/ . [accessed 13 Jun 2022].
Plant fungi	List of common names of plant fungal diseases along with associated pathogens or causes.	https://www.apsnet.org/edcenter/resources/commonnames/Pages/default.aspx . [accessed 13 Jun 2022].
Plants	International Plant Names Index for scientific names of vascular plants.	https://www.ipni.org . [accessed 13 Jun 2022].
Plants	Nomenclature for accessions of the National Plant Germplasm system.	https://www.gbif.org/dataset/66dd0960-2d7d-46ee-a491-87b9adcfe7b1 . [accessed 13 Jun 2022].
Plants	USDA National Plant Germplasm System.	https://www.ars-grin.gov . [accessed 13 Jun 2022].
Plants	USDA plant taxonomy, GRIN database of crop registrations & PVPs.	https://npgsweb.ars-grin.gov/gringlobal/taxon/taxonomysimple.aspx . [accessed 13 Jun 2022].
Plants	USDA PLANTS database, plant list of accepted nomenclature, taxonomy, and symbols.	https://plants.usda.gov/home . [accessed 13 Jun 2022].
Weeds	Composite list of weeds.	https://wssa.net/wssa/weed/composite-list-of-weeds/ . [accessed 13 Jun 2022].

Index	Description	Resource
Weeds	Database of weed images.	https://wssa.net/wssa/weed/weed-identification/ . [accessed 13 Jun 2022].

Single organisms. All organisms should be identified on first mention with the complete common name and binomial scientific name in parentheses unless no useful common name exists—then use only the scientific name.

Upon second and subsequent mentions within each autonomous manuscript entity (Abstract, IMRAD block, each table, and each figure), use a shortened version of the name of the organism such as common name only (e.g., tomato or two-spotted spider mite) or a shortened version of the scientific name only (e.g., *S. lycopersicum* or *T. urticae*). In HortTechnology, the common name should always be used to refer to an organism on subsequent mention after it has been reported with its scientific name on first use in each autonomous manuscript entity.

Example: 1st mention (all journals): tomato (*Solanum lycopersicum*)
 2nd and subsequent (HortScience and JASHS): tomato or *S. lycopersicum*
 2nd and subsequent (HortTechnology): tomato

Example: 1st mention (All journals): two-spotted spider mite (*Tetranychus urticae*)
 2nd and subsequent (HortScience and JASHS): two-spotted spider mite or *T. urticae*
 2nd and subsequent (HortTechnology): two-spotted spider mite

Groups of organisms. All groups of organisms should be identified on first mention with the complete common name of the organism group with the binomial scientific name following in parentheses unless no useful common name exists—then use only the scientific name. The scientific name for groups of organisms follows the format of “*Genus* sp.” with the genus name italicized followed by the letters “sp.” to indicate a group of species. In HortTechnology, the common name should always be used to refer to a group of organisms after it has been reported with its scientific name on first use in each autonomous manuscript entity.

Upon second and subsequent mentions within each autonomous manuscript entity (Abstract, IMRAD block, each table, and each figure), use a shortened version of the name of the group such as common name only (e.g., blueberry or crucifers) or a shortened version of the scientific name only (e.g., *Vaccinium* sp. or Brassicaceae). In HortTechnology, the common name should always be used to refer to an organism group on subsequent mention after it has been reported with its scientific name on first use in each autonomous manuscript entity.

Example: 1st mention (all journals): blueberry (*Vaccinium* sp.)
 2nd and subsequent (HortScience and JASHS): blueberry or *Vaccinium* sp.
 2nd and subsequent (HortTechnology): blueberry only

Example: 1st mention (all journals): crucifers (Brassicaceae)
 2nd and subsequent (HortScience and JASHS): crucifers or Brassicaceae
 2nd and subsequent (HortTechnology): crucifers

Common name. If the common name of the subject organism or group of subject organisms is widely known, the common name of the organism or group should appear in the Title. If the common name of the subject organism or group is not widely known, then the scientific name of the organism (e.g., genus and species without authority) or group (e.g., genus without authority) may be used in the Title of HortScience and JASHS papers and one or more common names reported as Keywords. HortTechnology requires the use of common names in the Title of manuscripts except when there is no useful common name (e.g., bacteria, fungi). Include the scientific name (without authority) of the subject organism or group in the Keywords, unless it appears in the Title. For two or more different organisms within the same genus, spell out the genus name for each species in the Keywords.

Scientific name. Include the scientific name of the organism(s) (e.g., genus and species without authority) or group(s) (e.g., genus without authority) in the Keywords. For two or more organisms within the same genus, spell out the genus name for each of the different species in the Keywords. All organisms should be identified on first use in all autonomous manuscript entities (i.e., Abstract, IMRAD block, each table, each figure) with the complete common name and/or binomial scientific name [e.g., tomato (*Solanum lycopersicum*), two-spotted spider mite (*Tetranychus urticae*)]. Upon second and subsequent uses within each manuscript section, use a shortened version such as complete common name only (e.g., tomato, two-spotted spider mite) or abbreviated binomial only (e.g., *S. lycopersicum*, *T. urticae*). In HortTechnology, the complete common name (e.g., tomato, two-spotted spider mite) should always be used to refer to an organism in each independent manuscript section after it has been reported with its binomial scientific name on first use.

Scientific name, authority. The authority is the person who first published the scientific name of an organism is its author. Reporting authorities for genera, species, and subtaxa (e.g., botanical variety, subspecies) is optional. If authors choose to include authority information, it must be supplied consistently the first time in the Abstract and IMRAD block any genus [when

reported without a specific epithet (e.g., *Petunia* Juss.)), species (e.g., *Prunus mume* Siebold & Zucc.), or subtaxon (e.g., *Brassica oleracea* L. var. *italica* Plenck) is mentioned in any context. The currently recognized authority should not be separated from the specific epithet or generic name by parentheses. Authorities listed in parentheses are understood to be the original author in cases when the name of the organism was changed from that given by the original author [e.g., *Arabidopsis thaliana* (L.) Heynh.].

Scientific name, binomial. The scientific name of an organism is a two-part genus-species binomial (e.g., *Ralstonia solanacearum*). The first part of the name – the generic epithet identifies the genus to which the species belongs, while the second part – the specific name or specific epithet – identifies the species within the genus.

Scientific name, trinomial. For botanical varieties, subspecies, and other subtaxa, the trinomial consisting of genus, species, and subtaxon is used (e.g., *Camellia sinensis* var. *assamica*, *Crocus biflorus* ssp. *stridii*, *Fusarium oxysporum* f. sp. *lycopersici*). Capitalize only the first letter of the genus name, leaving all other letters of the scientific name in lower case. Leave a space between the genus name and the specific epithet. Use italics for the name of the genus name and specific epithet. Names of subtaxa are treated in the same way as the binomial (i.e., italicized); however, abbreviations for words like botanical variety (var.), forma (f.), forma specialis (f. sp.), pathovar (pv.), subspecies (ssp.), etc. are not italicized. The same is true for the names of clones, cultivars, strains, varieties, and ecotypes of cultivated plants.

Plants

Plant nomenclature generally follows the same rules applied to all other organisms. However, additional examples of nomenclature guidelines for horticultural plants are provided below as a resource.

Clones and rootstocks. Use the full alphanumeric designations for a clone or rootstock (e.g., 'Malling 22' or 'Malling-Merton 112') in all independent manuscript elements (i.e., Abstract, IMRAD block, each table, each figure) with the diminutive following in parentheses [e.g., ('M.22') or ('MM.112')]. Subsequent references within each manuscript element may use the diminutive alone. When several stocks of the same series appear in sequence, give the diminutive for each (e.g., 'M.2', 'M.9', or 'M.27').

Clonal rootstocks. Clonal rootstocks are cultivars, and their full alphanumeric designations and diminutives should be set off by single quotations marks.

Grafts. When graft combinations are listed, separate the components by slashes with the scion listed first, interstock (if present) next, and rootstock last, with single quotation marks around each where appropriate (e.g., ‘Fairchild’/‘Cleopatra’).

Seedling rootstocks. Seedling rootstocks usually are not cultivars and should not be set off by single quotation marks. Seedling rootstocks become clones when increased in number asexually, which usually follows a naming process, which then produces a cultivar.

Common names. Common names of plants are not capitalized except when the name includes proper nouns such as names of people or places, etc. (e.g., Brussels sprouts, Colorado potato beetle, Douglas-fir, Easter lily, Japanese maple, St. Augustinegrass). Names of genera used as common names are neither italicized nor capitalized (e.g., camellia, rhododendron). When using the common name to refer to a single plant species (i.e., as opposed to a group of species or the commodity harvested from a species), use the singular form (e.g., apple) as in “this trait is common in apple.”

HortScience and JASHS

In HortScience and JASHS, report either the common name or scientific name (i.e., not both) after first use in all independent manuscript elements (i.e., Abstract, IMRAD block, each table, each figure). The use of common names for well-known species and groups of species is encouraged in HortScience and JASHS to improve readability. However, each common name must be qualified on first use in each manuscript element by including the corresponding scientific name immediately adjacent to the common name of the organism [e.g., southern root-knot nematode (*Meloidogyne incognita*), tomato (*Solanum lycopersicum*)] or common names of the group [blueberry (*Vaccinium* sp.), crucifers (Brassicaceae)]. This requirement applies to all organisms and groups of organisms mentioned by common name anywhere in the paper and is not limited to the subject organism(s) of the manuscript. For little-known species or for species with ambiguous common names, the use of scientific names only may be an appropriate option in HortScience and JASHS.

In HortScience and JASHS, report either the common name or scientific name (i.e., not both) after first use in all independent manuscript elements (i.e., Abstract, IMRAD block, each table, each figure).

HortTechnology

In HortTechnology, common names should be used as the primary form for identifying organisms and groups of organisms whenever possible. At first use in each independent manuscript element, report the common name immediately followed by the scientific name in parentheses [e.g., Colorado potato beetle (*Leptinotarsa decemlineata*)]. Use the common name exclusively thereafter within each manuscript element. Scientific names may be used without common names in HortTechnology only when an organism or group has no useful common name (e.g., bacteria, fungi).

Cultivar. A cultivar is an assemblage of plants that has been selected for a particular attribute or combination of attributes and that is clearly distinct, uniform, and stable in these characteristics and that when propagated by appropriate means retains these characteristics. The term "cultivar" encompasses clones derived vegetatively from a single parent; lines of selfed or inbred individuals; and collections of individuals that are resynthesized only by cross breeding—for example, F₁ hybrids. [Council of Science Editors 2014 (p. 389)]. The terms "cultivar" and "variety" are synonymous as applied to the names of cultivated plants, but cultivar is strongly preferred to avoid confusing cultivated variety (a term of convenience) with botanical variety, a subtaxon of species (e.g., *Abies lasiocarpa* var. *arizonica*). In HortTechnology, variety/varieties may be used as a synonym for the term cultivar/cultivars, but authors should choose one term, and not use both words within the same manuscript.

Names of cultivars must be clearly identified as such whenever they are used in the manuscript in one of the following ways:

- By single quotation marks that offset the cultivar name (e.g., 'NuMex' pepper, *Capsicum chinense* 'NuMex').
- By use of the word cultivar or the abbreviation "cv." that precedes the cultivar name (e.g., cucumber cultivar Green Ice, *Cucumis sativus* cv. Green Ice).

Do not use the word "cultivar" (or the abbreviation "cv.") and single quotation marks at the same time. Regardless of the origin of the name of a cultivar, capitalize its initial letter (with rare exceptions, depending on requirements of a modern language). In the body of tables and within figures, do not use single quotation marks except where their absence leads to ambiguity (e.g., when reporting data for both experimental germplasm and cultivars).

Interspecific crosses. The name of an interspecific hybrid consists of the generic name followed by a single Latin epithet ("collective" epithet), the latter immediately preceded by the math × (multiplication sign) (e.g., *Canna* × *generalis*, *Fragaria* × *ananassa*, *Pelargonium* × *hortorum*). Note that

the × is not italicized, and is flush against the species name, with no space between. This format is prescribed by the International Code of Nomenclature for Algae, Fungi, and Plants (Turland et al. 2018).

Registered cultivars. The Journal of Plant Registrations publishes articles on registered cultivars, germplasm, genetic stocks, mapping populations, and parental lines. Additional information on these registrations is also available from the US Department of Agriculture (USDA), Agricultural Research Service (ARS), Germplasm Resources Information Network (GRIN) database (USDA-ARS 2022), at the International Plant Names Index (2021), and at the USDA, Natural Resources Conservation Service (NRCS) PLANTS database (USDA-NRCS 2022a).

Strains. A strain is a genetic variant within a biological species. In plants, a strain is a designated group of offspring that are descended from a modified plant produced by conventional breeding, biotechnology, or a genetic mutation. Identify the strain (e.g., accession number, cell line, cultivar) of all subject organisms, where appropriate, and the source of any organisms (e.g., commercial nursery, research institution, seed company, university).

Trade names and trademarks. Cultivars that also have trade names or trademarks should include the trade designation only as secondary information for purposes of clarification [e.g., ‘Gerwat’ (Rozanne®) geranium, ‘Monlers’ (Golden Nugget™) Japanese barberry]. The cultivar name (i.e., not the trade name or trademark name) should be the primary form of identification for all cultivars. In most papers, the trade designation should be reported only once in the manuscript, usually on first reporting of the cultivar name in the IMRAD block.

Variety. See cultivar above. The terms "cultivar" and "variety" are synonymous as applied to the names of cultivated plants, but cultivar is strongly preferred to avoid confusing cultivated variety (a term of convenience) with botanical variety, a subtaxon of species (e.g., *Abies lasiocarpa* var. *arizonica*).

In HortTechnology, the terms “variety/varieties” may be used as a synonym for the term “cultivar/cultivars”. However, in the interest of consistency, authors should choose one term to use throughout the document (use either cultivar or variety, but not both). The terms “variety/varieties” are not used in either HortScience for JASHS.

Resources

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Chapter 17. Numbers & Statistics

Decimals

Place a zero before a decimal fraction (e.g., 0.52). Report most decimals to three decimal places. Report probability values to three decimal places (e.g., $P = 0.167$). Report statistics to two decimal places (e.g., χ^2 statistics, correlation coefficients, percentages, F statistics, R^2 , t statistics).

Round off all decimals that appear in the manuscript text including Abstract, IMRAD block (Introduction, Materials and Methods, Results and Discussion), Tables, and Figures to no more than three decimal places (e.g., 0.132). However, do not round off any numbers prior to their use in mathematical calculations (e.g., unit conversion factors), as this may lead to significant rounding errors; round off the result after all mathematical operations are completed.

One decimal place	Two decimal places	Three decimal places
<ul style="list-style-type: none"> Means Standard deviations Descriptive statistics 	<ul style="list-style-type: none"> Correlation coefficients Proportions Inferential test statistics such as chi-squares, F values, and t values. 	<ul style="list-style-type: none"> For P values greater than 0.001, report exact P values. For P values less than 0.001, report as $P < 0.001$.

Equations

Mathematical equations are punctuated as a single-sentence paragraph unless a short equation is embedded in the text. Leave a blank line space above and below each equation; center align equations in the text.

Leave a single space before and after arithmetic symbols. If an equation needs to be divided over two lines in the text, table titles, or figure captions, split it after the arithmetic symbol. Do not number all displayed equations unless the equation is complex or is referred to elsewhere in the text. If numbering is necessary, use Arabic numerals placed in brackets (not parentheses) to the far right of the equation or at the right margin (e.g., [1]). Refer to an equation in the text by the equation number (e.g., Eq. [3] or Eqs. [4-6]).

Use Arabic numerals for all mathematics where symbols are used (e.g., 3×4), arithmetic functions are discussed (e.g., divide by 6), or where exponents are used (e.g., 10^8). A space should separate symbols and operators from numerals and be present on either side of all operators (e.g., +, -, =, \times , \leq , $>$).

Fractions

Numbers may be written as decimals (e.g., 0.5) or as fractions (e.g., $1/2$, or $\frac{1}{2}$). All fractions may be written as numerals with a slash between numerator and denominator (e.g., $7/8$); however, some common fractions may be written as symbols or glyphs (e.g., $\frac{7}{8}$). Glyphs may be used, but consistency is the rule; do not mix two fraction formats in a single paragraph. If a fraction follows a whole number, leave one space between the whole number and the fraction (e.g., $12 \frac{1}{2}$ or $12 \frac{1}{2}$).

Spell out and hyphenate fractions when they stand alone as a modifier (e.g., “one-third of the plants,” “two-fifths of the area”). Use care in transposing common units such as one-half, e.g., if $1 \frac{1}{2}$ L of soil were used, do not write “1.5 L” unless the measurement of soil was accurate to 0.1 unit of measurement. Conversely, if a measurement was accurate to a specific decimal place, use decimals rather than fractions.

Mathematical Operators

Separate mathematical operators [e.g., add (+), subtract (-), multiply (\times), and all symbols of equality (e.g., \leq , $>$, =)] with a space between the operator and a numeral.

Do not separate mathematical operators which include a centered multiplication dot or dot operator (\cdot), parentheses to denote multiplication, an exponent designating power (e.g., X^2), a slash to designate division ($/$), or a factorial symbol (!).

Use Arabic numerals for all mathematics where symbols are used (e.g., 3×4), arithmetic function is discussed (e.g., “divide by 6”), and exponents are used (e.g., 10^8). A space should separate symbols and operators from numerals, and be present on either side of all operators, e.g., +, -, =, \times , \leq , $>$.

Numbers

Single-digit ordinals (numbers 1 to 9) used as adjectives use the ordinal form of the number.

Two-digit ordinals (10-99) used as adjectives use the numeric form of the number.

Example: "the first tree," "the third plant," "the fifth row" (ordinal form)

Example: "the 10th tree," "the 15th plant," "the 25th year" (numeric form)

If both single-digit ordinals (1 to 9) and two-digit ordinals (10-99), appear together as in a series, all ordinals are written in the numeric form for consistency.

Correct: "the 3rd, 5th, and 10th plants were tested"

Incorrect: "the third, fifth, and 10th plants were tested"

When enumerating parts of an argument, do not attach "ly" to ordinal numbers (e.g., firstly, secondly, thirdly); these spellings are considered poor grammar. Begin progressive clauses with the ordinal form of the numbers (e.g., first, second, third). See 17.13 Whole Numbers to find guidelines for reporting cardinal whole numbers.

Use numerals	Use words
<ul style="list-style-type: none"> • For decimals, ratios, and uncommon fractions. • For exact amounts of money • For exact numbers before units of measurement • For mathematical equations • For numbers 10 and greater • For numbers used with time • For percentages and percentiles Include the % symbol with no space between the number and the symbol. • For points and scores on scales 	<ul style="list-style-type: none"> • For numbers at beginning of sentence • For numbers under 10 • For stating approximate figures (e.g., the sample weighed approximately seven kilograms). • For stating "the percentage" without a number.

Percent

The percent sign (%) is used only with numerals; otherwise, the term "percent" is written out, as one word. Use the percent sign in a series of percentages (e.g., "1%, 5%, 10%, and 20% levels," "44% or 41% of the variation"). Repeat the percent sign when giving a range (e.g., 30% to 50%). Do not average data expressed in percentages.

Correct “the percent concentration used was the same for both trials”

Correct “a 5% concentration was used”

Incorrect “the % concentration used was the same for both trials”

Incorrect “the % concn used was the same for both trials”

Range of Numbers

When reporting ranges, “from 10 to 15” is preferred, but “range 10–15 (with en dash) is acceptable.

Ratios

Do not use slant lines to express ratios (e.g., $3/2$ should be expressed as 3:2 with no spaces before or after the colon).

Rounding Off

Use the following procedure for rounding a number in which three significant digits are to be retained:

1. If the digit to the right of the third digit is less than 5, leave the third digit unchanged (e.g., 4.122 rounds to 4.12).
2. If the digit to the right of the third digit is more than 5, increase the third digit by 1 (e.g., 4.128 rounds to 4.13).
3. If the digit to right of the third digit is exactly 5, followed by zeros, and the third digit is even, leave the third digit unchanged (e.g., 4.125 or 4.1250 rounds to 4.12).
4. If the digit to the right of the third digit is 5 and there is at least one digit other than 0 to the right of the 5, increase the third digit by 1 (e.g., 4.1253 rounds to 4.13).
5. When rounding an inconveniently large number, follow a similar procedure (e.g., the number 2,845,492 can be expressed as 2.85 million).

SI Prefixes

10^6 mega	M
10^3 kilo	k
10^2 hecto	h
10^{-1} deci	d
10^{-2} centi	c

10^{-3} milli	m
10^{-6} micro	μ
10^{-9} nano	n
10^{-12} pico	p

Significant Figures

In reporting a number, the number of significant digits (those known to be reasonably reliable) must be commensurate with the precision of the experimental method. More than three significant digits rarely are justified in horticultural measurements. If a quantity must be converted to SI units, multiply the quantity by the exact conversion factor and then round to the appropriate number of significant digits.

A recorded value of 37 mL represents two significant digits (3 and 7). If this same volume were written as 0.037 L, it would still contain only two significant digits. Zeros appearing as the first digits of a number are not significant since they merely locate the decimal point; thus, the two zeros in the value 0.037 are not significant. The values 0.0370 L and 0.370 L, however, represent three significant digits (3, 7, and the last zero); the value 1.037 L represents four significant digits (1, 0, 3, and 7); the value 1.0370 L represents five significant digits (1, 0, 3, 7, and the last zero); and the value 37.00 L represents four significant digits (3, 7, and the two zeros).

Use only the number of significant digits that is justified by the precision of the least precise measurement and that is meaningful in the context of use (e.g., “leaf length was 137.6 mm” may be justified, but it is not meaningful; use 138 mm).

Avoid exaggerated precision in statistical reporting. When reporting means, more than three significant digits rarely are justified. Also avoid exaggerated probability statements; data analysis software can be programmed to provide probability statements with many significant digits (e.g., $P = 0.00374$), but these may be based on assumptions that are never met exactly in actual practice.

Whole Numbers

Whole numbers less than 10 are spelled out, unless reported with *units of measurement* (e.g., report two trees, but 2 weeks). Numbers greater than nine are not spelled out. In the text, report numbers with four digits to the left of the decimal point without a comma between the thousand and hundred places (e.g., report “2060” not “2,060”). In tables, however, where there are numbers consisting of four or more digits to the left of the decimal, place commas between

each group of three digits (e.g., 1,264; 10,087; 1,364,000). Align the numbers in the tables on the commas. Simplify numbers for readability and ease of comparison to other numbers. Here are a few examples: 1) for numbers that have multiple zeros, substitute a word placeholder for the zeroes [e.g., report 22.3 million not 23,300,000]; 2) change the basic unit of measurement (e.g., report 2.5 kg, not 25,000 g); or 3) use exponents (e.g., report 7.8×10^9 , not 7,800,000,000) in cases where there is no loss of information in the simpler version.

As a rule, use Arabic numerals for whole numbers except in the following cases:

- **Adjacent numbers.** Spell out numbers when two numbers are adjacent to each other (e.g., write “thirty 10-L pots” instead of “30 10-L pots”).
- **Below 10.** Spell out numbers when the number is below 10 unless it immediately precedes a unit of measurement (e.g., “two plants” but “2 m,” “three trees” but “3 ha”).
- **First word.** Spell out numbers when they begin a sentence. Alternately, reword the sentence to avoid starting with a number or series of numbers, or end the preceding sentence with a semicolon instead of a period.
- **Manuscript titles.** Use Arabic numerals, rather than words, to express whole numbers of more than a single digit (i.e., greater than nine) or to report decimal numbers. Use words rather than numerals to express single digit numbers (1 through 9); these should be spelled out as “one through nine” in the Title.
- **Parentheses.** Do not use full parentheses to list points numerically in a sentence or paragraph. Use right closing parentheses to list points [e.g., use 5) or d) not (5) or (d)].
- **Plurals.** Plurals of numbers, such as years, are formed without apostrophes (e.g., “1990s”).
- **Proper name.** Spell out numbers when a number is part of a proper name, except for cultivar names that include numbers.
- **Series.** Spell out numbers in a series if all numbers are below 10 (e.g., “two, five, and nine cultivars”); however, if at least one number in the series is 10 or more, then use all numbers (e.g., “6 and 12 leaves”) for consistency. Numbers in a series are separated by commas, with a comma preceding the last conjunction (e.g., “57, 14, 115, and 56”).

Resources

Council of Science Editors. 2014. *Scientific style and format: The CSE manual for authors, editors, and publishers* (8th ed). University of Chicago Press, Chicago, IL, USA.

Hatcher L. 2018. *APA style for papers, presentations, and statistical results: The complete guide*. Shadow Finch Media, Saginaw, MI, USA.

Chapter 18. Units of Measurement

18.1 Types of Units

SI Units

The most widely used standard units of measurement in science are International System of Units (SI) units, which are based on the metric system. SI units are founded on seven SI base units (i.e., ampere, candela, kelvin, kilogram, meter, mole, second). Numerous other units, called derived units, are defined in terms of these seven base units via equations; in addition, there are 20 SI prefixes used to form decimals and multiples of SI units. Certain other units are outside SI but are widely accepted for use with SI (e.g., day, hour, liter, hectare, tonne, minute). Additional information on SI units is available from Bureau International des Poids et Mesures (2019). Additionally, an online resource for SI and non-SI unit conversions is available (National Institute of Standards and Technology 2019a).

United States customary units

United States customary units (US units) are a non-SI standard of measurement (e.g., acre, fluid ounce, foot, gallon, inch, mile, ounce, pound, ton, yard). Agricultural scientists often design field studies or collect data in US units, rather than SI units, to be consistent with standard production practices in the United States. Measurements initially recorded in any system of measurement (SI or non-SI), are in *original units*. Conversion of such data to any another system, such as from US units to SI units, yields *converted units*.

Original units

Original units refer to a measurement expressed in the original system of measurement, without any mathematical conversion to another system of measurement. Converted units are the result of a mathematical conversion of original units to another system of measurement (e.g., US units to SI units).

18.2 Journal Requirements

HortScience

ASHS requires that only SI units be reported in HortScience. Reported SI units may be derived from either 1) original SI units or 2) non-SI units converted to SI units.

HortTechnology

In contrast, HortTechnology allows both SI units and non-SI units to be reported. However, units must be either 1) original SI units or 2) original non-SI units (i.e., not converted units). As a result, HortTechnology manuscripts often contain a mixture of both SI and non-SI units.

Because of the special requirements of applied agricultural sciences, the requirement for original units was reaffirmed by the HortTechnology Editorial Board in 2021. Reporting of original units is thought to eliminate conversion errors and thus improve accuracy, precision, and utility of recommendations made to practitioners. Prior to 2005, all data were reported in both US and SI unit systems in HortTechnology manuscripts; this format was discontinued. Instead, a conversion table for all reported units of measurement is prepared by ASHS and added to each HortTechnology manuscript at publication.

HortTechnology authors should report only original units of measurement in the IMRAD block (Introduction, Materials and Methods, Results, and Discussion) unless unit equivalents are needed to compare data with those from other studies that used a different unit system (e.g., in the Introduction or Discussion). In such cases, report original units first immediately followed by unit equivalents in parentheses. Equivalents calculated from original units of measurement should include at least one additional decimal place [e.g., 6 cm (2.4 inches), 3.5 oz/yard² (118.67 g·m⁻²)].

Report original units in tables and figures, with unit conversion equations to either US units or SI units listed in table footnotes or figure captions (e.g., 1 L = 0.2642 gal, 1 lb/acre = 1.1209 kg·ha⁻¹). In some cases, it may be more efficient to report unit equivalents instead of conversion equations. Unit equivalents reported in tables and figures should follow the same conventions as used in the IMRAD block.

JASHS

ASHS requires that only SI units be reported in JASHS. Reported SI units may be derived from either 1) original SI units or 2) non-SI units converted to SI units.

18.3 Units of Measurement

Air Flow

Wind speed is reported in meters per second ($\text{m}\cdot\text{s}^{-1}$), millimeters per second ($\text{mm}\cdot\text{s}^{-1}$), or micrometers per second ($\mu\text{m}\cdot\text{s}^{-1}$); kilometers per hour ($\text{km}\cdot\text{h}^{-1}$) is not preferred. HortTechnology manuscripts may use US units such as knot(s) or miles per hour (mph) if they represent original units of measurement.

When reporting air flow in field studies, state the measurement distance above the surface because wind speed varies with this value. In controlled environments, reference to the volume of air movement per unit time or the volume rate of air movement is more meaningful. The unit of this quantity is cubic meters per second ($\text{m}^3\cdot\text{s}^{-1}$).

Application Rate

Dry Material. In HortScience and JASHS application rates of dry materials (e.g., fertilizer, pesticide, seed) are reported in kilograms per square meter ($\text{kg}\cdot\text{m}^{-2}$) or in grams, milligrams, or micrograms per square meter in small experimental plots; for large-scale applications, report kilograms per hectare ($\text{kg}\cdot\text{ha}^{-1}$). HortTechnology manuscripts may also use US units of measurement such as ounces per square foot (oz/ft^2), pounds per acre (lb/acre), etc., as necessary, to meet the requirement of reporting in original units.

Liquid Material. For liquid applications to small and large plots, report liters per square meter ($\text{L}\cdot\text{m}^{-2}$) or liters per hectare ($\text{L}\cdot\text{ha}^{-1}$), respectively in HortScience and JASHS. When volume may be important, report liters per cubic meter ($\text{L}\cdot\text{m}^{-3}$). HortTechnology manuscripts may also use US units such as fluid ounces per square foot ($\text{fl oz}/\text{ft}^2$), gallons per acre (gal/acre), etc. if they are the original units used in the experiment.

Centrifugation

Use force of gravity (g_n), not revolutions per minute (rpm). Italicize only the “ g ”, not the subscript.

Example: The sample was centrifuged at 20,000 g_n .

Concentration

Molecular mass, known. When the molecular mass of a substance is known, report concentration as moles per kilogram ($\text{mol}\cdot\text{kg}^{-1}$), moles per cubic meter ($\text{mol}\cdot\text{m}^{-3}$), or moles per liter ($\text{mol}\cdot\text{L}^{-1}$).

Molecular mass, unknown. When molecular mass is unknown, report concentrations as milligrams per kilogram ($\text{mg}\cdot\text{kg}^{-1}$), milligrams per cubic meter ($\text{mg}\cdot\text{m}^{-3}$), or milligrams per liter ($\text{mg}\cdot\text{L}^{-1}$).

Molar and Normal. Use the capital letters M and N to indicate molar and normal concentration, respectively (e.g., 2 N NaSO_4). For dilute solutions, use μM (micromolar) rather than 10^{-6} M (e.g., 1.0 μM NaSO_4). Use the decimal system or multiplier of 10, for units of concentration (e.g., 0.1 M or 0.1 $\text{mol}\cdot\text{L}^{-1}$, not M/10).

Parts per million, billion, trillion. Expressing concentration in parts per million (ppm), parts per billion (ppb), or parts per trillion (ppt) is acceptable in HortScience and JASHS but not preferred because the terms are ambiguous. These terms may be used in HortTechnology where they represent original units of measurement.

Percentage. Avoid percentage expressions, but when using solution percentages, indicate volume/volume (v/v) or weight/volume (w/v).

Currency

If monetary units are necessary to report crop yield values, the value in US dollars should be reported first, with the local equivalent following in parentheses. Express values less than \$1 decimally (e.g., \$0.80).

Dates

Date. Use Arabic numerals for all calendar dates. When indicating a specific date, give day (one or two digits), month (three-letter abbreviation), and year (four-digit year), if necessary, in that order [e.g., 1 Sep (not 01 Sep), 2 Jul 2021, 30 Jun 2020]. Do not use Arabic numerals for months; “4/3/19” could indicate 3 Apr 2019 in the United States, but 4 Mar 2019 in other parts of the world.

Day. Spell out the names of days of the week (Sunday through Saturday) in all cases.

Month. Abbreviate all months with the first three letters of the month without a period (e.g., Jan, Feb, Mar) when they are used with a number (e.g., date and/or year) but spell out the name of the month when it is used alone or at the beginning of a sentence. When indicating a specific month, do not insert a comma between the month and the year (e.g., Oct 2020).

Season. When referring to a specific season given within the year, capitalize the first letter (e.g., Spring 2021) but use lowercase if the season is a generic term (e.g., “the plants were harvested in the summer”).

Years. When referring to a span of 12 months (such as a fiscal year) and it includes parts of 2 years or to a continuous period of more than 12 months that includes parts of 2 years or more, use the abbreviated notation (e.g., 1997-98, 2019-20). When referring to a group of continuous years, add the plural “s” without an apostrophe (e.g., 1990s, not 1990’s). When referring to a span of years that includes change-of-century years, use the full notation (e.g., 1998-2002).

Environment

Conditions in controlled-environment plant growth rooms and chambers, greenhouses, and tissue culture facilities should be reported in detail to allow for comparison of results and duplication of experiments.

Guidelines for measuring and reporting environmental parameters for plant experiments in controlled environments are prepared by the International Committee for Controlled Environment Guidelines (ICCEG). The ICCEG is sponsored by the Australian Controlled Environment Working Group (ACEWG), North American Committee on Controlled Environment Technology and Use (NCERA-101), and UK Controlled Environment Users’ Group (UK-CEUG). The following guidelines are available:

- Guidelines for Greenhouses (ICCEG 2016a)

- Guidelines for Growth Rooms and Chambers (ICCEG 2016b)
- Guidelines for Tissue Culture Facilities (ICCEG 2016c)

See Appendix Table 18-3 for a list of variables, units of measurement, and additional factor requirements for reporting environmental parameters in ASHS journals.

Exchange Capacity

Report exchange capacity and exchangeable ion composition in equivalents per gram (eq/g) or milliequivalents per gram (meq/g). If the cation exchange capacity is determined by a single ion saturation technique, the ion used should be specified because it can affect the cation exchange capacity measured.

Fertilizer

Abbreviation. In general, nitrogen–phosphorus–potassium fertilizer reference may be abbreviated N–P–K; use only en dashes, not hyphens (i.e., not N-P-K), to separate the nutrients.

Analysis. Fertilizer analyses should be reported in terms of elemental P and K, not P_2O_5 or K_2O ($P = 0.4365 \times P_2O_5$ and $K = 0.8301 \times K_2O$). For example, a fertilizer with the bag analysis 10–10–10 should be reported as 10N–4.4P–8.3K.

Description. When specific fertilizers are mentioned in the text, include a generic description of the product, followed by the name of the manufacturer and location [city, state/province/county (where applicable), country] of the manufacturer’s headquarters in parentheses.

Proportion. Where proportions are given, list the amounts up to one decimal point without spaces between the numerals and the element, with en dashes separating each [e.g., 10N–4.4P–8.3K, not 10–4.4–8.3 (N–P–K)]. When sulfur (or any other element) analysis is important (such as with a sulfur-coated urea), report S (or the other element), e.g., 44N–0P–0K–13S, with en dashes.

Source. Provide the formulation of the fertilizer (e.g., nitrate, sulfate) when reporting materials.

Frequency

Frequency may be reported as the hertz (Hz) or the reciprocal (s^{-1}), which are equivalent. Hertz is preferred for frequency of light or other electromagnetic radiation, whereas the reciprocal second is preferred for rotational frequency. The unit revolutions per second (rps) is preferred to revolutions per minute (rpm) because minute is not a base SI unit.

Gauge

Gauge numbers as an expression of thickness may be arbitrary; therefore, report the actual dimension (e.g., “the wire was 0.13 mm thick”) instead of gauge, whenever possible. See Thickness for reporting plastic film.

Heat

Express specific latent heat as joules per kilogram ($J \cdot kg^{-1}$). Express heat flux as joules per second ($J \cdot s^{-1}$) or watts (W). Heat flux density is the rate of energy of change per unit area ($J \cdot s^{-1} \cdot m^{-2}$); however, watts per square meter ($W \cdot m^{-2}$) is used more often in the US.

Latitude/Longitude

Where climatological information is a factor in the research being reported, it may be advisable to give longitude and latitude (e.g., lat. $52^{\circ}33'05''N$, long. $13^{\circ}21'10''E$). Note that there are no spaces between the figures.

Example: South China Agricultural University, Guangzhou, Guangdong, China (lat. $23^{\circ}9'28.80''N$, long. $113^{\circ}20'52.80''E$).

Example: New Mexico State University Leyendecker Plant Science Center at Las Cruces, NM, USA (lat. $32.196920^{\circ}N$, long. $106.743960^{\circ}W$, elevation 1173 m).

Length

The SI unit of length is the meter (m). The micron and millimicron have been replaced by the micrometer (μm) and nanometer (nm), respectively. In HortTechnology, inches (not abbreviated), feet (ft), or yards (not abbreviated) should be used if they represent original units of measurement.

Light Energy

Light is a form of energy which can be measured in 1) energy units (e.g., joule, calorie), 2) intensity (e.g., photon), 3) power (e.g., watts), 4) quantum units (e.g., quanta, einstein), or 5) subjective brightness as seen by human eye (candle, footcandle, lumen, lux).

Light energy as detected by the human eye is measured as illuminance in lumens per unit area with units of foot-candles (lumens per square foot) or lux (lumens per square meter). However, foot-candles and lux, both based on lumens, underestimate the blue (400-500 nm) and red (600-700 nm) light. Plants are highly efficient at utilizing blue and red wavelengths for photosynthesis; thus, light energy as utilized by plants is measured in photons not lumens. See Photosynthesis.

Magnification

The multiplication sign should precede the level in expressions of power of magnification with no space between the symbol and the power (e.g., $\times 400$).

Mass

Weight varies with the force of gravity, whereas mass is independent of gravity. However, many journals, including HortTechnology, prefer the use of weight. See Weight.

Mix Ratios

Do not use slash lines to express ratios (e.g., "3/2" should be expressed as "3:2" with no spaces before or after the colon).

Monetary

If monetary units are necessary to report crop yield values, the value in US dollars should be reported first, with the local equivalent following in parentheses. Express values less than \$1 decimally (e.g., \$0.80).

Numbers

Comma. Insert commas to separate numbers greater than or equal to 10,000 into thousands (e.g., 43,560).

Numerals. Use numerals for numbers preceding a unit of measurement and abbreviate the unit of measurement they appear as the first words in a sentence (e.g., “A dose of 6 mg of chemical was applied” but “Six milligrams of chemical were applied”). Use numerals for numbers 10 and above (e.g., 10, 36.7, 5280), unless they appear as the first word in a sentence (e.g., “We harvested 11 plants” but “Eleven plants were harvested”).

Placeholder. Use numeral 0 (zero) as a placeholder before a decimal point (e.g., 0.12).

Space. Report a space between the numerical value and the unit expression (e.g., 100 mg·L⁻¹).

Symbols. Use numerals and the symbols for units of measurement (e.g., “5 kg” is acceptable; “5 kilograms” and “five kg” are not).

Words. Use words for whole numbers one through nine (e.g., one, three, nine), except where they are immediately followed by units of measurement (e.g., 1 mg, 3 yards).

Words. Use words for whole numbers that begin a sentence (e.g., “Three plants were harvested”).

Photosynthesis

Light energy for plants is measured in photons as photosynthetically active radiation (PAR). Photosynthetic photon flux (PPF) is photon flux in the 400 to 700-nm waveband. Light falling onto a surface is measured as photosynthetic photon flux density (PPFD). For studies with other wavebands, the waveband should be specified.

photon (γ). A photon is a unit of energy which transmits light.

photosynthetically active radiation (PAR). Photosynthetically active radiation includes the wavelengths of light within the visible range of 400 to 700 nm that drive photosynthesis. The einstein (E) is a unit of measurement for PAR (i.e., equivalent to the energy in 1 mole of photons); however, it is not an SI unit. The equivalent SI unit of measurement for PAR is micromoles of photons per square meter per second ($\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$).

photosynthetic photon flux (PPF). Photosynthetic photon flux measures the total amount of PAR produced by a lighting system each second. The unit used to express PPF is micromoles of photons per second ($\mu\text{mol}\cdot\text{s}^{-1}$). PPF is an indication of the efficiency of a lighting system rather than measuring the amount of light that reaches the surface of a plant.

photosynthetic photon flux density (PPFD). Photosynthetic photon flux density measures photosynthetic flux density. PPFD measures the total amount of PAR that intersects with the plant surface. It is a more accurate measurement of the number of photosynthetically active photons that fall on a given surface per second. PPFD is measured in micromoles of photons per square meter per second ($\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$). Since PPFD is a measurement for a single location on a plant canopy, PPFD measurements may be averaged over a defined growing area to indicate average photosynthetic flux density in the growing area.

Pressure

The SI unit of pressure is the pascal (Pa) or newton per square ($\text{N}\cdot\text{m}^{-2}$). Do not use kilograms per meter ($\text{kg}\cdot\text{m}^{-1}$) for pressure readings. US units [e.g., atmospheres (not abbreviated), bars (not abbreviated), pounds per square inch (psi)] should be used in HortTechnology if they represent original units of measurement. Instruments that do not measure or test pressure should not be called “pressure testers”; they should be referred to as penetrometers or firmness testers.

Precipitation

Precipitation should be expressed in millimeters of water depth in HortScience and JASHS. Inches of water depth should be used in HortTechnology if they represent original units of measurement.

Relative Humidity

Relative humidity is the ratio of specific humidity to the saturation specific humidity, expressed as a percentage (e.g., 78%). If the term “specific humidity” is preferred, then the units of grams per kilogram ($\text{g}\cdot\text{kg}^{-1}$) may be used.

SI Units

The International System of Units (SI) is the system of measurement commonly used in scientific and technological research and development. The SI is made up of 7 base units that

define 22 derived units with special names and symbols. An online resource for SI and unit conversions is available (National Institute of Standards and Technology 2019a).

Sieve Size

Give pore dimension or the number of pores per unit area.

Temperature

The term “temperature” is meaningless unless an adjective accompanies the word. For example, we speak of leaf temperature, soil temperature, or air temperature. Each of these temperatures is defined carefully to not include the heating effects of the sun’s radiation (e.g., air temperature, leaf temperature). Report the type of sensor and location used for temperature readings. Temperatures may be “high or higher”, “low or lower”, but not “warm or warmer”, “cool or cooler.”

The preferred unit of temperature in HortScience and JASHS is degrees Celsius ($^{\circ}\text{C}$), not the SI unit for the kelvin (K, not $^{\circ}\text{K}$). Do not use the synonym “centigrade.” Use the symbol $^{\circ}\text{C}$, with a degree sign, each time a temperature is mentioned. When reporting temperature in a series or in a range, use $^{\circ}\text{C}$ at the end (e.g., 20, 40, and 50 $^{\circ}\text{C}$; 18 to 24 $^{\circ}\text{C}$). When temperatures are separated in the sentence, use the symbol $^{\circ}\text{C}$ with each (e.g., report “at 32.2 $^{\circ}\text{C}$ ” rather than “at 32.2 $^{\circ}$ ”).

Report day and night temperatures when needed [e.g., 27/13 $^{\circ}\text{C}$ day/night)]. To avoid confusion with temperatures below 0 $^{\circ}\text{C}$, do not use the range en dash with temperature readings (e.g., report “8 to 10 $^{\circ}\text{C}$ ”, not “8–10 $^{\circ}\text{C}$ ”; report “–4 to –2 $^{\circ}\text{C}$ ” not “–4–2 $^{\circ}\text{C}$ ”). Degrees Fahrenheit ($^{\circ}\text{F}$) should be used in HortTechnology when they represent original units of measurement

Time

Time can refer to a specific clock time in terms of hours, minutes, and seconds or refer to calendar days, weeks, months, or years.

Calendar date. Report dates in the format of “Date Month” (e.g., 10 Jun) or “Date Month Year” (e.g., 2 Jul 2021). Dates less than 10 should not include a leading zero. All months should be abbreviated with three letters and the year should include four digits. If the month does not reference a specific date, it should be spelled out (e.g., “we planted in June”).

Calendar day. Spell out days of the week (e.g., Monday, Wednesday, Saturday). Abbreviate the term day(s) in tables and figures, and when used with a number in the IMRAD block (e.g., 1 d, 29 d). Spell out day(s) in the Abstract.

Calendar terms. In tables and figures, abbreviate the terms year(s), month(s), and week(s) as yr, mo, and wk, respectively. Spell out year(s), month(s), and week(s) in the IMRAD block and the Abstract (e.g., 1 year, both years, 4 months, several weeks).

Clock time, 12-h system. The 12-h system sometimes leads to confusion (e.g., 12:00 can mean noon or midnight). Use the capitals AM and PM to designate before and after noon, respectively. Indicate the time in minutes following the colon, even if it is zero, e.g., 3:00 AM is correct, rather than 3 AM. Do not use the contraction “o’clock” with abbreviations of time.

Clock time, 24-h system. The 24-h system is indicated by four digits, the first two for hours and the last two for minutes. The day begins at midnight, denoted 0000 HR, and the last minute of the day is 2359 HR. Thus, 0830 HR is the same as 8:30 AM, 1245 HR is the same as 12:45 PM, and 2315 HR is the same as 11:15 PM. Use the capitals HR to designate clock hours, as distinguished from the abbreviation used for quantitative hours (h).

Clock time, day length. Give day length in quantitative hours (e.g., 11 h 22 min with no comma) along with quality of daylight. Do not imply day length through time-zone abbreviations.

Clock time, hour, minute, second. Abbreviate the terms hour(s), minute(s), and second(s), as h (not hr), min, and s (not sec), respectively, in tables and figures and when used with a number in the IMRAD block. Spell out in the Abstract.

Clock time, time zones. Time zones (CDT, EST, UTC) are irrelevant to most studies. If day length is critical, do not imply it through time-zone abbreviations.

Thickness

The thickness of agricultural plastic film is frequently measured in mils. The mil is equivalent to 1/1000 inch or 0.001 inch. Mils are not equivalent to millimeters (1 mil = 0.0254 mm).

HortTechnology manuscripts should report original unit of measurement rather than reporting the thickness of plastic film a converted unit. In HortScience and JASHS, use micrometers (μm) or millimeters (mm) to give thickness of plastic film or any other thin material. See Appendix Table 18-4 for conversions from mils to millimeters.

Transpiration

Express transpiration as kilograms per square meter per second ($\text{kg}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$) on a mass basis and as cubic meters per square meter per second ($\text{m}^3\cdot\text{m}^{-2}\cdot\text{s}^{-1}$) on a volume basis.

Volume

The SI unit of volume is the cubic meter (m^3). The unit cubic centimeter (cm^3 , not cc) is acceptable. In HortTechnology, US units of volume [e.g., cubic inch (inch^3), cubic foot (ft^3), cubic yard (yard^3), fluid ounce (fl oz), gallon (gal)] are used if they represent original units of measurement. When describing the volume of containers in an experiment, provide the volume; other dimensions (e.g., height, width) can be added if relevant.

Water Potential

Accord to Savage (1979, p 495), volumetric water potential is the potential (energy) needed to move a unit volume of water from the system under consideration to the reference position, normally taken to be that of pure free water at the same temperature as the water in the system and at a pressure of one standard atmosphere, namely 101.3 kPa. Hence, the units of volumetric water potential are joules per cubic meter ($\text{J}\cdot\text{m}^{-3}$), newtons per square meter ($\text{N}\cdot\text{m}^{-2}$), or pascals (Pa). Alternatively, the term “specific water potential” has the same meaning as volumetric water potential, except that a unit mass of water is moved to the reference state and the unit is joules per kilogram ($\text{J}\cdot\text{kg}^{-1}$). Volumetric water potential = $\pi(T) \times$ specific water potential where $\pi_w = 1000 \text{ kg}\cdot\text{m}^{-3}$, implying that it is a constant for all temperatures.

Weight

When the word “weight” is used, be sure the intended meaning is clear. In some research, weight is a force for which the SI unit is the newton (N); in much of agricultural research, weight is usually a synonym for mass, for which the SI unit is the kilogram (kg).

In HortTechnology, US units of weight [e.g., ounces (oz), pounds (lb), tons (not abbreviated)] should be used if they represent original units of measurement. The term ton(s) is understood to mean the US short ton (i.e., 2000 lb). When referring to metric tons, use the preferred SI unit megagrams (Mg) or tonnes (t). Both megagrams and tonnes are equivalent to the metric ton (i.e., 1000 kg). When the word “weight” is used, the intended meaning needs to be clear. In some research, weight is a force for which the SI unit is the newton (N); in much of agricultural research, weight is usually a synonym for mass.

Yield

Report crop yield in kilograms per hectare ($\text{kg}\cdot\text{ha}^{-1}$), megagrams per hectare ($\text{Mg}\cdot\text{ha}^{-1}$), or tonnes per hectare ($\text{t}\cdot\text{ha}^{-1}$) in HortScience and JASHS. In HortTechnology, pounds per acre (lb/acre) or tons per acre (tons/acre) should be used if they represent original units of measurement.

Additional guidelines as published by the National Institute of Standards and Technology may be found online (National Institute of Standards and Technology 2019b). A comprehensive guide that includes a checklist of style requirements is also available (Thompson and Taylor 2008).

Resources

- American Society for Horticultural Science. 1997. ASHS publications style manual. ASHS Press, Alexandria, VA, USA.
- Bureau International des Poids et Mesures. 2019. SI brochure: The International System of Units (SI). <https://www.bipm.org/en/publications/si-brochure/>. [accessed 4 Feb 2022].
- Council of Science Editors. 2014. Scientific style and format: The CSE manual for authors, editors, and publishers (8th ed). University of Chicago Press, Chicago, IL, USA.
- National Information Standards Organization. 2010. Bibliographic references. ANSI/NISO Z39.29-2005 (R2010). <https://www.niso.org/publications/ansiniso-z3929-2005-r2010>. [accessed 4 Feb 2022].
- National Institute of Standards and Technology. 2019a. Metric conversion software. <https://www.nist.gov/pml/weights-and-measures/metric-conversion-software>. [accessed 4 Feb 2022].
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- Thompson A, Taylor BN. 2008. Guide for the use of the International System of Units (SI). National Institute of Standards and Technology NIST Spec Publ 811.

PART IV.

REVIEWER GUIDELINES

Chapter 19. Review Criteria

Scholarly peer reviews are an essential and important component of publishing in scientific journals. Peer reviewers offer critical feedback on methodology and interpretation of research and provide suggestions to enhance structure and clarity of scientific writing. Peer reviews also help editors make informed decisions on a paper's suitability for publication; specifically, they offer advice and recommendations on whether a manuscript should be accepted for publication, considered acceptable with revisions, or declined for publication in a journal. The following checklists and questions are provided as tools to help reviewers critically assess the merits of a manuscript based on the requirements of scientific methodology and writing criteria.

19.1 Scientific Writing Criteria

Science

A primary goal of scientific writing is to achieve a credible presentation of data, facts, and knowledge. If key findings of research are to be effectively communicated, scientific reporting must be accurate, logical, objective, precise, reliable, science-based, and statistically valid. Such writing requires a prerequisite adherence to scientific method. *Science is about coherence.*

Criteria	Science Checklist	✓
Accurate	<ul style="list-style-type: none"> Factual, free from error, technically correct. 	
Logical	<ul style="list-style-type: none"> Claims based on clear thought process, logic, and reason. Avoids incorrect arguments, errors in logic, or fallacies. Consistent agreement of parts and free of contradictory elements. 	
Objective	<ul style="list-style-type: none"> Assumptions and methods are without bias or prejudice. Interpretation of a concept, measurement, or conclusion is consistent with scientific method. Conservative use of descriptive language to maintain neutrality. 	
Precise	<ul style="list-style-type: none"> Meticulous in measurements, methods, or observations. Exact in expression of details. Specific in interpretation of data analysis or findings. 	
Valid	<ul style="list-style-type: none"> Conclusions based on appropriate methods for data acquisition, categorization, compilation, and analysis. Inferences substantiated and based on evidence. Interpretation of results cogent, coherent, and logical. 	

Structure

A secondary goal of scientific writing is to accomplish a clear and comprehensible presentation of information. If key findings from studies are to be efficiently communicated, the writing structure needs to be complete, concise, ordered, structured, and understandable. *Structure is about clarity.*

Criteria	Structure Checklist	✓
Accessible	<ul style="list-style-type: none"> • Accessible, clear, without confusion; easy to read and understand. • All material necessary for comprehension is included. • Proper use of abbreviations, definitions, and terms where appropriate. 	
Complete	<ul style="list-style-type: none"> • Provides sufficient information to allow for independent validation of assertions, arguments, or claims being made particularly in methods of data collection and analysis. • All exhibits such as tables and figures are complete and able to stand alone, apart from the text or other tables and figures. 	
Concise	<ul style="list-style-type: none"> • All words are focused on the efficient communication of the arguments, assertions, or claims being made. • Not overly verbose or wordy; written in simple, direct sentences. • Duplicate, extraneous, or irrelevant material that obscures the thesis of the document is eliminated. 	
Ordered	<ul style="list-style-type: none"> • Information is arranged in a systematic, orderly way. • Subject matter is presented in a methodical, easy-to-follow line of thinking or outline. • Each topic is developed in support of the thesis. 	

Style

A third goal of scientific writing is to attain a consistent format of presentation of information in compliance with international scientific reporting standards. If key findings from research studies are to be communicated in a way that allows for validation by other researchers, then scientific writing needs to conform to minimum criteria in standardization such as abbreviations, numbers, nomenclature, statistical reporting, terminology, and units of measurement. Adherence to format standards is important for numerous reasons, not the least of which is that inattention to detail with respect to scientific writing format often raises concerns regarding an analogous lack of attention to proper scientific method. *Style is about consistency.*

Criteria	Style Checklist	✓
Format	<ul style="list-style-type: none"> • Conforms to publication-specific instructions and format guidelines. • General format is consistent in overall appearance with other documents similarly published. • Information is presented in a consistent manner throughout the document. 	
Nomenclature	<ul style="list-style-type: none"> • In compliance with accepted rules of communicating scientific information. • Conforms to established standards for abbreviations, labels, nomenclature, symbols, and terms consistent with commonly accepted international guidelines. 	
Statistics	<ul style="list-style-type: none"> • In accordance with ordinary rules for presentation of statistical data analysis. • In compliance with current standards of statistical reporting. 	
Syntax	<ul style="list-style-type: none"> • In accordance with ordinary rules of American English. • Follows standard guidelines with respect to capitalization, definitions, grammar, hyphenation, punctuation, spelling, sentence structure, and vocabulary. 	
Units of measure	<ul style="list-style-type: none"> • Conforms to international standards for reporting units of measurement in scientific journals. 	

19.2 Scientific Writing Criteria by Section

Title

Criteria	Checklist for Title	✓
Purpose	<ul style="list-style-type: none"> • Does the title achieve its designated purpose? 	
Concise	<ul style="list-style-type: none"> • Does the title contain the fewest words possible to clearly identify the key subject and findings of the article? 	
Independent	<ul style="list-style-type: none"> • Is the title capable of standing on its own when disconnected from the name of the journal in which it is published? 	
Precise	<ul style="list-style-type: none"> • Does the title precisely describe the key subject and findings of the work? 	
Unique	<ul style="list-style-type: none"> • Is the title unique? Does it avoid duplicating another title in use? 	

Byline

Criteria	Checklist for Byline	✓
Purpose	<ul style="list-style-type: none"> Does the Byline achieve its designated purpose? 	
Author affiliation	<ul style="list-style-type: none"> Are all author(s) mailing addresses complete? 	
Contributing author	<ul style="list-style-type: none"> Does the Byline include all contributing authors who meet the criteria for authorship of the work? 	
Corresponding author	<ul style="list-style-type: none"> Have the authors designated who will serve as post-publication corresponding author? 	

Keywords

Criteria	Checklist for Keywords	✓
Purpose	<ul style="list-style-type: none"> Do the Keywords achieve their designated purpose? 	
Duplication	<ul style="list-style-type: none"> Do the Keywords avoid duplicating words in the title? 	
Order	<ul style="list-style-type: none"> Are the Keywords arranged in alphabetical order? 	
Precision	<ul style="list-style-type: none"> Have the authors avoided ambiguous abbreviations, jargon, and specialized terminology that may be lacking in precision for efficient retrieval by readers, indexing services, and search engines? 	
Relevance	<ul style="list-style-type: none"> Are the Keywords specific and meaningful with respect to key findings? Have all extraneous words been removed? 	

Abstract

Criteria	Checklist for Abstract	✓
Purpose	<ul style="list-style-type: none"> Does the Abstract achieve its designated purpose? [For HortTechnology manuscripts, does the Abstract include a clear message indicating how the results can be used by practitioners?] 	
Complete	<ul style="list-style-type: none"> Is the Abstract complete? Does the Abstract state the principal objectives and scope of the study, briefly describe the methods employed, summarize the results, and state the conclusions? 	
Independent	<ul style="list-style-type: none"> Can the Abstract stand on its own, independent from the rest of the text, and be understood without having read the paper? 	
Concise	<ul style="list-style-type: none"> Is the Abstract concise—not too detailed or too long? Does it exceed 5% of the length of the entire paper? 	

Introduction

Criteria	Checklist for Introduction	✓
Purpose	<ul style="list-style-type: none"> Does the Introduction achieve its purpose? Does it answer clearly and concisely the question “<i>Why</i> was this research conducted?” Is there mention of the new information the researchers hope to acquire? 	
Question	<ul style="list-style-type: none"> Does the Introduction include a statement of the research question to be answered, problem to be solved, relationship to be examined or association not yet explained, or the socioeconomic benefit to be derived from the work that justifies doing the research? 	
Hypothesis	<ul style="list-style-type: none"> For experimental research, has the hypothesis to be tested been clearly stated? Is it new? Is it worthy of consideration? 	
Prior Work	<ul style="list-style-type: none"> Does the Introduction include mention of (and in-text citations to) key results of prior work relevant to the subject that this research plans to challenge, confirm, or develop? 	
References	<ul style="list-style-type: none"> Have all the in-text citations in the Introduction been checked against the end references in the References Cited to make sure there is a one-to-one match? 	

Materials and Methods

Criteria	Checklist for Materials and Methods	✓
Purpose	<ul style="list-style-type: none"> Have the Materials and Methods achieved the designated purpose? Do they answer the question “<i>How</i> was this research conducted?” 	
Hypothesis	<ul style="list-style-type: none"> For experimental studies, have the authors translated a research question into a hypothesis? 	
Experimental Design	<ul style="list-style-type: none"> Do the Materials and Methods clearly identify the type of study (e.g., exploratory, observational, or experimental)? If experimental, have the experimental subject(s), experimental unit(s), and treatment(s) been clearly and accurately identified? Were the experiments designed with appropriate controls? 	
Experimental Methods	<ul style="list-style-type: none"> Do the Materials and Methods include enough information on all equipment, materials, and procedures so that the study can be repeated? Are the methods employed appropriate for the experiment? Have the authors included a citation and a summary of the procedure for any technique used in the study that was developed by other authors or derived from a published study? Are there any signs of bias in the collection of data? 	

Results

Criteria	Checklist for Results	✓
Purpose	<ul style="list-style-type: none"> Has the Results section achieved its designated purpose? Does it clearly and concisely answer the question "<i>What</i> was learned from this study?" 	
Summary	<ul style="list-style-type: none"> Does the Results section summarize the data, emphasizing important patterns and trends? 	
Examples	<ul style="list-style-type: none"> Does the Results section include adequate explanatory text, examples, and references to appropriate tables and figures to support generalizations made about the data? 	
Precision	<ul style="list-style-type: none"> Are the results being reported commensurate with the precision of the experimental method? 	
Units of measure	<ul style="list-style-type: none"> If any unit of measurement have been converted to another unit of measurement (e.g., US units to SI units), have exact conversion factors been used to avoid rounding errors? For HortTechnology, have only original units of measurement been reported without conversion? 	

Discussion

Criteria	Checklist for Discussion	✓
Purpose	<ul style="list-style-type: none"> Has the Discussion section achieved its designated purpose? Does it answer the question "<i>Who</i> benefits from this research?" 	
Conclusions	<ul style="list-style-type: none"> Have the results been interpreted in a manner that supports the conclusions and generalizations with evidence? 	
Exceptions	<ul style="list-style-type: none"> Have any exceptions to the generalizations, patterns, principles, or relationships been pointed out with adequate discussion of possible reasons for these outcomes? 	
Prior Work	<ul style="list-style-type: none"> Have the results and interpretations been compared to previously published work (including work that agrees or does not agree) as well as with the hypothesis of the study? 	
Significance	<ul style="list-style-type: none"> Has a brief statement regarding the significance of the work been included? Does the statement refrain from extrapolating implications beyond the scope of the study? 	

Tables

Criteria	Checklist for Tables	✓
Purpose	<ul style="list-style-type: none"> • Has each table achieved its designated purpose? • Does each table augment, clarify, or illustrate related text? 	
Elements	<ul style="list-style-type: none"> • Are all the necessary parts or elements of each table present [e.g., column heads, column spanners (optional), footnotes, row titles, stubs, table cells, table title]? 	
Independent	<ul style="list-style-type: none"> • Are all tables constructed to be independent from the text (i.e., functional, and able to be understood without reference to any other part of the manuscript)? • Do they meet the requirement of being able to “<i>stand alone</i>” independent of the text? 	
Numbers	<ul style="list-style-type: none"> • Are the tables numbered in the same order in which they are referenced in the text? 	

Figures

Criteria	Checklist for Figures	✓
Purpose	<ul style="list-style-type: none"> • Have all the figures achieved their designated purpose? • Do they reveal trends or patterns in the data or help illustrate the results of the study? 	
Independent	<ul style="list-style-type: none"> • Are all figures capable of standing alone, without reference to any other part of the manuscript? 	
Complete	<ul style="list-style-type: none"> • Are all elements necessary for understanding a figure included (e.g., axes, caption, labels, legends)? 	
Numbered	<ul style="list-style-type: none"> • Are the figures numbered in the same order in which they are referenced in the text? 	
Quality	<ul style="list-style-type: none"> • Have all figures been submitted with appropriate resolution to yield high quality output for print viewing (300 dpi)? 	

References Cited

Criteria	Checklist for References Cited	✓
Purpose	<ul style="list-style-type: none"> Has the References Cited section achieved its designated purpose? 	
Complete	<ul style="list-style-type: none"> Have all end references been verified by the author(s) to be complete (i.e., containing all required elements of an end reference)? Do all end references derived from an internet site include a date of access? For end references that have been assigned a DOI number, has that number been included in the References Cited? 	
Correct	<ul style="list-style-type: none"> Have all end references been verified by the author(s) to be accurate and traceable to a reliable published source? 	
Parallel	<ul style="list-style-type: none"> Do all in-text citations refer to a complete end reference in the References Cited and vice versa? 	
Relevant	<ul style="list-style-type: none"> Are all in-text citations relevant to a specific argument or thesis of the study? 	

Resources

International Committee of Medical Journal Editors. 2019. Recommendations for the conduct, reporting, editing, and publication of scholarly work in medical journals.
<http://www.icmje.org/recommendations/>. [accessed 4 Feb 2022]

Maisonneuve H, Enckell PH, Polderman A, Thapa R, Vekony M (eds). 2003. The science editors handbook. European Association of Science Editors, Tampere, Finland.

Chapter 20. Review Decisions

20.1 Accept

An accept decision is an “*Accept, no revision needed*” decision. This decision indicates that the Editor-in-Chief, in consultation with Consulting Editors and reviewers, has issued a final decision for approval of a manuscript for publication. This category means that the underlying science and/or scientific methods are deemed to be sound, and the manuscript meets the minimum requirements for publication in an ASHS journal. There may be minor format or other issues to be corrected, but these are negligible. Further input from authors is not required.

20.2 Conditional Accept with Option to Revise

A conditional accept is an “*Accept, minor revision needed*” decision. This decision indicates that the Editor-in-Chief, in consultation with Consulting Editors and reviewers, has issued a decision for acceptance of a manuscript pending minor revisions. Minor revisions generally mean that the underlying science and/or scientific methods are deemed to be sound, and the manuscript meets the minimum requirements of publication in an ASHS journal. Upon revision, the author(s) will need to provide a detailed “Response to Reviewer Comments” letter addressing the reviewers’ comments point-by-point. After acceptable and timely completion of revisions by the author(s), the manuscript will be accepted for publication.

20.3 Provisional Decline with Option to Resubmit

A provisional decline is a “*Decline, major revision needed*” decision. The decision indicates that the Editor-in-Chief, in consultation with Consulting Editors and reviewers, has requested major revisions to meet publishing standards for scientific journals. Major revisions generally mean that the underlying science and/or scientific methods are deemed to be sound, but substantive changes are needed prior to resubmission to meet the minimum requirements of publication in an ASHS journal. Resubmission involves the assignment of a new manuscript number; this may or may not result in the formation of a new review team. In addition, upon resubmission the

author(s) will need to provide a detailed "Response to Reviewer Comments" letter addressing the reviewers' comments point-by-point.

20.4 Decline without Option to Resubmit

A "*Declined, no resubmission*" decision is a permanent decline of a manuscript for publication. It means that the Editor-in-Chief, in consultation with Consulting Editors and reviewers, has declined the manuscript without the option to revise and resubmit. Such a decision may be the result of any one of several reasons including:

Scope. The topic of the subject manuscript is outside the scope of the target journal (see Chapter 2).

Scientific method. Significant problems, issues, or questions with respect to the underlying scientific method, experimental design, etc. were identified by the review process. Such problems cannot be addressed by revisions in structure or style.

Noncompliance. An author's inability or unwillingness to make revisions requested may eventually lead to a "*Declined, no resubmission*" decision, especially if revisions proffered by the author(s) are deemed to be wholly inadequate. When a revised manuscript fails to meet standard minimum requirements for publication in an ASHS journal, and there is a consensus that the author(s) have not made a good-faith effort to comply with the comments of the review team and/or editors, the review process may be terminated.

**PART V.
APPENDIX**

Glossary

alpha. Alpha (α) refers to the likelihood that the true population parameter lies outside the confidence interval.

assumption, statistical test. Use of statistical tests requires that certain assumptions about the data are met. Examples of assumptions include: 1) observations are independent (i.e., the value of one observation does not affect the value of other observations); 2) data for the dependent variable are normally distributed; or 3) data from different groups are homoscedastic (i.e., different groups have the same standard deviation).

confounding variable. A confounding variable is an unmeasured factor which influences both the independent variable and the dependent variable. A confounding variable has two conditions: 1) it must be correlated with an independent variable; and 2) it must be causally related to the dependent variable. In practice, a confounding variable may distort or mask the nature of the true relationship between the independent variable and the dependent variable. Randomization is the best way to reduce impact of confounding factors.

control. A control is any standard or treatment against which one or more treatments are compared.

error variables. Numerous variables, in addition to the independent variable, may influence the dependent variable. Variables that are unknown or unmeasured are called error variables. Error variables account for all the individual differences in response measurements that are not accounted for by the independent variable. Error variables are controlled by randomization.

error, experimental. Error in experiments refers to unexplained variation in a collection of observations or measurements that is not accounted for by the independent variable.

error, standard. Standard error is a measure of the variability of a statistic (e.g., correlation coefficient, mean, regression coefficient). It is an estimate of the standard deviation of a sampling distribution.

error, systematic. A systemic error is a consistent predictable difference between an observed value and the true value of a measurement (e.g., equipment calibration, observer bias, measurement bias). In practice, this type of error results in a directional shift around the true value of a measurement.

error, Type I. A Type I error is the mistaken rejection of the null hypothesis when it is true (false positive).

error, Type II. A Type II error is the mistaken acceptance of a null hypothesis when it is false (false negative).

error. The term "error" is associated with numerous concepts including experimental error, standard error, systematic error, Type I error, Type II error, variation among replicates, discrepancy between a sample mean and a population mean, etc. Use of the term is discouraged without defining the intended concept.

experiment. An experiment is a controlled study that is designed to understand cause-and-effect relationships.

experimental design (experimental layout). The experimental design refers to the physical arrangement of experimental units, including replications and the interspersions of experimental treatments among the experimental units.

experimental material (study subject). The experimental material is the primary subject of interest in a study. It is the individual entity or physical matter that is analyzed, examined, investigated, observed, or treated during a particular study (e.g., plant species, organism, material, etc.) and is the target entity for inferences calculated from the data.

experimental unit. The experimental unit is the smallest unit of experimental material upon which a single treatment is assigned in an act of randomization (i.e., each experimental unit is randomly assigned to receive a single treatment). A single experimental unit cannot receive two different treatments. Two experimental units within a single replicate containing all treatments cannot receive the same treatment. An experimental unit may be comprised of multiple sampling units.

factor. A factor (also called independent variable or predictor variable) is a variable manipulated by the experimenter. Each factor has two or more levels (i.e., different levels of the factor). Combinations of factor levels are called treatments. If there is only one factor with x levels, there would be x treatments.

genetic mapping populations. Genetic mapping populations consist of a population of individuals that are used for mapping genes; the individuals are derived from crosses among a species where the parents differ in the trait(s) to be studied,.

horticultural science. Horticultural science is a professional discipline within the field of agriculture; it is most closely related to agronomy. However, horticultural science is differentiated from agronomy by the economic and social value of the species or crops considered. Horticultural science is concerned with understanding the art, economics, management, practice, science, and technology of producing specialty crops that are generally cultivated for the benefit of humans. In contrast, agronomy is concerned with the production of commodity crops such as cereals or grains, forages, legumes or pulses, and oilseeds, which are primarily cultivated for fiber, livestock feed, or industrial purposes.

horticulture. Horticulture is a branch of agriculture concerned with the art, economics, management, practice, science, and technology of producing non-commodity, labor-intensive, specialty plants cultivated for aesthetics, economics, food, medicine, or other benefit, generally with the purpose of enhancing the quality of life for humans.

horticulturist. A horticulturist is a professional with expertise in the art, management, marketing, practice, production, science, or technology of growing non-commodity, labor-intensive, specialty plants used for aesthetics, economics, food, medicine, or other benefit, primarily for the purpose of enhancing the quality of life for humans. The professional title "horticulturist" is a specialist

designation like agronomist, botanist, or economist. Most specialist titles are based on nouns, not adjectives; for that reason, the term “horticulturalist”, which is based on an adjective, is not preferred as a professional designation.

horticultural crops. Horticultural crops include non-commodity, labor-intensive, specialty crops that are used for aesthetics, economics, food, medicine, or other benefit, primarily for the purpose of enhancing the quality of life for humans. Horticultural crops do not include commodity crops such as forages, grains, oilseeds, and pulses, especially those used for fiber, livestock feed, or industrial purposes. Horticulture crops are often categorized into two broad groups: food crops and non-food crops.

horticultural food crops. Horticultural food crops include specialty crops such as: edible flowers, herbs, leafy greens, mushrooms, nuts, sea vegetables, small fruits, seeds, tree fruits, and vegetables, as well as other labor-intensive crops used to produce consumer products such as beverages, edible oils, and syrups.

horticultural non-food crops. Horticultural non-food crops include crops used for aesthetic enrichment, environmental conservation, landscape design, or propagation, with many examples such as bedding plants, cut flowers, ground covers, landscape plants, ornamental plants, seeds, shrubs, transplants, trees, turfgrass, and vines.

hypothesis, alternative. In experimental research, the alternative hypothesis is usually the hypothesis that sample observations are not influenced by chance (i.e., observations are influenced by some non-random cause or event) rather than by chance.

hypothesis, null. In experimental research, the null hypothesis is usually the hypothesis that sample observations are influenced by chance (i.e., observations are influenced by some random cause or event) rather than a non-random event.

hypothesis. A research hypothesis is a tentative conjecture that introduces a research question, variables of interest, and proposes a relationship among variables which can be tested by further observation or experimentation.

measurement. A measurement is an observation or quantification of an attribute for a single variable obtained from a single sampling unit or a single experimental unit. Measurements may be made by unaided human senses (estimates) but are more commonly obtained using instruments to detect and measure quantities.

null hypothesis. See hypothesis, null.

parameter. A parameter is a characteristic of a population.

power analysis. Power analysis is a mathematical calculation used to estimate sample sizes needed to detect a significant difference between two means.

probability value. The probability value (*P* value) is the probability of getting the observed result, or more extreme result, if the null hypothesis is true. A large *P* value is interpreted as stronger evidence that

the null hypothesis is true. A small P value suggests there is stronger evidence in favor of the alternative hypothesis.

probability, statistical. In statistical reporting, probability (α) refers to the probability of a Type I error (mistaken rejection of a null hypothesis that is true).

pseudo-replication. Pseudo-replication is the use of inferential statistics to test for treatment effects with data from experiments where treatments are not replicated, or replicates are not statistically independent.

random error. A random error is an *inconsistent* difference between an observed value and the true value of a measurement. Random errors are considered unavoidable because control of all unpredictable events in an experiment is not realistic. In practice, random errors result in variable fluctuations around the true value of a measurement.

randomization. The purpose of randomization is to guarantee the validity of the test results by ensuring that errors are independently distributed. A lack of independence of errors prohibits knowing the probability of a Type I error (rejection of a null hypothesis that is true). In practice, there is often a conflict between using complete randomization procedures and the desirability of having treatments interspersed among homogeneous blocks (e.g., systematic designs). Common sense combined with knowledge of biological or production systems should be utilized to address this conflict.

repetition. Repetition refers to the number of times that a complete experiment was repeated. In field studies, this may refer to a duplication of the entire experiment in either time (e.g., multiple years) or space (i.e., multiple locations). Repetition is especially important for field studies where it is difficult to control confounding variables and where the risk/outcome of making a Type I error needs to be minimized (e.g., recommendations).

replication. A single replicate refers to one complete set of experimental units that contains all treatments; a replicate includes one experimental unit per treatment. Replication refers to the assignment of more than one experimental unit to the same treatment. The main purpose of replication is to provide an estimate of experimental error so comparisons among treatments can be made. Each replication must be independent of every other replication. Multiple replicates (duplicates of all treatments) are necessary to calculate standard error of the mean, which is required to estimate confidence intervals. In practice, replication reduces the effects of “noise” or random variation or error, thereby increasing the precision of a treatment effect estimate.

reproducibility. Reproducibility (repeatability) refers to the ability to be copied or reproduced (e.g., results); it is a major principle underpinning scientific method. In practice, a reproducible study is documented in such a way that deduction of scientific results is fully transparent.

research, experimental. Experimental research seeks to assess the nature of a relationship among variables by manipulation of some variables. Experiments have three characteristics: 1) the researcher randomly assigns experimental units to treatments; 2) the researcher actively manipulates an independent variable; and 3) the researcher maintains a high degree of experimental control over

environmental conditions and other confounding variables (Hatcher 2018, p 15). Experimental studies can show that variables are related or correlated, and they can estimate the probability of cause-and-effect relationships among variables.

research, exploratory. Exploratory research involves collecting data to explain a phenomenon more completely; it provides objectivity of knowledge relating to a fact, issue, problem, or situation in question. Whereas, observational and experimental research both typically use hypothesis testing, exploratory research does not.

research, observational. Observational studies seek to assess the nature of a relationship among variables without manipulation of any variables. In contrast to experimental research: 1) the researcher does not actively manipulate an independent variable; and 2) the researcher does not maintain a high degree of experimental control over environmental conditions and other confounding variables. Observational studies can show that variables are related or correlated – but they cannot estimate the probability of cause-and-effect relationships among variables. Any inferences about causality would be inappropriate.

sample size. Sample size is the number of sampling units that are observed or measured [e.g., 100 individual plants in an experimental unit (e.g., field plot)].

sampling unit. A sampling unit is the smallest entity within an experimental unit on which observations or measurements are recorded (e.g., a single plant on which height is recorded).

standard deviation. Standard deviation (*SD*) is a measure of dispersion or spread of data. It estimates how close observations are to the mean.

standard error. Standard error (*SE*) is a measure of the variability of a statistic (e.g., correlation coefficient, mean, regression coefficient). It is an estimate of the standard deviation of a sampling distribution.

statistic. A statistic is a characteristic of a sample. It may be used to estimate a population parameter.

systematic error. A systemic error is a *consistent* predictable difference between an observed value and the true value of a measurement (e.g., equipment calibration, observer bias, measurement bias). In practice, this type of error results in a directional shift around the true value of a measurement

treatment. A treatment is a particular combination of one or more factors applied to an experimental unit. The total number of experimental units needed to randomly assign all treatments to can be found by multiplying together the total number of levels for each factor. If there is only one factor with *x* levels, then there would be *x* treatments.

Type I error. A Type I error is the mistaken rejection of the null hypothesis when it is true (false positive).

Type II error. A Type II error is the mistaken acceptance of a null hypothesis when it is false (false negative).

variable, dependent (outcome variable). A dependent variable is an outcome or response variable that is influenced by the manipulation of an independent or predictor variable.

variable, independent (predictor variable). An independent variable is a treatment variable that is changed or manipulated to measure a response in a dependent variable.

variable. A variable is any characteristic, number, or quantity that can be measured, counted, or manipulated.

Special Reports

Cultivar and Germplasm Releases

Criteria	Checklist	✓
Title	Does the title include the name of the organism (scientific or common) as well as clear mention of the candidate for release by introducing a new unique name, number, alphanumeric string, or description of the subject useful trait?	
Introduction	Does the Introduction section include two integral parts: 1) justification for release of the material and 2) a clear statement describing in detail the characteristics or useful traits for which the material was selected?	
Origin (Materials and Methods)	Does the Origin section include a complete history of the cultivar or germplasm leading to its selection and release?	
Description (Results)	Does the Description section establish distinctness, uniformity, and stability (DUS) for a cultivar release; or provide a detailed explanation of useful characteristics for a germplasm release?	
Availability	Does the Availability section include two parts: 1) statement confirming that the material has been officially released by a public or private agency; 2) clear instructions on how to proceed with a request for materials which include mention of the type of release and the terms of availability for interested parties?	

Cultivar and Germplasm Releases are a type of Special Report published in HortScience. These reports are used to describe new and novel plant cultivars, germplasm, parental lines, genetic stocks, and genomic mapping populations.

The term “cultivar” is a shortened combination of the phrase “cultivated variety”. Whereas “cultivar” and “variety” are often considered to be interchangeable, the latter term also refers to a taxonomic classification (a botanical variety of a species). To avoid confusion, HortScience prefers to use the term “cultivar” rather than “variety” for the purpose described herein.

Purpose

There are numerous categories for release including public release with no restrictions; public release with protection [e.g., Plant Variety Protection (PVP), plant patent, utility patent, International Union for the Protection of New Varieties (UPOV)]; private release with protection (e.g., trademark, trade secret), or limited release with restrictions (material transfer agreements or licenses implemented with or without other other forms of intellectual property protection, etc.).

Cultivar Release

A cultivar release refers to the advancement of a novel genotype, confirmed to be distinct, unique, and stable (DUS) for one or more useful traits. The decision to advance a cultivar for release normally utilizes extensive data collection and analysis, obtained from numerous planting sites and replications over a period of multiple years, to statistically validate superior traits and performance relative to a commercial standard. Cultivar releases are ready for commercial use with distribution depending on the type of release, supply of stock available, and pursuant to any limitations prescribed by intellectual property protection (IPR) agreements.

The publication of cultivar releases serves many purposes including: 1) to introduce new improved cultivars to the public and research community; 2) to provide evidence that the new cultivar is distinct, unique, and stable (DUS) for one or more useful traits; 3) to document superiority of a new cultivar relative to a standard; 4) to publish the breeding history and origin of a new cultivar; 5) to credit the inventor, plant breeder, institution, organization, or entity responsible for the development of the new cultivar; 6) to provide the terms of availability for the cultivar release.

Germplasm Release

A germplasm release, in contrast, refers to the advancement of plant or genetic material (e.g., parental lines, genetic stocks, genomic mapping populations, etc.) that contains one or more unique traits, trait combination, and/or exotic genetic background, but lacks the supporting data to statistically validate superior traits and performance relative to a standard. Germplasm releases include materials that have not been confirmed to be distinct, uniform, and stable; however, they are believed to be useful for research and breeding efforts, but are not considered ready for commercial release, without additional evaluation and development efforts.

A germplasm release serves many purposes including: 1) to introduce new potentially useful germplasm to the research community; 2) to provide evidence that the new germplasm

possesses one or more useful traits; 3) to publish the origin of the new germplasm; 4) to credit the inventor, plant breeder, institution, organization, or entity responsible for the release of the new germplasm; and 5) to provide the terms of availability for the germplasm release.

Structure

Cultivar and Germplasm Releases adhere to ASHS publication requirements as outlined in Chapters 4-14. However, due to the singular purpose of this Special Report, it is acceptable to substitute certain subheadings for the traditional IMRAD structure (Introduction, Materials & Methods, Results, and Discussion) as detailed in the Research Sections below.

Index Elements

Title. The title for a cultivar or germplasm release should be brief (i.e., no more than 15 words). It must include mention of the organism (either by species or common name) and the name or identifying number of the material being released (e.g., cultivar name, germplasm name or number, etc.). Cultivar names should be punctuated by enclosure in single quotes unless the cultivar name is preceded by the word "cultivar". All words in the cultivar name are capitalized with no additional formatting (e.g., italics, bold, or underline, etc.). Germplasm names or numbers should appear as a string of alphanumeric text without italics or quotation marks.

Byline. Author names are listed in the same order as they will appear on the published report. The name of each author is given according to the preference of the author; however, authors should report at least one given name (i.e., not just initials) in addition to the surname (family name). The order of authors appearing on the Byline usually follows the order of decreasing degree of contribution to the research or project. Generally, the first author is the person who carries the highest level of professional responsibility for the work.

Author affiliation. Complete author affiliations and mailing addresses should be provided to enable interested persons in the public and scientific community to communicate with the author or entity responsible for distribution of samples. The institution(s) in which the author(s) carried out the reported research should be identified under the Byline. Affiliations not directly related to the reported germplasm release should not be included here but may be mentioned in a footnote.

Keywords. Include three to seven words or phrases; keywords should not duplicate any words or phrases used in the title. Place the keywords in alphabetical order, separated by commas.

Include mention of the organism (either the scientific name or common name) if either is not already present in the title. Do not attach footnotes to any Keywords.

Footnotes (Unnumbered block). There are two parts to the Byline Footnotes — an unnumbered section and a numbered section. The first footnote section is unnumbered and written as a block of copy, not as individual paragraphs. It may include the following information in the sequence indicated below:

Received. Received for publication date (date to be filled in by ASHS); this will indicate the calendar day, in the format Day Month Year (e.g., 1 Jan 2022) that ASHS received the manuscript.

Published. Published online date (date to be filled in by ASHS).

Funding. Statement of sources of funding for the research project.

Corresponding author. Provide complete name (first and last) and email address for corresponding author.

Report Sections

Abstract (none). Cultivar and Germplasm Releases are published without Abstracts.

Introduction (do not label). The Introduction provides justification for the advance and release of a new cultivar or germplasm. Topics appropriate to consider here include: 1) *Justification* — economic importance of novel or subject trait; 2) *History* — background of novel or subject trait; 3) *Description* — characterization of subject trait (e.g., phenotype, genotype); 4) *Source* — discovery or source of subject trait; 5) *Genetics* — genetic variation and inheritance of subject trait; 6) *Prior work* — discussion of closely aligned prior work relating to subject trait; and 7) *Benefits* — identification of stakeholders and potential commercial or research benefits to be realized following release of the material. Specific topics may vary depending on type of cultivar or germplasm.

Materials and Methods (or Origin and Development). The Materials and Methods section describes the origin, history and derivation of a new cultivar or germplasm. Topics appropriate to consider here include: 1) *Materials* — original sources of plant materials or subject trait; 2) *Breeding program* — description of breeding program [e.g., without hybridization (clonal, pure line, mass selected, etc.); hybridization (backcross, bulk, pedigree); special breeding techniques (mutation, gene transfer)]; 3) *Experimental design* — treatments, environments evaluated (i.e.,

adaptation), standards for comparison, etc.; 4) *Data collection*—equipment, measurements, observations, measurements, procedures, and techniques with appropriate references to the work of others; and 5) *Data analysis*—analysis of data to statistically validate superiority of traits. The pedigree information may be presented either as a block of text or as a figure. Include all prior names or numerical designations used for the subject material prior to its final selection and release. Describe standardized methods or equipment used for measurement of important traits wherever possible [e.g., to describe color, use the Royal Horticultural Society Colour Chart or the CIELAB (L*A*B*) color space].

Results (or Description). This section provides additional information related to the phenotype and genotype of the cultivar or germplasm release with detailed discussion regarding the trait(s) of interest. Topics appropriate to consider here include: 1) *Selections*—general descriptions of superior selections including novel combinations of useful traits; 2) *Traits*—detailed discussion of useful traits such as adaptability (environment), maturity (early, late), quality (aesthetics, food, fiber, landscape, etc.), resistance to stressors [biotic (disease, insect, etc.); abiotic (cold, drought, frost, heat, etc.)], suitability (handling, harvest, marketing, shipping, processing, storage, etc.); 3) *Type of material*—complete description of the type of material to be released (e.g., clonal, pure line, composite, synthetic, multi-line, hybrid, mutant, transgenic, etc.); 4) *Propagation*—detailed description of method of propagation and maintenance of new release; 5) *Distinctness, uniformity, and stability (DUS)*—confirmation of distinctness, uniformity, and stability for cultivar releases and superiority compared to standard for both cultivars and germplasm; The rationale for releasing the material should be clearly stated. If the material is a cultivar, the basis for claiming DUS should also be detailed. Justification for DUS may be presented within a text block or within a table with a side-by-side comparison to a standard. The standard should be a cultivar within the same category of material as the subject release.

Availability. This section should detail how samples of the new cultivar or germplasm may be acquired and utilized by interested parties. Topics appropriate to consider here include: 1) *Release type*—plant cultivars, germplasm, parental lines, genetic stocks, and genomic mapping populations, etc.; 2) *Terms of release* {e.g., public release with no restrictions; public release with protection [Plant Variety Protection (PVP), plant patent, utility patent, International Union for the Protection of New Varieties (UPOV)], private release with limited protection (trademark, trade secret; or material transfer agreements) or limited release with protection (licenses implemented with or without other other forms of intellectual property protection)}; 3)

Distribution—contact information for the inventor, entity, or agent responsible for distribution of the release material; 4) *Release date*—date after which interested parties may contact the inventor, entity, or agency for additional information regarding availability of the release; 5)

Quantity—expected quantities of material to be available for release; and 6) *Citation*—specific recommendations for future citation of released material.

Example:

Certified ‘Wendy’ plants are being propagated under royalty agreements with licensed nurseries, the names of whom will be supplied on request. The Atlantic Food and Horticulture Research Center has been granted Plant Breeder's Rights for ‘Wendy’ in Canada (Certificate No. 2467) and a US Plant Patent has been awarded (USPP 18,340).

Example:

‘EmerDak’ is sold under the trademark Emerald Flare® (US Trademark Reg. No. 5,359,589; registered 19 Dec 2017) and is available for nonexclusive licensing. For more information, contact the NDSU Research Foundation, 1735 NDSU Research Park Drive, Suite 124, Dept. 4400, PO Box 6050, Fargo, ND 58108-6050, USA; phone 701-231-6681; <http://www.ndsuresearchfoundation.org/>.

References Cited. See Chapter 14. References Cited for numerous other examples.

Example:

Walker SJ, Funk P, Joukhadar I, Place T, Havlik C, Tonnessen B. 2021. ‘NuMex Odyssey’, a New Mexico–type green chile pepper for mechanical harvest. *HortScience*. 56:1605–1607. <https://doi.org/10.21273/HORTSCI15793-21>.

Tables. Include Tables immediately after the References Cited section.

Figures. Include Figures immediately after the Tables section. Place each Figure on a new page. Include at least one photograph illustrating the distinguishing characteristic(s).

Resources

American Society for Horticultural Science. 1997. ASHS publications style manual. ASHS Press, Alexandria, VA, USA.

Bernal E, Francis DM. 2021. Processing tomato germplasm with improved resistance to bacterial spot. *HortScience*. 56(4):519-520. <https://doi.org/10.21273/HORTSCI15616-20>.

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Rivera-Burgos LA, Silverman EJ, Wehner TC. 2021. NC-GSB-524W, NC-GSB-527W, NC-GSB-528W, NC-

GSB-530W, NC-GSB-531W, and NC-GSB-532W watermelon lines with gummy stem blight resistance and good fruit quality. HortScience. 56(12):1599-1604.
<https://doi.org/10.21273/HORTSCI16095-21>.

West TP, Morgenson G, Hagemeyer CC. 2022. *Betula tianschanica* 'EmerDak' (Emerald Flare® Tianshan birch): A new pyramidal landscape tree. HortScience. 57(4):504-505.
<https://doi.org/10.21273/HORTSCI16427-21>.

Tables

Chapter 14. References Cited

Appendix Table 14-2. List of commonly used words and abbreviations for use in preparing the References Cited section in ASHS journals.

Appendix Table 14-3. List of journal names and abbreviations for use in preparing the References Cited section in ASHS journals (sorted by journal abbreviation).

Appendix Table 14-4. List of journal names and abbreviations for use in preparing the References Cited section in ASHS journals (sorted by journal name).

Chapter 15. Abbreviations

Appendix Table 15-1. List of terms and abbreviations with guidelines for use in ASHS journals.

Chapter 18. Units of Measurement

Appendix Table 18-1. United States customary (US) units and International System of Units (SI) units and conversion factors to convert US to SI units and SI to US units as reported in HortTechnology table footnotes and figure captions.

Appendix Table 18-2. List of common units of measurement, abbreviations, and symbols with guidelines for use in ASHS journals. Abbreviations of units of measurement must always be preceded by a numeral.

Appendix Table 18-3. List of variables, units of measurement, and additional factor requirements for reporting environmental parameters in ASHS journals.

Appendix Table 18-4. Plastic film thickness conversion chart from mils (original unit) to inches (derived unit), micrometers (converted unit), and millimeters (converted unit).

Appendix Table 14-2. List of commonly used words and abbreviations for use in preparing the References Cited section in ASHS journals.

Word	Abbreviation
Abstract(s)	Abstr
Academia, Academies, Academy	Acad
Acta	Acta
Advances	Adv
African	Afr
Agroecology	Agroecol
Agriculturae, Agriculture, Agriculturist	Agric
Agronomy	Agron
Alternative	Altern
America, American	Am
Analysis, Analytical	Anal
Annals	Ann
Annual	Annu
Application(s), Applied	Appl
Aquatic	Aquat
Arboriculture	Arboric
Archive(s)	Arch
Aromatic	Aromat
Asian	Asian
Associated, Associates, Association	Assoc
Assurance	Assur
Atmosphere, Atmospheric	Atmos
Australasian	Australas
Australian	Aust
Austrian	Austrian
Bacteriological, Bacteriology	Bacteriol
Biochemical, Biochemistry	Biochem
Biologia, Biology	Biol
Biometric(s)	Biometr
Biophysical, Biophysics	Biophys
Bioresource(s)	Bioresour
Biotechnic	Biotech
Biotechnologica, Biotechnological, Biotechnology	Biotechnol
Biosystems	Biosyst
Botanical, Botany	Bot
Brazilian	Braz
Breeding	Breed

Word	Abbreviation
Britain, British	Br
Bulgarian	Bulg
Bulletin	Bull
Bureau	Bur
Canadian	Can
Center, Centre, Central	Cent
Characterization	Charact
Chemical, Chemistry	Chem
Chilean, Chilena	Chil
China	China
Chinese	Chin
Chimica	Chim
Chronicle(s)	Chron
Circular	Circ
Citriculture	Citric
Climate(s)	Clim
Climatological, Climatology	Climatol
Clinical	Clin
College	Coll
Colombiana	Colomb
Colloquium	Colloq
Communication(s)	Commun
Compost	Compost
Computational, Computer(s)	Comput
Conference	Conf
Congress	Congr
Contamination	Contam
Contribution(s)	Contrib
Cooperative	Coop
Critical	Crit
Culture	Cult
Current	Curr
Cytological, Cytology	Cytol
Department	Dept
Development(s)	Dev
Digest	Dig
Disease	Dis
Dissertation	Diss
Distributed, Distribution(s)	Distr
Division	Div
Ecology, -ical	Ecol
Economic(s)	Econ

Word	Abbreviation
Ecosystem(s)	Ecosyst
Education	Educ
Egyptian	Egypt
Electronic(s)	Electron
Emirates	Emir
Engineer(s), Engineering	Eng
Enology	Enol
Entomologia, Entomologist, Entomological, Entomology	Entomol
Environment, Environmental	Environ
Essential	Essent
Eurasian	Euras
Europe, European	Eur
Evolution, Evolutionary	Evol
Experiment, Experimental	Exp
Extension	Ext
Faculty	Fac
Federal	Fed
Fertilizer	Fert
Fisheries	Fish
Forage	Forage
Forest, Forestry	For
Francaise, France	Fr
Frontiers	Front
Function, Functional	Funct
Gazette	Gaz
General	Gen
Genetic, Genetics	Genet
Genome	Genome
Genomic	Genomic
Government	Gov
Geophysical, Geophysics	Geophys
Geotechnic(s), Geotechnica	Geotech
Handbook	Handb
Heredity	Hered
Herbal	Herb
Historical, History	Hist
Horticulturae, Horticultural, Horticulture	Hortic
Human	Human
Improvement	Improv
India	India
Indian	Indian
Industrial, Industry	Ind

Word	Abbreviation
Information	Inf
Institute(s), Institution(s)	Inst
Interaction(s), Interactive	Interact
International	Int
Irrigation	Irrig
Israel	Isr
Italian	Ital
Japan, Japanese	Jpn
Journal	J
Korean	Korean
Laboratories, Laboratory	Lab
Leaflet(s)	Leafl
Letter(s)	Lett
Linnean	Linnean
Magazine	Mag
Management	Manage
Marine	Mar
Market	Market
Marketing	Market
Medical, Medicinal, Medicine	Med
Meeting	Meet
Meteorological, Meteorology	Meterol
Method	Method
Mexican, Mexicana, Mexicano	Mex
Microbe	Microbe
Microbial	Microb
Microbiological, Microbiology	Microbiol
Microscopical, Microscopy	Microsc
Molecular	Mol
Monograph(s)	Monogr
Mycological, Mycology	Mycol
Mycotoxin	Mycotoxin
National	Natl
Natural, Naturalist, Nature	Nat
Nematological, Nematology	Nematol
Netherlands	Neth
New Zealand	N Z
Newsletter	Newsl
Nutrition, Nutritional	Nutr
Official	Off
Opinion(s)	Opin
Organ	Organ

Word	Abbreviation
Organic	Org
Organization	Organ
Pakistan	Pak
Paper(s)	Pap
Pathological, Pathology	Pathol
Pesticide(s)	Pestic
Photosynthesis	Photosynth
Physica, Physical, Physics	Phys
Physiologia, Physiologie, Physiological, Physiology	Physiol
Phytological, Phytology	Phytol
Phytopathological, Phytopathology	Phytopathol
Plant	Plant
Planta	Planta
Plantas, Plantarum	Plant
Plants	Plants
Pollution	Pollut
Polonica	Pol
Pomological, Pomology	Pomol
Postharvest	Postharvest
Product(s), Production	Prod
Progress	Prog
Propagation	Propag
Protection	Prot
Publication(s)	Publ
Quality	Qual
Region(s), Regional	Reg
Register, Registration(s)	Regist
Regular, Regulation(s), Regulator(s), Regulatory	Regul
Renewable	Renewable
Report(s), Reporter	Rep
Reproduction, Reproductive	Reprod
Research	Res
Resource(s)	Resour
Review(s), Revue	Rev
Royal	R
Russian	Russ
Safety	Saf
Scandinavian, Scandinavica	Scand
School	Sch
Science(s), Scientia, Scientific, Scientist(s)	Sci
Series	Ser
Service(s)	Serv

Word	Abbreviation
Sexual	Sex
Sinica	Sin
Society	Soc
Soil	Soil
South African	S Afr
Special	Spec
Spectrometry	Spectrom
Spectroscopy	Spectrosc
Standard(s)	Stand
Station	Stn
Statistical, Statistics	Stat
Study, Studies	Stud
Supplement(s)	Suppl
Sustainable	Sustain
Symposium	Symp
Systematics, Systems	Syst
Technica, Technical, Technik, Technique(s)	Tech
Technological, Technologist(s), Technology	Technol
Temperature(s)	Temp
Theoretical	Theor
Thesis	Thesis
Tissue	Tissue
Toxicology	Toxicol
Transactions	Trans
Tropical	Trop
Turfgrass	Turfgrass
Turkish	Turk
United States	US
United States of America	USA
United States Department of Agriculture	US Dept Agric
Universities, University	Univ
Utilization	Util
Varieties, Variety	Var
Vegetable(s), Vegetation	Veg
Version	Ver
Virology	Virol
Viticulture	Vitic
Volume	Vol
Yearbook	Yearb

Appendix Table 14-3. List of journal names and abbreviations for use in preparing the References Cited section in ASHS journals (sorted by journal abbreviation).

Journal abbreviation	Journal name
Acta Agric Scand	Acta Agriculturae Scandinavica
Acta Hortic	Acta Horticulturae
Acta Hortic Sin	Acta Horticulturae Sinica
Adv Agron	Advances in Agronomy
Adv Appl Microbiol	Advances in Applied Microbiology
Adv Ecol Res	Advances in Ecological Research
Adv Genet	Advances in Genetics
Adv Hortic Sci	Advances in Horticultural Science
Adv Lipid Res	Advances in Lipid Research
Adv Microb Ecol	Advances in Microbial Ecology
Adv Soil Sci	Advances in Soil Science
Adv Water Resour	Advances in Water Resources
Afr J Agric Res	African Journal of Agricultural Research
Afr J Biotechnol	African Journal of Biotechnology
Agrarforschung Schweiz	Agrarforschung Schweiz (Agricultural Research Switzerland)
Agribusiness	Agribusiness
Agric Ecosyst Environ	Agriculture, Ecosystems and Environment
Agric Admin Ext	Agricultural Administration and Extension
Agric Biol	Agricultural Biology
Agric Biol Chem	Agricultural and Biological Chemistry
Agric Econ Res	Agricultural Economics Research
Agric Environ	Agriculture and Environment
Agric Environ Lett	Agricultural and Environmental Letters
Agric Food Sci	Agricultural Food Science
Agric Food Sci	Agricultural and Food Science
Agric For Meteorol	Agriculture and Forest Meteorology
Agric Hist	Agricultural History
Agric Hist Rev	The Agricultural History Review
Agric Human Values	Agriculture and Human Values
Agric Inf Dev Bull	Agricultural Information Development Bulletin
Agric Meteorol	Agricultural Meteorology
Agric Res Technol	Agricultural Research and Technology
Agric Rev	Agricultural Reviews
Agric Syst	Agricultural Systems
Agriculture	Agriculture (Basel, Switzerland)
Agrochem Soil Sci	Agrochemistry and Soil Science
Agrochemophysica	Agrochemophysica

Journal abbreviation	Journal name
Agrochimica	Agrochimica
Agroecol Sustain Food Syst	Agroecology and Sustainable Food Systems
Agron J	Agronomy Journal
Agron Sustain Dev	Agronomy for Sustainable Development
Agroplantae	AgroPlantae
AIChE J	American Institute Chemical Engineers Journal
Alexandria J Agric Res	Alexandria Journal of Agricultural Sciences
Am J Agric Econ	American Journal of Agricultural Economics
Am J Altern Agric	American Journal of Alternative Agriculture
Am J Bot	American Journal of Botany
Am J Clin Nutr	American Journal of Clinical Nutrition
Am J Enol Vitic	American Journal of Enology and Viticulture
Am J Potato Res	American Journal of Potato Research
Am J Sci	American Journal of Science
Am Lab	American Laboratory
Am Potato J	American Potato Journal
Anal Biochem	Analytical Biochemistry
Anal Chem	Analytical Chemistry
Anal Chim Acta	Analytical Chimica Acta
Anal Lett	Analytical Letters
Angew Bot	Angewandte Botanik (Journal of Applied Botany)
Ann Agric Crop Sci	Annals of Agricultural and Crop Sciences
Ann Agric Fenn	Annales Agriculturae Fenniae
Ann Agric Sci	Annals of Agricultural Sciences
Ann Agron	Annals of Agronomy
Ann Appl Biol	Annals of Applied Biology
Ann Appl Stat	Annals of Applied Statistics
Ann Arid Zone	Annals of Arid Zone
Ann Bot	Annals of Botany
Ann For Sci	Annals of Forest Science
Ann Geophys	Annals of Geophysics
Ann Inst Stat Math	Annals of the Institute of Statistical Mathematics
Ann Math Stat	Annals of Mathematical Statistics
Ann Microbiol	Annals of Microbiology
Ann N Y Acad Sci	Annals of the New York Academy of Sciences
Ann Probab	Annals of Probability
Ann Stat	Annals of Statistics
Annu Rep NMR Spectrosc	Annual Reports on NMR Spectroscopy
Annu Rev Biochem	Annual Review of Biochemistry
Annu Rev Cell Biol	Annual Review of Cell Biology
Annu Rev Ecol Syst	Annual Review of Ecology, Evolution, and Systematics

Journal abbreviation	Journal name
Annu Rev Entomol	Annual Review of Entomology
Annu Rev Food Sci Technol	Annual Review of Food Science and Technology
Annu Rev Microbiol	Annual Review of Microbiology
Annu Rev Phys Chem	Annual Review of Physical Chemistry
Annu Rev Phytopathol	Annual Review of Phytopathology
Annu Rev Plant Biol	Annual Review of Plant Biology
Annu Rev Plant Physiol	Annual Review of Plant Physiology
Annu Rev Plant Physiol Plant Mol Biol	Annual Review of Plant Physiology and Plant Molecular Biology
Antonie van Leeuwenhoek	Antonie van Leeuwenhoek
Appl Eng Agric	Applied Engineering in Agriculture
Appl Entomol Phytopathol	Applied Entomology and Phytopathology
Appl Environ Microbiol	Applied and Environmental Microbiology
Appl Microbiol	Applied Microbiology
Appl Microbiol Biotechnol	Applied Microbiology and Biotechnology
Appl Plant Sci	Applications in Plant Sciences
Appl Soil Ecol	Applied Soil Ecology
Appl Spectrosc	Applied Spectroscopy
Appl Turfgrass Sci	Applied Turfgrass Science
Arab J Plant Prot	Arab Journal of Plant Protection
Arboric J	Arboricultural Journal
Arch Biochem Biophys	Archives of Biochemistry and Biophysics
Arch Environ ContAm Toxicol	Archives of Environmental Contamination and Toxicology
Arch Phytopathol Plant Prot	Archives of Phytopathology and Plant Protection
Arid Zone Res	Arid Zone Research
Arnoldia	Arnoldia
Asian J Agric Food Sci	Asian Journal of Agriculture and Food Science
Asian J Agric Res	Asian Journal of Agricultural Research
Asian J Plant Pathol	Asian Journal of Plant Pathology
Asian J Plant Sci Res	Asian Journal of Plant Science and Research
At Spectrosc	Atomic Spectroscopy
Atmos Environ	Atmospheric Environment
Aust J Agric Res	Australian Journal of Agricultural Research
Aust J Biol Sci	Australian Journal of Biological Science
Aust J Bot	Austrian Journal of Botany
Aust J Chem	Australian Journal of Chemistry
Aust J Exp Agric	Australian Journal of Experimental Agriculture
Aust J Grape Wine Res	Australian Journal of Grape Wine Research
Aust J Plant Physiol	Australian Journal of Plant Physiology
Aust J Soil Res	Australian Journal of Soil Research
Bamboo Sci Cult	Bamboo Science and Culture

Journal abbreviation	Journal name
Ber Dtsch Chem Ges	Berichte der Deutschen Chemischen Gesellschaft
Better Crops Plant Food	Better Crops with Plant Food
Biochem J	Biochemical Journal
Biochem Mol Biol J	Biochemistry and Molecular Biology Journal
Biochem Physiol Pflanz	Biochemie und Physiologie der Pflanzen
Biochem Soc Trans	Biochemical Society Transactions
Biochem Syst Ecol	Biochemical Systematics and Ecology
Biochim Biophys Acta	Biochimica et Biophysica Acta
Biochimie	Biochimie
Biol Agric Hortic	Biological Agriculture and Horticulture
Biol Agric Hortic	Biological Agriculture and Horticulture
Biol Fert Soils	Biology and Fertility of Soils
Biol Fertl Soils	Biology and Fertility of Soils
Biol Mass Spectrom	Biological Mass Spectrometry
Biol Plant	Biologia Plantarum
Biometr Bull	Biometrics (<i>previous title for Biometrics Bulletin</i>)
Biometrics	Biometrics
Biometrika	Biometrika
Biophys J	Journal of Biophysics
Bioresour Technol	Bioresource Technology
Biosci Biotechnol Biochem	Bioscience, Biotechnology, and Biochemistry
Biotechnol Prog	Biotechnology Progress
Biotropica	Biotropica
BMC Plant Biol	BMC Plant Biology
Bot Bull Acad Sin	Botanical Bulletin of Academia Sinica
Bot Chron (Patras)	Botanika Chronika Patras
Bot Gaz	Botanical Gazette
Bot J Linnean Soc	Botanical Journal of the Linnean Society
Bot Rev	The Botanical Review: Interpreting Botanical Progress
Boundary-Layer Meteorol	Boundary-Layer Meteorology
Br J Appl Phys	British Journal of Applied Physics
Bradleya	Bradleya
Bulg J Agric Sci	Bulgarian Journal of Agricultural Science
Bull Am Meteorol Soc	Bulletin of the American Meteorological Society
Bull Chem Soc Jpn	Bulletin of the Chemical Society of Japan
Bull Environ ContAm Toxicol	Bulletin of Environmental Contamination and Toxicology
Bull Torrey Bot Club	Bulletin of the Torrey Botanical Club
Bull Yale Univ Sch For Environ Stud	Bulletin of Yale University School for Environmental Studies
C R Acad Agric Fr	Comptes-rendus de l'Académie Académie d'Agriculture de France
Calif Agric (Berkeley)	California Agriculture

Journal abbreviation	Journal name
Calif Agric Exp Stn Circ	California Agricultural Experiment Station Circular
Can Entomol	The Canadian Entomologist
Can J Agric Sci	Canadian Journal of Agricultural Science
Can J Biochem Physiol	Canadian Journal of Biochemistry and Physiology
Can J Bot	Canadian Journal of Botany
Can J Chem	Canadian Journal of Chemistry
Can J Fish Aquat Sci	Canadian Journal of Fisheries and Aquatic Sciences
Can J For Res	Canadian Journal of Forest Research
Can J Genet Cytol	Canadian Journal of Genetics and Cytology
Can J Microbiol	Canadian Journal of Microbiology
Can J Phys	Canadian Journal of Physics
Can J Plant Pathol	Canadian Journal of Plant Pathology
Can J Plant Sci	Canadian Journal of Plant Science
Can J Soil Sci	Canadian Journal of Soil Science
Can J Spectrosc	Canadian Journal of Spectroscopy
Caryologia	Caryologia International Journal of Cytology, Cytosystematics and Cyto genetics
Cell Death Differ	Cell Death and Differentiation
Cell Mol Life Sci	Cellular and Molecular Life Sciences
Cell Tissue Res	Cell and Tissue Research
Cell Mol Biol	Cellular and Molecular Biology
Chem Abstr	Chemical Abstracts
Chem Eng Sci	Chemical Engineering Science
Chem Geol	Chemical Geology
Chem Phys Lett	Chemical Physics Letters
Chem Phys Lipids	Chemistry and Physics of Lipids
Chem Rev	Chemical Reviews
Chemosphere	Chemosphere
Chin Herb Med	Chinese Herbal Medicines
Chron Higher Educ	Chronicle of Higher Education
CIM Bull	CIM Bulletin
Clim Change	Climate Change
Clin Toxicol	Clinical Toxicology
Collect Czech Chem Commun	Collection of Czechoslovak Chemical Communications
Commun Agric Appl Biol Sci	Communications in Agricultural and Applied Biological Sciences
Commun Soil Sci Plant Anal	Communications in Soil Science and Plant Analysis
Compost Sci Util	Compost Science and Utilization
Comput Appl Biosci	Computer Applications in the Biosciences
Comput Electron Agric	Computers and Electronics in Agriculture
Comput Geosci	Computers and Geosciences
Comput J	The Computer Journal

Journal abbreviation	Journal name
Comput Phys Commun	Computer Physics Communications
Crit Rep Anal Chem	Critical Reviews in Analytical Chemistry
Crit Rep Appl Chem	Critical Reports on Applied Chemistry
Crit Rev Biochem	Critical Reviews in Biochemistry
Crit Rev Biochem Mol Biol	Critical Reviews in Biochemistry and Molecular Biology
Crit Rev Biotechnol	Critical Reviews in Biotechnology
Crit Rev Environ Control	Critical Reviews in Environmental Control
Crit Rev Food Sci Nutr	Critical Reviews in Food Science and Nutrition
Crit Rev Microbiol	Critical Reviews in Microbiology
Crit Rev Plant Sci	Critical Reviews in Plant Science
Croat Chem Acta	Croatica Chemica Acta
Crop Breed Appl Biotechnol	Crop Breeding and Applied Biotechnology
Crop Forage Turfgrass Manage	Crop Forage and Turfgrass Management
Crop Forage Turfgrass Manage	Crop, Forage and Turfgrass Management
Crop J	Crop Journal
Crop Prot	Crop Protection
Crop Sci	Crop Science
Cryobiology	Cryobiology
Cucurbit Genet Coop Rep	Cucurbit Genetics Cooperative Report
Curr Biol	Current Biology
Curr Genet	Current Genetics
Curr Microbiol	Current Microbiology
Curr Opin Cell Biol	Current Opinion in Cell Biology
Curr Opin Struct Biol	Current Opinion in Structural Biology
Curr Res Nutr Food Sci	Current Research in Nutrition and Food Science
Curr Sci	Current Science
Curr Top Nutraceutical Res	Current Topics in Nutraceutical Research
Cytologia	Cytologia
Czech J Genet Plant Breed	Czech Journal of Genetics and Plant Breeding
Dev Ind Microbiol	Developments in Industrial Microbiology
DNA Cell Biol	DNA and Cell Biology
Down Earth	Down to Earth
East Afr Agric For J	The East African Agricultural Journal
Ecol Applic	Ecological Applications
Ecol Modell	Ecological Modelling
Ecol Monogr	Ecological Monographs
Ecology	Ecology
Econ Bot	Economic Botany
Econ Dev Cult Change	Economic Development and Cultural Change
Econ Entomol	Journal of Economic Entomology
Econometrica	Econometrica: Journal of the Econometric Society

Journal abbreviation	Journal name
Ecotoxicol Environ Saf	Ecotoxicology and Environmental Safety
Egypt J Hortic	Egyptian Journal of Horticulture
Egypt J Soil Sci	Egyptian Journal of Soils Science
ElectroAnal Chem (Lausanne)	Journal of Electroanalytical Chemistry (Lausanne, Switzerland)
EMBO J	European Molecular Biology Organization Journal
Emir J Food Agric	Emirates Journal of Food and Agriculture
Emp J Exp Agric	Empire Journal of Experimental Agriculture
Eng Geol	Engineering Geology
Entomol Exp Appl	Entomologia Experimentalis et Applicata
Environ Pollut	Environmental Pollution
Environ Entomol	Environmental Entomology
Environ Exp Bot	Environmental and Experimental Botany
Environ Geol Water Sci	Environmental Geology and Water Sciences
Environ Int	Environment International
Environ Lett	Environmental Letters
Environ Pollut (Tor)	Environment and Pollution (Toronto, Ont)
Environ Sci Technol	Environmental Science and Technology
Environ Sci Technol Lett	Environmental Science and Technology Letters
Environ Toxicol Chem	Environmental Toxicology and Chemistry
Enzymologia	Enzymologia
EPPO Bull	European and Mediterranean Plant Protection Organization Bulletin
Estuarine Coastal Mar Sci	Estuarine and Coastal Marine Science
Euphytica	Euphytica: Netherlands Journal of Plant Breeding
Eur J Hortic Sci	European Journal of Horticultural Science
Eur J Plant Pathol	European Journal of Plant Pathology
Euras Soil Sci	Eurasian Soil Science
Exp Agric	Experimental Agriculture
Exp Cell Res	Experimental Cell Research
FAM Econ Rev	Family Economics Review
FEMS Microbiol Ecol	FEMS Microbiology Ecology
FEMS Microbiol Immunol	FEMS Microbiology Immunology
FEMS Microbiol Lett	FEMS Microbiology Letters
FEMS Microbiol Rev	FEMS Microbiology Reviews
Fert Res	Fertilizer Research
Field Crop Abstr	Field Crop Abstracts
Field Crops Res	Field Crops Research
Flowering Plants Afr	Flowering Plants of Africa
Folia Hortic	Folia Horticulturae
Folia Hortic	Folia Horticulturae
Food Agric Immunol	Food and Agricultural Immunology

Journal abbreviation	Journal name
Food Environ Virol	Food and Environmental Virology
Food Nutr (Roma)	Food and Nutrition
Food Sci Biotechnol	Food Science and Biotechnology
Food Sci Human Wellness	Food Science and Human Wellness
For Ecol Manage	Forest Ecology and Management
For Sci	Forestry Science
Forestry	Forestry
Fresenius Z Anal Chem	Fresenius' Zeitschrift für Analytische Chemie
Front Agric Sci Eng	Frontiers of Agricultural Science and Engineering
Front Ecol Environ	Frontiers in Ecology and the Environment
Front Plant Sci	Frontiers in Plant Science
Front Sustain Food Syst	Frontiers in Sustainable Food Systems
Fruit Growing Res	Fruit Growing Research
Fruits	Fruits
Funct Foods Health Dis	Functional Foods in Health and Disease
Future Food J Food Agric Soc	Future of Food-Journal on Food Agriculture and Society
Gayana Bot	Gayana Botánica
Gen Appl Plant Physiol	General and Applied Plant Physiology
Genes Dev	Genes and Development
Genet Mol Res	Genetics and Molecular Research
Genetics	Genetics
Genome	Genome
Gent Resour Crop Evol	Genetic Resources and Crop Evolution
Geochem Int	Geochemistry International
Geochim Cosmochim Acta	Geochimica et Cosmochimica Acta
Geoderma	Geoderma
Geogr Rev	Geographical Review
Geol Mag	Geological Magazine
Geol Soc Am Bull	Geological Society of America Bulletin
Geol Soc Am Spec Pap	Geological Society of America Special Papers
Geology	Geology
Geophys Res Lett	Geophysics Research Letters
Geophysics	Geophysics
Geotech Test J	Geotechnical Testing Journal
Geotechnique	Géotechnique
GM Crops Food Biotechnol Agric Food Chain	GM Crops and Food-Biotechnology in Agriculture and the Food Chain
Ground Water Monit Rev	Ground Water Monitoring Review
Groundwater	Groundwater
Harv Pap Bot	Harvard Papers in Botany
Hawaii Inst Trop Agric Human Resour Res Ext Ser	Hawaii Institute of Tropical Agriculture and Human Resources Research Extension Series

Journal abbreviation	Journal name
Health Phys	Health Physics
Hebarist	The Herbarist
Herb Rev	The Herbal Review
HerbalGram	HerbalGram
Heredity	Heredity
Hildgardia	Hildgardia
Hist Agric	History of Agriculture
Hortic Bras	Horticultura Brasileira
Hortic Environ Biotechnol	Horticulture, Environment, and Biotechnology
Hortic J	Horticulture Journal
Hortic Plant J	Horticultural Plant Journal
Hortic Res	Horticulture Research
Hortic Rev	Horticulture Reviews
Hortic Sci	Horticultural Science
Hortic Sci	Horticulture Science
Hortic Sci Technol	Horticultural Science and Technology
Horticulturae	Horticulturae
HortScience	HortScience
HortTechnology	HortTechnology
Hunan Agric Sci Technol	Hunan Agricultural Science and Technology
Hydrobiologia	Hydrobiologia
IAHS Publ	International Association of Hydrological Sciences Publications
IEEE Trans Geosci Remote Sens	IEEE Transactions on Geoscience and Remote Sensing
IEEE Trans Nucl Sci	IEEE Transactions on Nuclear Science
IIMS Agric Food	AIMS Agriculture and Food
Ill Agric Econ	Illinois Agricultural Economics
Ind Eng Chem	Industrial and Engineering Chemistry
Indian J Agric Sci	Indian Journal of Agricultural Sciences
Indian J Agron	Indian Journal of Agronomy
Indian J Exp Biol	Indian Journal of Experimental Biology
Indian J Exp Bot	Indian Journal of Experimental Botany
Indian J Genet Plant Breed	Indian Journal of Genetics and Plant Breeding
Indian J Hortic	Indian Journal of Horticulture
Indian J Plant Prot	Indian Journal of Plant Protection
Indian J Pure Appl Phys	Indian Journal of Pure and Applied Physics
Insect Biochem Mol Biol	Insect Biochemistry and Molecular Biology
Int J Agric Technol	International Journal of Agricultural Technology
Int J Environ Agric Res	International Journal of Environmental and Agriculture Research
Int J Environ Anal Chem	International Journal of Environmental Analytical Chemistry
Int J Food Microbiol	International Journal of Food Microbiology

Journal abbreviation	Journal name
Int J Fruit Sci	International Journal of Fruit Science
Int J Heat Mass Transfer	International Journal of Heat and Mass Transfer
Int J Herb Med	International Journal of Herbal Medicine
Int J Plant Sci	International Journal of Plant Sciences
Int J Trop Agric	International Journal of Tropical Agriculture
Int Rice Comm Newsl	International Rice Research Newsletter
Int Turfgrass Soc Res J	International Turfgrass Society Research Journal
Invasive Plant Sci Manage	Invasive Plant Science and Management
Iowa State J Res	Iowa State Journal of Research
Irrig Sci	Irrigation Science
Isr J Agric Res	Israel Journal of Agricultural Research
Isr J Bot	Israel Journal of Botany
Isr J Chem	Israel Journal of Chemistry
Issues Sci Technol	Issues in Science and Technology
J Pant Nutr Soil Sci	Journal of Plant Nutrition and Soil Science
J Bamboo Res	Journal of Bamboo Research
J Agri Resour Econ	Journal of Agricultural and Resource Economics
J Agric Econ	Journal of Agricultural Economics
J Agric Educ	Journal of Agricultural Education
J Agric Eng	Journal of Agricultural Engineering
J Agric Eng Res	Journal of Agricultural Engineering Research
J Agric Food Chem	Journal of Agricultural and Food Chemistry
J Agric Food Chem	Journal of Agricultural and Food Chemistry
J Agric Food Chem	Journal of Agricultural and Food Chemistry
J Agric Food Syst Community Dev	Journal of Agriculture, Food Systems, and Community Development
J Agric Food Technol	Journal of Agriculture and Food Technology
J Agric Meterol	Journal of Agricultural Meteorology
J Agric Res	Journal of Agricultural Research
J Agric Saf Health	Journal of Agricultural Safety and Health
J Agric Scand Sect B Soil Plant Sci	Acta Agriculturae Scandinavica Section B-Soil and Plant Science
J Agric Sci	The Journal of Agricultural Science
J Agrobiol	Journal of Agrobiology
J Agromedicine	Journal of Agromedicine
J Agron Crop Sci	Journal of Agronomy and Crop Science
J Air Pollut Control Assoc	Journal of the Air Pollution Control Association
J Am Pomol Soc	Journal of the American Pomological Society
J Am Chem Soc	Journal of the American Chemical Society
J Am Soc Agron	Journal of the American Society of Agronomy
J Am Soc Hortic Sci	Journal of the American Society for Horticultural Science
J Am Soc Sugar Beet Technol	Journal of the American Society of Sugar Beet Technologists

Journal abbreviation	Journal name
J Am Stat Assoc	Journal of the American Statistical Association
J Am Stat Assoc	Journal of the American Statistical Association
J Am Water Works Assoc	Journal of the American Water Works Association
J Anal Appl Pyrolysis	Journal of Analytical and Applied Pyrolysis
J AOAC Int	Journal of AOAC International
J Appl Bacteriol	Journal of Applied Bacteriology
J Appl Bot Food Qual	Journal of Applied Botany and Food Quality
J Appl Ecol	Journal of Applied Ecology
J Appl Environ Microbiol	Journal of Applied and Environmental Microbiology
J Appl Hortic	Journal of Applied Horticulture
J Appl Meteorol	Journal of Applied Meteorology
J Appl Phys	Journal of Applied Physics
J Appl Res Med Aromat Plants	Journal of Applied Research on Medicinal and Aromatic Plants
J Appl Seed Prod	Journal of Applied Seed Production
J Arboric	Journal of Arboriculture
J Arid Environ	Journal of Arid Environments
J Assoc Off Agric Chem	Journal of the Association of Official Agricultural Chemists
J Assoc Off Anal Chem	Journal of the Association of Official Analytical Chemists
J Atmos Chem	Journal of Atmospheric Chemistry
J Atmos Sci	Journal of Atmospheric Sciences
J Bacteriol	Journal of Bacteriology
J Bamboo Rattan	Journal of Bamboo and Rattan
J Berry Res	Journal of Berry Research
J Bioenerg	Journal of Bioenergetics
J Biol Agric Healthc	Journal of Biology, Agriculture and Healthcare
J Biol Chem	Journal of Biological Chemistry
J Biopestic	Journal of Biopesticides
J Chem Ecol	Journal of Chemical Ecology
J Chem Educ	Journal of Chemical Education
J Chem Phys	Journal of Chemical Physics
J Chem Soc	Journal of the Chemical Society
J Chem Soc Chem Commun	Journal of the Chemical Society, Chemical Communications
J Chem Soc Dalton Trans	Journal of the Chemical Society, Dalton Transactions
J Chem Soc Faraday Trans 1	Journal of the Chemical Society, Faraday Transactions 1
J Chem Soc Faraday Trans 2	Journal of the Chemical Society, Faraday Transactions 2
J Chin Soc Hortic Sci	Journal of the Chinese Society for Horticultural Science
J Chromatogr	Journal of Chromatography
J Comput Chem	Journal of Computational Chemistry
J Crop Improv	Journal of Crop Improvement
J Environ Hortic	Journal of Environmental Horticulture

Journal abbreviation	Journal name
J Environ Qual	Journal of Environmental Quality
J Environ Sci Health B	Journal of Environmental Science and Health Part B- Pesticides Food Contaminants and Agricultural Wastes
J Environ Sci Health B	Journal of Environmental Science and Health Part B Pesticides, Food Contaminants, and Agricultural Wastes
J Essent Oil Bear Plants	Journal of Essential Oil Bearing Plants
J Ext	Journal of Extension
J Food Agric Environ	Journal of Food, Agriculture and Environment
J Food Saf	Journal of Food Safety
J Food Technol Pres	Journal of Food Technology and Preservation
J Funct Foods	Journal of Functional Foods
J Herb Med	Journal of Herbal Medicine
J Herb Med	Journal of Herbal Medicine
J Herb Pharmacother	Journal of Herbal Pharmacotherapy
J Hortic Res	Journal of Horticultural Research
J Hortic Sci Biotechnol	Journal of Horticultural Science and Biotechnology
J Integr Agric	Journal of Integrative Agriculture
J Med Food	Journal of Medicinal Food
J Med Plants By-Prod	Journal of Medicinal Plants and By-Products-JMPB
J Membr Biol	Journal of Membrane Biology
J Nat Med	Journal of Natural Medicines
J Plant Nutr	Journal of Plant Nutrition
J Plant Pathol	Journal of Plant Pathology
J Plant Physiol	Journal of Plant Physiology
J Plant Regist	Journal of Plant Registrations
J Sci Food Agric	Journal of the Science of Food and Agriculture
J Sci Food Agric	Journal of the Science of Food and Agriculture
J Sci Food Agric	Journal of the Science of Food and Agriculture
J Seed Sci	Journal of Seed Science
J Soil Sci Plant Nutr	Journal of Soil Science and Plant Nutrition
J Taiwan Soc Hortic Sci	Journal of the Taiwan Society for Horticultural Science
J Trop Agric	Journal of Tropical Agriculture
Mol Breed	Molecular Breeding
Mol Plant Pathol	Molecular Plant Pathology
Mol Plant-Microbe Interact	Molecular Plant-Microbe Interactions
N Z J Crop Hortic Sci	New Zealand Journal of Crop and Horticultural Science
Nat Biotechnol	Nature Microbiology
Nat Cell Biol	Nature Cell Biology
Nat Clim Change	Nature Climate Change
Nat Genet	Nature Genetics
Nat Plants	Nature Plants
Nat Rev Mol Cell Biol	Nature Reviews Molecular Cell Biology

Journal abbreviation	Journal name
Nature	Nature
Outlook Agric	Outlook Agriculture
Philippine J Crop Sci	Philippine Journal of Crop Science
Plant Biol	Plant Biology
Plant Biotechnol	Plant Biotechnology
Plant Biotechnol J	Plant Biotechnology Journal
Plant Breed	Plant Breeding
Plant Breed Seed Sci	Plant Breeding and Seed Science
Plant Cell	Plant Cell
Plant Cell Environ	Plant Cell and Environment
Plant Cell Physiol	Plant and Cell Physiology
Plant Cell Tissue Organ Cult	Plant Cell Tissue and Organ Culture
Plant Dis	Plant Disease
Plant Foods Human Nutr	Plant Foods for Human Nutrition
Plant Genet Resour Charact Util	Plant Genetic Resources-Characterizations and Utilization
Plant Genome	Plant Genome
Plant Growth Regul	Plant Growth Regulation
Plant Health Prog	Plant Health Progress
Plant J	Plant Journal
Plant Methods	Plant Methods
Plant Mol Biol	Plant Molecular Biology
Plant Prod Sci	Plant Production Science
Plant Sci	Plant Science
Plant Sci J	Plant Science Journal
Plant Sociol	Plant Sociology
Plant Soil	Plant and Soil
Plant Tissue Cult Biotechnol	Plant Tissue Culture and Biotechnology
Postharvest Biol Technol	Postharvest Biology and Technology
Proc Am Soc Test Mater	Proceedings American Society for Testing and Materials
Propag Ornamental Plants	Propagation of Ornamental Plants
Qual Assur Saf Crops Foods	Quality Assurance and Safety of Crops and Foods
Rec Pat Food Nutr Agric	Recent Patents on Food, Nutrition and Agriculture
Renewable Agric Food Syst	Renewable Agriculture and Food Systems
Res Agric Agron	Research in Agriculture and Agronomy
Res J Pharmacogn	Research Journal of Pharmacognosy
S Afr J Enol Vitic	South African Journal of Enology and Viticulture
Sci Hortic	Scientia Horticulturae
Sci Pap Ser B Hortic	Scientific Papers-Series B-Horticulture
Seed Sci Res	Seed Science Research
Seed Sci Technol	Seed Science and Technology
Seed Technol	Seed Technology

Journal abbreviation	Journal name
Soil Sci Plant Nutr	Soil Science and Plant Nutrition
South-Western J Hortic Biol Environ	South-Western Journal of Horticulture Biology and Environment
Tech Bull Fac Hortic Chiba Univ	Technical Bulletin of Faculty of Horticulture Chiba University
Theor Appl Genet	Theoretical and Applied Genetics
Tree Genet Genomes	Tree Genetics and Genomes
Trends Plant Sci	Trends in Plant Science
Trop Agric	Tropical Agriculturist
Vitis	Vitis

Appendix Table 14-4. List of journal names and abbreviations for use in preparing the References Cited section in ASHS journals (sorted by journal name).

Journal name	Journal abbreviation
Acta Agriculturae Scandinavica	Acta Agric Scand
Acta Agriculturae Scandinavica Section B-Soil and Plant Science	J Agric Scand Sect B Soil Plant Sci
Acta Horticulturae	Acta Hortic
Acta Horticulturae Sinica	Acta Hortic Sin
Advances in Agronomy	Adv Agron
Advances in Applied Microbiology	Adv Appl Microbiol
Advances in Ecological Research	Adv Ecol Res
Advances in Genetics	Adv Genet
Advances in Horticultural Science	Adv Hortic Sci
Advances in Lipid Research	Adv Lipid Res
Advances in Microbial Ecology	Adv Microb Ecol
Advances in Soil Science	Adv Soil Sci
Advances in Water Resources	Adv Water Resour
African Journal of Agricultural Research	Afr J Agric Res
African Journal of Biotechnology	Afr J Biotechnol
Agrarforschung Schweiz (Agricultural Research Switzerland)	Agrarforschung Schweiz
Agribusiness	Agribusiness
Agricultural Administration and Extension	Agric Admin Ext
Agricultural and Biological Chemistry	Agric Biol Chem
Agricultural and Environmental Letters	Agric Environ Lett
Agricultural and Food Science	Agric Food Sci
Agricultural Biology	Agric Biol
Agricultural Economics Research	Agric Econ Res
Agricultural Food Science	Agric Food Sci
Agricultural History	Agric Hist
Agricultural Information Development Bulletin	Agric Inf Dev Bull
Agricultural Meteorology	Agric Meteorol
Agricultural Research and Technology	Agric Res Technol
Agricultural Reviews	Agric Rev
Agricultural Systems	Agric Syst
Agriculture (Basel, Switzerland)	Agriculture
Agriculture and Environment	Agric Environ
Agriculture and Forest Meteorology	Agric For Meteorol

Journal name	Journal abbreviation
Agriculture and Human Values	Agric Human Values
Agriculture, Ecosystems and Environment	Agric Ecosyst Environ
Agrochemistry and Soil Science	AgroChem Soil Sci
Agrochemophysica	Agrochemophysica
Agrochimica	Agrochimica
Agroecology and Sustainable Food Systems	Agroecol Sustain Food Syst
Agronomy for Sustainable Development	Agron Sustain Dev
Agronomy Journal	Agron J
AgroPlantae	Agroplantae
AIMS Agriculture and Food	IIMS Agric Food
Alexandria Journal of Agricultural Sciences	Alexandria J Agric Res
American Institute Chemical Engineers Journal	AIChE J
American Journal of Agricultural Economics	Am J Agric Econ
American Journal of Alternative Agriculture	Am J Altern Agric
American Journal of Botany	Am J Bot
American Journal of Clinical Nutrition	Am J Clin Nutr
American Journal of Enology and Viticulture	Am J Enol Vitic
American Journal of Potato Research	Am J Potato Res
American Journal of Science	Am J Sci
American Laboratory	Am Lab
American Potato Journal	Am Potato J
Analytical Biochemistry	Anal Biochem
Analytical Chemistry	Anal Chem
Analytical Chimica Acta	Anal Chim Acta
Analytical Letters	Anal Lett
Angewandte Botanik (Journal of Applied Botany)	Angew Bot
Annales Agriculturae Fenniae	Ann Agric Fenn
Annals of Agricultural and Crop Sciences	Ann Agric Crop Sci
Annals of Agricultural Sciences	Ann Agric Sci
Annals of Agronomy	Ann Agron
Annals of Applied Biology	Ann Appl Biol
Annals of Applied Statistics	Ann Appl Stat
Annals of Arid Zone	Ann Arid Zone
Annals of Botany	Ann Bot
Annals of Forest Science	Ann For Sci
Annals of Geophysics	Ann Geophys
Annals of Mathematical Statistics	Ann Math Stat
Annals of Microbiology	Ann Microbiol
Annals of Probability	Ann Probab
Annals of Statistics	Ann Stat
Annals of the Institute of Statistical Mathematics	Ann Inst Stat Math

Journal name	Journal abbreviation
Annals of the New York Academy of Sciences	Ann N Y Acad Sci
Annual Reports on NMR Spectroscopy	Annu Rep NMR Spectrosc
Annual Review of Biochemistry	Annu Rev Biochem
Annual Review of Cell Biology	Annu Rev Cell Biol
Annual Review of Ecology, Evolution, and Systematics	Annu Rev Ecol Syst
Annual Review of Entomology	Annu Rev Entomol
Annual Review of Food Science and Technology	Annu Rev Food Sci Technol
Annual Review of Microbiology	Annu Rev Microbiol
Annual Review of Physical Chemistry	Annu Rev Phys Chem
Annual Review of Phytopathology	Annu Rev Phytopathol
Annual Review of Plant Biology	Annu Rev Plant Biol
Annual Review of Plant Physiology	Annu Rev Plant Physiol
Annual Review of Plant Physiology and Plant Molecular Biology	Annu Rev Plant Physiol Plant Mol Biol
Antonie van Leeuwenhoek	Antonie van Leeuwenhoek
Applications in Plant Sciences	Appl Plant Sci
Applied and Environmental Microbiology	Appl Environ Microbiol
Applied Engineering in Agriculture	Appl Eng Agric
Applied Entomology and Phytopathology	Appl Entomol Phytopathol
Applied Microbiology	Appl Microbiol
Applied Microbiology and Biotechnology	Appl Microbiol Biotechnol
Applied Soil Ecology	Appl Soil Ecol
Applied Spectroscopy	Appl Spectrosc
Applied Turfgrass Science	Appl Turfgrass Sci
Arab Journal of Plant Protection	Arab J Plant Prot
Arboricultural Journal	Arboric J
Archives of Biochemistry and Biophysics	Arch Biochem Biophys
Archives of Environmental Contamination and Toxicology	Arch Environ ContAm Toxicol
Archives of Phytopathology and Plant Protection	Arch Phytopathol Plant Prot
Arid Zone Research	Arid Zone Res
Arnoldia	Arnoldia
Asian Journal of Agricultural Research	Asian J Agric Res
Asian Journal of Agriculture and Food Science	Asian J Agric Food Sci
Asian Journal of Plant Pathology	Asian J Plant Pathol
Asian Journal of Plant Science and Research	Asian J Plant Sci Res
Atmospheric Environment	Atmos Environ
Atomic Spectroscopy	At Spectrosc
Australian Journal of Agricultural Research	Aust J Agric Res
Australian Journal of Biological Science	Aust J Biol Sci
Australian Journal of Chemistry	Aust J Chem
Australian Journal of Experimental Agriculture	Aust J Exp Agric

Journal name	Journal abbreviation
Australian Journal of Grape Wine Research	Aust J Grape Wine Res
Australian Journal of Plant Physiology	Aust J Plant Physiol
Australian Journal of Soil Research	Aust J Soil Res
Austrian Journal of Botany	Aust J Bot
Bamboo Science and Culture	Bamboo Sci Cult
Berichte der Deutschen Chemischen Gesellschaft	Ber Dtsch Chem Ges
Better Crops with Plant Food	Better Crops Plant Food
Biochemical Journal	Biochem J
Biochemical Society Transactions	Biochem Soc Trans
Biochemical Systematics and Ecology	Biochem Syst Ecol
Biochemie und Physiologie der Pflanzen	Biochem Physiol Pflanz
Biochemistry and Molecular Biology Journal	Biochem Mol Biol J
Biochimica et Biophysica Acta	Biochim Biophys Acta
Biochimie	Biochimie
Biologia Plantarum	Biol Plant
Biological Agriculture and Horticulture	Biol Agric Hortic
Biological Agriculture and Horticulture	Biol Agric Hortic
Biological Mass Spectrometry	Biol Mass Spectrom
Biology and Fertility of Soils	Biol Fert Soils
Biology and Fertility of Soils	Biol Fert Soil
Biometrics	Biometrics
Biometrics (<i>previous title for Biometrics Bulletin</i>)	Biometr Bull
Biometrika	Biometrika
Bioresource Technology	Bioresour Technol
Bioscience, Biotechnology, and Biochemistry	Biosci Biotechnol Biochem
Biotechnology Progress	Biotechnol Prog
Biotropica	Biotropica
BMC Plant Biology	BMC Plant Biol
Botanical Bulletin of Academia Sinica	Bot Bull Acad Sin
Botanical Gazette	Bot Gaz
Botanical Journal of the Linnean Society	Bot J Linnean Soc
Botanika Chronika Patras	Bot Chron (Patras)
Boundary-Layer Meteorology	Boundary-Layer Meteorol
Bradleya	Bradleya
British Journal of Applied Physics	Br J Appl Phys
Bulgarian Journal of Agricultural Science	Bulg J Agric Sci
Bulletin of Environmental Contamination and Toxicology	Bull Environ ContAm Toxicol
Bulletin of the American Meteorological Society	Bull Am Meteorol Soc
Bulletin of the Chemical Society of Japan	Bull Chem Soc Jpn
Bulletin of the Torrey Botanical Club	Bull Torrey Bot Club
Bulletin of Yale University School for Environmental Studies	Bull Yale Univ Sch For Environ Stud

Journal name	Journal abbreviation
California Agricultural Experiment Station Circular	Calif Agric Exp Stn Circ
California Agriculture	Calif Agric (Berkeley)
Canadian Journal of Agricultural Science	Can J Agric Sci
Canadian Journal of Biochemistry and Physiology	Can J Biochem Physiol
Canadian Journal of Botany	Can J Bot
Canadian Journal of Chemistry	Can J Chem
Canadian Journal of Fisheries and Aquatic Sciences	Can J Fish Aquat Sci
Canadian Journal of Forest Research	Can J For Res
Canadian Journal of Genetics and Cytology	Can J Genet Cytol
Canadian Journal of Microbiology	Can J Microbiol
Canadian Journal of Physics	Can J Phys
Canadian Journal of Plant Pathology	Can J Plant Pathol
Canadian Journal of Plant Science	Can J Plant Sci
Canadian Journal of Soil Science	Can J Soil Sci
Canadian Journal of Spectroscopy	Can J Spectrosc
Caryologia International Journal of Cytology, Cytosystematics and Cytogenetics	Caryologia
Cell and Tissue Research	Cell Tissue Res
Cell Death and Differentiation	Cell Death Differ
Cellular and Molecular Biology	Cell Mol Biol
Cellular and Molecular Life Sciences	Cell Mol Life Sci
Chemical Abstracts	Chem Abstr
Chemical Engineering Science	Chem Eng Sci
Chemical Geology	Chem Geol
Chemical Physics Letters	Chem Phys Lett
Chemical Reviews	Chem Rev
Chemistry and Physics of Lipids	Chem Phys Lipids
Chemosphere	Chemosphere
Chinese Herbal Medicines	Chin Herb Med
Chronicle of Higher Education	Chron Higher Educ
CIM Bulletin	CIM Bull
Climate Change	Clim Change
Clinical Toxicology	Clin Toxicol
Collection of Czechoslovak Chemical Communications	Collect Czech Chem Commun
Communications in Agricultural and Applied Biological Sciences	Commun Agric Appl Biol Sci
Communications in Soil Science and Plant Analysis	Commun Soil Sci Plant Anal
Compost Science and Utilization	Compost Sci Util
Comptes-rendus de l'Académie Académie d'Agriculture de France	C R Acad Agric Fr
Computer Applications in the Biosciences	Comput Appl Biosci

Journal name	Journal abbreviation
Computer Physics Communications	Comput Phys Commun
Computers and Electronics in Agriculture	Comput Electron Agric
Computers and Geosciences	Comput Geosci
Critical Reports on Applied Chemistry	Crit Rep Appl Chem
Critical Reviews in Analytical Chemistry	Crit Rep Anal Chem
Critical Reviews in Biochemistry	Crit Rev Biochem
Critical Reviews in Biochemistry and Molecular Biology	Crit Rev Biochem Mol Biol
Critical Reviews in Biotechnology	Crit Rev Biotechnol
Critical Reviews in Environmental Control	Crit Rev Environ Control
Critical Reviews in Food Science and Nutrition	Crit Rev Food Sci Nutr
Critical Reviews in Microbiology	Crit Rev Microbiol
Critical Reviews in Plant Science	Crit Rev Plant Sci
Croatica Chemica Acta	Croat Chem Acta
Crop Breeding and Applied Biotechnology	Crop Breed Appl Biotechnol
Crop Forage and Turfgrass Management	Crop Forage Turfgrass Manage
Crop Journal	Crop J
Crop Protection	Crop Prot
Crop Science	Crop Sci
Crop, Forage and Turfgrass Management	Crop Forage Turfgrass Manage
Cryobiology	Cryobiology
Cucurbit Genetics Cooperative Report	Cucurbit Genet Coop Rep
Current Biology	Curr Biol
Current Genetics	Curr Genet
Current Microbiology	Curr Microbiol
Current Opinion in Cell Biology	Curr Opin Cell Biol
Current Opinion in Structural Biology	Curr Opin Struct Biol
Current Research in Nutrition and Food Science	Curr Res Nutr Food Sci
Current Science	Curr Sci
Current Topics in Nutraceutical Research	Curr Top Nutraceutical Res
Cytologia	Cytologia
Czech Journal of Genetics and Plant Breeding	Czech J Genet Plant Breed
Developments in Industrial Microbiology	Dev Ind Microbiol
DNA and Cell Biology	DNA Cell Biol
Down to Earth	Down Earth
Ecological Applications	Ecol Applic
Ecological Modelling	Ecol Modell
Ecological Monographs	Ecol Monogr
Ecology	Ecology
Econometrica: Journal of the Econometric Society	Econometrica
Economic Botany	Econ Bot
Economic Development and Cultural Change	Econ Dev Cult Change

Journal name	Journal abbreviation
Ecotoxicology and Environmental Safety	Ecotoxicol Environ Saf
Egyptian Journal of Horticulture	Egypt J Hortic
Egyptian Journal of Soils Science	Egypt J Soil Sci
Emirates Journal of Food and Agriculture	Emir J Food Agric
Empire Journal of Experimental Agriculture	Emp J Exp Agric
Engineering Geology	Eng Geol
Entomologia Experimentalis et Applicata	Entomol Exp Appl
Environment and Pollution (Toronto, Ont)	Environ Pollut (Tor)
Environment International	Environ Int
Environmental and Experimental Botany	Environ Exp Bot
Environmental Entomology	Environ Entomol
Environmental Geology and Water Sciences	Environ Geol Water Sci
Environmental Letters	Environ Lett
Environmental Pollution	Environ Pollut
Environmental Science and Technology	Environ Sci Technol
Environmental Science and Technology Letters	Environ Sci Technol Lett
Environmental Toxicology and Chemistry	Environ Toxicol Chem
Enzymologia	Enzymologia
Estuarine and Coastal Marine Science	Estuarine Coastal Mar Sci
Euphytica: Netherlands Journal of Plant Breeding	Euphytica
Eurasian Soil Science	Euras Soil Sci
European and Mediterranean Plant Protection Organization Bulletin	EPPO Bull
European Journal of Horticultural Science	Eur J Hortic Sci
European Journal of Plant Pathology	Eur J Plant Pathol
European Molecular Biology Organization Journal	EMBO J
Experimental Agriculture	Exp Agric
Experimental Cell Research	Exp Cell Res
Family Economics Review	FAm Econ Rev
FEMS Microbiology Ecology	FEMS Microbiol Ecol
FEMS Microbiology Immunology	FEMS Microbiol Immunol
FEMS Microbiology Letters	FEMS Microbiol Lett
FEMS Microbiology Reviews	FEMS Microbiol Rev
Fertilizer Research	Fert Res
Field Crop Abstracts	Field Crop Abstr
Field Crops Research	Field Crops Res
Flowering Plants of Africa	Flowering Plants Afr
Folia Horticulturae	Folia Hortic
Folia Horticulturae	Folia Hortic
Food and Agricultural Immunology	Food Agric Immunol
Food and Environmental Virology	Food Environ Virol

Journal name	Journal abbreviation
Food and Nutrition	Food Nutr (Roma)
Food Science and Biotechnology	Food Sci Biotechnol
Food Science and Human Wellness	Food Sci Human Wellness
Forest Ecology and Management	For Ecol Manage
Forestry	Forestry
Forestry Science	For Sci
Fresenius' Zeitschrift für Analytische Chemie	Fresenius Z Anal Chem
Frontiers in Ecology and the Environment	Front Ecol Environ
Frontiers in Plant Science	Front Plant Sci
Frontiers in Sustainable Food Systems	Front Sustain Food Syst
Frontiers of Agricultural Science and Engineering	Front Agric Sci Eng
Fruit Growing Research	Fruit Growing Res
Fruits	Fruits
Functional Foods in Health and Disease	Funct Foods Health Dis
Future of Food-Journal on Food Agriculture and Society	Future Food J Food Agric Soc
Gayana Botánica	Gayana Bot
General and Applied Plant Physiology	Gen Appl Plant Physiol
Genes and Development	Genes Dev
Genetic Resources and Crop Evolution	Gent Resour Crop Evol
Genetics	Genetics
Genetics and Molecular Research	Genet Mol Res
Genome	Genome
Geochemistry International	Geochem Int
Geochimica et Cosmochimica Acta	Geochim Cosmochim Acta
Geoderma	Geoderma
Geographical Review	Geogr Rev
Geological Magazine	Geol Mag
Geological Society of America Bulletin	Geol Soc Am Bull
Geological Society of America Special Papers	Geol Soc Am Spec Pap
Geology	Geology
Geophysics	Geophysics
Geophysics Research Letters	Geophys Res Lett
Geotechnical Testing Journal	Geotech Test J
Géotechnique	Geotechnique
GM Crops and Food-Biotechnology in Agriculture and the Food Chain	GM Crops Food Biotechnol Agric Food Chain
Ground Water Monitoring Review	Ground Water Monit Rev
Groundwater	Groundwater
Harvard Papers in Botany	Harv Pap Bot
Hawaii Institute of Tropical Agriculture and Human Resources Research Extension Series	Hawaii Inst Trop Agric Human Resour Res Ext Ser

Journal name	Journal abbreviation
Health Physics	Health Phys
HerbalGram	HerbalGram
Heredity	Heredity
Hildgardia	Hildgardia
History of Agriculture	Hist Agric
Horticultura Brasileira	Hortic Bras
Horticulturae	Horticulturae
Horticultural Plant Journal	Hortic Plant J
Horticultural Science	Hortic Sci
Horticultural Science and Technology	Hortic Sci Technol
Horticulture Journal	Hortic J
Horticulture Research	Hortic Res
Horticulture Reviews	Hortic Rev
Horticulture Science	Hortic Sci
Horticulture, Environment, and Biotechnology	Hortic Environ Biotechnol
HortScience	HortScience
HortTechnology	HortTechnology
Hunan Agricultural Science and Technology	Hunan Agric Sci Technol
Hydrobiologia	Hydrobiologia
IEEE Transactions on Geoscience and Remote Sensing	IEEE Trans Geosci Remote Sens
IEEE Transactions on Nuclear Science	IEEE Trans Nucl Sci
Illinois Agricultural Economics	Ill Agric Econ
Indian Journal of Agricultural Sciences	Indian J Agric Sci
Indian Journal of Agronomy	Indian J Agron
Indian Journal of Experimental Biology	Indian J Exp Biol
Indian Journal of Experimental Botany	Indian J Exp Bot
Indian Journal of Genetics and Plant Breeding	Indian J Genet Plant Breed
Indian Journal of Horticulture	Indian J Hortic
Indian Journal of Plant Protection	Indian J Plant Prot
Indian Journal of Pure and Applied Physics	Indian J Pure Appl Phys
Industrial and Engineering Chemistry	Ind Eng Chem
Insect Biochemistry and Molecular Biology	Insect Biochem Mol Biol
International Association of Hydrological Sciences Publications	IAHS Publ
International Journal of Agricultural Technology	Int J Agric Technol
International Journal of Environmental Analytical Chemistry	Int J Environ Anal Chem
International Journal of Environmental and Agriculture Research	Int J Environ Agric Res
International Journal of Food Microbiology	Int J Food Microbiol
International Journal of Fruit Science	Int J Fruit Sci
International Journal of Heat and Mass Transfer	Int J Heat Mass Transfer

Journal name	Journal abbreviation
International Journal of Herbal Medicine	Int J Herb Med
International Journal of Plant Sciences	Int J Plant Sci
International Journal of Tropical Agriculture	Int J Trop Agric
International Rice Research Newsletter	Int Rice Comm Newsl
International Turfgrass Society Research Journal	Int Turfgrass Soc Res J
Invasive Plant Science and Management	Invasive Plant Sci Manage
Iowa State Journal of Research	Iowa State J Res
Irrigation Science	Irrig Sci
Israel Journal of Agricultural Research	Isr J Agric Res
Israel Journal of Botany	Isr J Bot
Israel Journal of Chemistry	Isr J Chem
Issues in Science and Technology	Issues Sci Technol
Journal of Agricultural and Food Chemistry	J Agric Food Chem
Journal of Agricultural and Resource Economics	J Agri Resour Econ
Journal of Agricultural Economics	J Agric Econ
Journal of Agricultural Education	J Agric Educ
Journal of Agricultural Engineering	J Agric Eng
Journal of Agricultural Engineering Research	J Agric Eng Res
Journal of Agricultural Meteorology	J Agric Meterol
Journal of Agricultural Research	J Agric Res
Journal of Agricultural Safety and Health	J Agric Saf Health
Journal of Agriculture and Food Technology	J Agric Food Technol
Journal of Agriculture, Food Systems, and Community Development	J Agric Food Syst Community Dev
Journal of Agrobiology	J Agrobiol
Journal of Agromedicine	J Agromedicine
Journal of Agronomy and Crop Science	J Agron Crop Sci
Journal of Analytical and Applied Pyrolysis	J Anal Appl Pyrolysis
Journal of AOAC International	J AOAC Int
Journal of Applied and Environmental Microbiology	J Appl Environ Microbiol
Journal of Applied Bacteriology	J Appl Bacteriol
Journal of Applied Botany and Food Quality	J Appl Bot Food Qual
Journal of Applied Ecology	J Appl Ecol
Journal of Applied Horticulture	J Appl Hortic
Journal of Applied Meteorology	J Appl Meteorol
Journal of Applied Physics	J Appl Phys
Journal of Applied Research on Medicinal and Aromatic Plants	J Appl Res Med Aromat Plants
Journal of Applied Seed Production	J Appl Seed Prod
Journal of Arboriculture	J Arboric
Journal of Arid Environments	J Arid Environ

Journal name	Journal abbreviation
Journal of Atmospheric Chemistry	J Atmos Chem
Journal of Atmospheric Sciences	J Atmos Sci
Journal of Bacteriology	J Bacteriol
Journal of Bamboo and Rattan	J Bamboo Rattan
Journal of Bamboo Research	J Bamboo Res
Journal of Berry Research	J Berry Res
Journal of Bioenergetics	J Bioenerg
Journal of Biological Chemistry	J Biol Chem
Journal of Biology, Agriculture and Healthcare	J Biol Agric Healthc
Journal of Biopesticides	J Biopestic
Journal of Biophysics	Biophys J
Journal of Chemical Ecology	J Chem Ecol
Journal of Chemical Education	J Chem Educ
Journal of Chemical Physics	J Chem Phys
Journal of Chromatography	J Chromatogr
Journal of Computational Chemistry	J Comput Chem
Journal of Crop Improvement	J Crop Improv
Journal of Economic Entomology	Econ Entomol
Journal of Electroanalytical Chemistry (Lausanne, Switzerland)	ElectroAnal Chem (Lausanne)
Journal of Environmental Horticulture	J Environ Hortic
Journal of Environmental Quality	J Environ Qual
Journal of Environmental Science and Health Part B- Pesticides Food Contaminants and Agricultural Wastes	J Environ Sci Health B
Journal of Environmental Science and Health Part B Pesticides, Food Contaminants, and Agricultural Wastes	J Environ Sci Health B
Journal of Essential Oil Bearing Plants	J Essent Oil Bear Plants
Journal of Extension	J Ext
Journal of Food Safety	J Food Saf
Journal of Food Technology and Preservation	J Food Technol Pres
Journal of Food, Agriculture and Environment	J Food Agric Environ
Journal of Functional Foods	J Funct Foods
Journal of Herbal Medicine	J Herb Med
Journal of Herbal Medicine	J Herb Med
Journal of Herbal Pharmacotherapy	J Herb Pharmacother
Journal of Horticultural Research	J Hortic Res
Journal of Horticultural Science and Biotechnology	J Hortic Sci Biotechnol
Journal of Integrative Agriculture	J Integr Agric
Journal of Medicinal Food	J Med Food
Journal of Medicinal Plants and By-Products-JMPB	J Med Plants By-Prod
Journal of Membrane Biology	J Membr Biol

Journal name	Journal abbreviation
Journal of Natural Medicines	J Nat Med
Journal of Plant Nutrition	J Plant Nutr
Journal of Plant Nutrition and Soil Science	J Pant Nutr Soil Sci
Journal of Plant Pathology	J Plant Pathol
Journal of Plant Physiology	J Plant Physiol
Journal of Plant Registrations	J Plant Regist
Journal of Seed Science	J Seed Sci
Journal of Soil Science and Plant Nutrition	J Soil Sci Plant Nutr
Journal of the Air Pollution Control Association	J Air Pollut Control Assoc
Journal of the American Chemical Society	J Am Chem Soc
Journal of the American Pomological Society	J Am Pomol Soc
Journal of the American Society for Horticultural Science	J Am Soc Hortic Sci
Journal of the American Society of Agronomy	J Am Soc Agron
Journal of the American Society of Sugar Beet Technologists	J Am Soc Sugar Beet Technol
Journal of the American Statistical Association	J Am Stat Assoc
Journal of the American Statistical Association	J Am Stat Assoc
Journal of the American Water Works Association	J Am Water Works Assoc
Journal of the Association of Official Agricultural Chemists	J Assoc Off Agric Chem
Journal of the Association of Official Analytical Chemists	J Assoc Off Anal Chem
Journal of the Chemical Society	J Chem Soc
Journal of the Chemical Society, Chemical Communications	J Chem Soc Chem Commun
Journal of the Chemical Society, Dalton Transactions	J Chem Soc Dalton Trans
Journal of the Chemical Society, Faraday Transactions 1	J Chem Soc Faraday Trans 1
Journal of the Chemical Society, Faraday Transactions 2	J Chem Soc Faraday Trans 2
Journal of the Chinese Society for Horticultural Science	J Chin Soc Hortic Sci
Journal of the Science of Food and Agriculture	J Sci Food Agric
Journal of the Science of Food and Agriculture	J Sci Food Agric
Journal of the Science of Food and Agriculture	J Sci Food Agric
Journal of the Taiwan Society for Horticultural Science	J Taiwan Soc Hortic Sci
Journal of Tropical Agriculture	J Trop Agric
Molecular Breeding	Mol Breed
Molecular Plant Pathology	Mol Plant Pathol
Molecular Plant-Microbe Interactions	Mol Plant-Microbe Interact
Nature	Nature
Nature Cell Biology	Nat Cell Biol
Nature Climate Change	Nat Clim Change
Nature Genetics	Nat Genet
Nature Microbiology	Nat Biotechnol
Nature Plants	Nat Plants
Nature Reviews Molecular Cell Biology	Nat Rev Mol Cell Biol
New Zealand Journal of Crop and Horticultural Science	N Z J Crop Hortic Sci

Journal name	Journal abbreviation
Outlook Agriculture	Outlook Agric
Philippine Journal of Crop Science	Philippine J Crop Sci
Plant and Cell Physiology	Plant Cell Physiol
Plant and Soil	Plant Soil
Plant Biology	Plant Biol
Plant Biotechnology	Plant Biotechnol
Plant Biotechnology Journal	Plant Biotechnol J
Plant Breeding	Plant Breed
Plant Breeding and Seed Science	Plant Breed Seed Sci
Plant Cell	Plant Cell
Plant Cell and Environment	Plant Cell Environ
Plant Cell Tissue and Organ Culture	Plant Cell Tissue Organ Cult
Plant Disease	Plant Dis
Plant Foods for Human Nutrition	Plant Foods Human Nutr
Plant Genetic Resources-Characterizations and Utilization	Plant Genet Resour Charact Util
Plant Genome	Plant Genome
Plant Growth Regulation	Plant Growth Regul
Plant Health Progress	Plant Health Prog
Plant Journal	Plant J
Plant Methods	Plant Methods
Plant Molecular Biology	Plant Mol Biol
Plant Production Science	Plant Prod Sci
Plant Science	Plant Sci
Plant Science Journal	Plant Sci J
Plant Sociology	Plant Sociol
Plant Tissue Culture and Biotechnology	Plant Tissue Cult Biotechnol
Postharvest Biology and Technology	Postharvest Biol Technol
Proceedings American Society for Testing and Materials	Proc Am Soc Test Mater
Propagation of Ornamental Plants	Propag Ornamental Plants
Quality Assurance and Safety of Crops and Foods	Qual Assur Saf Crops Foods
Recent Patents on Food, Nutrition and Agriculture	Rec Pat Food Nutr Agric
Renewable Agriculture and Food Systems	Renewable Agric Food Syst
Research in Agriculture and Agronomy	Res Agric Agron
Research Journal of Pharmacognosy	Res J Pharmacogn
Scientia Horticulturae	Sci Hortic
Scientific Papers-Series B-Horticulture	Sci Pap Ser B Hortic
Seed Science and Technology	Seed Sci Technol
Seed Science Research	Seed Sci Res
Seed Technology	Seed Technol
Soil Science and Plant Nutrition	Soil Sci Plant Nutr
South African Journal of Enology and Viticulture	S Afr J Enol Vitic

Journal name	Journal abbreviation
South-Western Journal of Horticulture Biology and Environment	South-Western J Hortic Biol Environ
Technical Bulletin of Faculty of Horticulture Chiba University	Tech Bull Fac Hortic Chiba Univ
The Agricultural History Review	Agric Hist Rev
The Botanical Review: Interpreting Botanical Progress	Bot Rev
The Canadian Entomologist	Can Entomol
The Computer Journal	Comput J
The East African Agricultural Journal	East Afr Agric For J
The Herbal Review	Herb Rev
The Herbarist	Hebarist
The Journal of Agricultural Science	J Agric Sci
Theoretical and Applied Genetics	Theor Appl Genet
Tree Genetics and Genomes	Tree Genet Genomes
Trends in Plant Science	Trends Plannt Sci
Tropical Agriculturist	Trop Agric
Vitis	Vitis

Appendix Table 15-1. List of terms and abbreviations with guidelines for use in ASHS journals.

Terms	Abbreviation	Guidelines
active ingredient	a.i.	Abbreviation allowed without definition in all parts of manuscript.
at	@	Abbreviation not allowed.
average	avg	Abbreviation allowed without definition, but only in tables and figures.
base pair	bp	Abbreviation allowed without definition in all parts of manuscript.
botanical variety	var.	Abbreviation allowed without definition but may only be used in formal nomenclature. Do not use for cultivar.
by	×	Abbreviation allowed without definition to designate dimension or interaction. Use the small math symbol ×; do not use asterisk (*).
chilling injury	CI	Abbreviation allowed with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table, and each figure) [i.e., chilling injury (CI)]; abbreviation to be used thereafter.
company	Co.	Abbreviation allowed with definition, but only when used as part of a proper noun.
concentration	concn	Abbreviation allowed without definition, but only in tables and figures.
controlled atmosphere	CA	Abbreviation allowed with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table, and each figure) [i.e., controlled atmosphere (CA)]; abbreviation to be used thereafter.
cross species (interspecific hybrid)	×	Abbreviation allowed without definition. Use the small math symbol × with no space between the symbol and the specific epithet.

Terms	Abbreviation	Guidelines
crossed with	×	Abbreviation allowed without definition. Use the small math symbol ×.
cultivar	cv., cvs.	Abbreviation allowed without definition, but only with formal nomenclature. Do not use for botanical variety.
diameter	diam	Abbreviation allowed without definition, but only in tables and figures.
dry mass	DM	Abbreviation allowed with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table, and each figure) [i.e., dry mass (DM)]; abbreviation to be used thereafter.
dry weight	DW	Abbreviation allowed with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table, and each figure) [i.e., dry weight (DW)]; abbreviation to be used thereafter.
electrical conductivity	EC	Abbreviation allowed with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table, and each figure) [i.e., electrical conductivity (EC)]; abbreviation to be used thereafter.
enzyme-linked immunosorbent assay	ELISA	Abbreviation allowed with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table, and each figure) [i.e., enzyme-linked immunosorbent assay (ELISA)]; abbreviation to be used thereafter.
equation	Eq., Eqs.	Abbreviation allowed without definition. Use abbreviation only with numerals. Enclose numerals in brackets, e.g., Eq. [1], Eqs. [2] to [4].
experiment	Expt., Expts.	Abbreviation allowed without definition. Use abbreviation with numerals in the text and in table column heads (e.g., Expt. 1, Expts. 1 and 3).
figure	Fig., Figs.	Abbreviation allowed without definition. Use abbreviation only with numerals (e.g., Fig. 3, Figs. 2-4).
filial generation	F ₁ , F ₂	Abbreviation allowed without definition. Use subscripts for generation numbers; do not use F1, F2, etc.
fresh mass	FM	Abbreviation allowed with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table,

Terms	Abbreviation	Guidelines
		and each figure) [i.e., fresh mass (FM)]; abbreviation to be used thereafter.
fresh weight	FW	Abbreviation allowed with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table, and each figure) [i.e., fresh weight (FW)]; abbreviation to be used thereafter.
gas-liquid chromatography	GLC	Abbreviation allowed with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table, and each figure) [i.e., gas-liquid chromatography (GLC)]; abbreviation to be used thereafter.
height	ht	Abbreviation allowed without definition, but only in tables and figures.
high-performance liquid chromatography	HPLC	Abbreviation allowed with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table, and each figure) [i.e., high-performance liquid chromatography (HPLC)]; abbreviation to be used thereafter.
infrared	IR	Abbreviation allowed with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table, and each figure) [i.e., infrared (IR)]; abbreviation to be used thereafter.
inside diameter	i.d.	Abbreviation allowed without definition in most sections; do not use abbreviation in the Abstract.
latitude	lat.	Abbreviation allowed without definition but use abbreviation only with coordinates.
logarithm, common (to base 10)	log	Abbreviation allowed without definition but use abbreviation only with numerals.
logarithm, natural	ln	Abbreviation allowed without definition but use abbreviation only with numerals.
longitude	long.	Abbreviation allowed without definition but use abbreviation only with coordinates.

Terms	Abbreviation	Guidelines
magnification, power of	×	Abbreviation allowed without definition. Use the small math symbol ×. Use abbreviation before magnification with no space (e.g., ×40).
mix ratio (volume)	v/v	Abbreviation allowed without definition but use only with numerals.
mix ratio (mass)	w/w	Abbreviation allowed without definition but use only with numerals.
modified atmosphere	MA	Abbreviation allowed with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table, and each figure) [i.e., modified atmosphere (MA)]; abbreviation to be used thereafter.
net photosynthesis	Pn	Abbreviation allowed with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table, and each figure) [i.e., net photosynthesis (Pn)]; abbreviation to be used thereafter.
number	no.	Abbreviation allowed without definition. Use only in tables and figures; do not use number sign (#).
outside diameter	o.d.	Abbreviation allowed without definition in most sections; do not use abbreviation in the Abstract.
parental generation	P1, P2	Abbreviation allowed without definition. Use capital letters without subscripts to indicate parents (e.g., P1, P2); do not use with subscripts (e.g., P ₁ , P ₂).
photosynthetic photon flux	PPF	Abbreviation allowed with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table, and each figure) [i.e., photosynthetic photon flux (PPF)]; abbreviation to be used thereafter.
photosynthetic photon flux density	PPFD	Abbreviation allowed, with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table, and each figure) [i.e., photosynthetic photon flux density (PPFD)]; abbreviation may be used thereafter.

Terms	Abbreviation	Guidelines
photosynthetically active radiation	PAR	Abbreviation allowed with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table, and each figure) [i.e., photosynthetically active radiation (PAR)]; abbreviation to be used thereafter.
polyvinyl chloride	PVC	Abbreviation allowed with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table, and each figure) [i.e., polyvinyl chloride (PVC)]; abbreviation to be used thereafter.
randomly amplified polymorphic DNA	RAPD	Abbreviation allowed with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table, and each figure) [i.e., randomly amplified polymorphic DNA (RAPD)]; abbreviation to be used thereafter.
relative humidity	RH	Abbreviation allowed with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table, and each figure) [i.e., relative humidity (RH)]; abbreviation to be used thereafter.
restricted fragment length polymorphism	RFLP	Abbreviation allowed with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table, and each figure) [i.e., restricted fragment length polymorphism (RFLP)]; abbreviation to be used thereafter.
scanning electron microscopy	SEM	Abbreviation allowed with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table, and each figure) [i.e., scanning electron microscopy (SEM)]; abbreviation to be used thereafter.
species (singular or plural)	sp.	Abbreviation allowed without definition, but may only be used in formal nomenclature; do not use spp.
subspecies	ssp.	Abbreviation allowed without definition, but may only be used in formal nomenclature; do not use spp. or subsp.
temperature	temp	Abbreviation allowed without definition only in tables and figures.
thin-layer chromatography	TLC	Abbreviation allowed with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table, and each figure) [i.e., thin-layer chromatography (TLC)]; abbreviation to be used thereafter.

Terms	Abbreviation	Guidelines
transmission electron microscopy	TEM	Abbreviation allowed with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table, and each figure) [i.e., transmission electron microscopy (TEM)]; abbreviation to be used thereafter.
ultraviolet	UV	Abbreviation allowed with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table, and each figure) [i.e., ultraviolet (UV)]; abbreviation to be used thereafter.
volume	vol	Abbreviation allowed without definition only in tables and figures.
weight	wt	Abbreviation allowed without definition only in tables and figures. Use “weight” only in HortTechnology. Use “mass” in HortScience and JASHS.
wettable powder	WP	Abbreviation allowed with definition. Define at first use in each autonomous entity (Abstract, IMRAD block, each table, and each figure) [i.e., wettable powder (WP)]; abbreviation to be used thereafter.

Appendix Table 18-1. United States customary (US) units and International System of Units (SI) units and conversion factors to convert US to SI units and SI to US units as reported in HortTechnology table footnotes and figure captions.

To convert US unit to SI unit, multiply US unit by:	US unit	SI unit	To convert SI unit to US unit, multiply SI unit by:
0.01	%	$g \cdot g^{-1}$	100
10	%	$g \cdot kg^{-1}$	0.1
10	%	$g \cdot L^{-1}$	0.1
10	%	$mg \cdot g^{-1}$	0.1
10	%	$mL \cdot L^{-1}$	0.1
1	%	mL/100 mL	1
0.4047	acre(s)	ha	2.4711
1233.4819	acre-ft	m^3	0.0008
254.0000	acre-inch(es)/acre	$m^3 \cdot ha^{-1}$	0.0039
102.7902	acre-inch(es)	m^3	0.0097
101.3250	atmosphere(s)	kPa	0.0099
0.1013	atmosphere(s)	MPa	9.8692
100	bar(s)	kPa	0.01
0.1	bar(s)	MPa	10
1.0551	Btu	kJ	0.9478
0.0352	bushel(s)	m^3	28.3776
4.1868	calorie(s)	kJ	0.2388
9.2303	calorie(s)/lb	$kJ \cdot kg^{-1}$	0.1083
1	cbar	kPa	1
1.3332	cm Hg	kPa	0.7501
1.3332	cm mercury	kPa	0.7501
3.6246	cord(s)	m^3	0.2759

To convert US unit to SI unit, multiply US unit by:	US unit	SI unit	To convert SI unit to US unit, multiply SI unit by:
45.3592	cwt	kg	0.0220
0.0454	cwt	Mg	22.0462
0.0454	cwt	t	22.0462
112.0851	cwt/acre	kg·ha ⁻¹	0.0089
10.7639	fc	lx	0.0929
29,574	fl oz	μL	3.3814 × 10 ⁻⁵
29.5735	fl oz	mL	0.0338
3.1833	fl oz/100 ft ²	mL·m ⁻²	0.3141
3.1833	fl oz/1000 ft ²	L·ha ⁻¹	0.3141
0.0781	fl oz/100 gal	mL·L ⁻¹	12.8000
0.0731	fl oz/acre	L·ha ⁻¹	13.6840
73.0778	fl oz/acre	mL·ha ⁻¹	0.0137
0.3183	fl oz/ft ²	L·m ⁻²	3.1414
318.3268	fl oz/ft ²	mL·m ⁻²	0.0031
1.0444	fl oz/ft ³	L·m ⁻³	0.9575
1044.3793	fl oz/ft ³	mL·m ⁻³	0.0010
0.7813	fl oz/gal	mL/100 mL	1.2800
7.8125	fl oz/gal	mL·L ⁻¹	0.1280
65.1985	fl oz/lb	mL·kg ⁻¹	0.0153
104.3176	fl oz/oz	mL/100 g	0.0096
35.3696	fl oz/yard ²	mL·m ⁻²	0.0283
38.6807	fl oz/yard ³	mL·m ⁻³	0.0259
0.3048	ft	m	3.2808
9.2903	ft ²	dm ²	0.1076
0.0929	ft ²	m ²	10.7639
0.2296	ft ² /acre	m ² ·ha ⁻¹	4.3560
28.3168	ft ³	L	0.0353

To convert US unit to SI unit, multiply US unit by:	US unit	SI unit	To convert SI unit to US unit, multiply SI unit by:
0.0283	ft ³	m ³	35.3147
0.0700	ft ³ /acre	m ³ ·ha ⁻¹	14.2913
1.3558	ft-lb	J	0.7376
3.7854	gal	L	0.2642
0.1242	gal/100 ft	L·m ⁻¹	8.0520
407.4583	gal/100 ft ²	mL·m ⁻²	0.0025
4074.5851	gal/100 ft ²	L·ha ⁻¹	0.0002
0.4075	gal/100 ft ²	L·m ⁻²	2.4542
9.3540	gal/acre	L·ha ⁻¹	0.1069
40.7458	gal/ft ²	L·m ⁻²	0.0245
0.2540	gauge	μm	3.9370
0.7457	horsepower	kJ·s ⁻¹	1.3410
0.7457	horsepower	kW	1.3410
2.54	inch(es)	cm	0.3937
25.4	inch(es)	mm	0.0394
27.3403	inch(es)/ft ²	cm·m ⁻²	0.0366
3.3864	inch(es) Hg	kPa	0.2953
3.3864	inch(es) mercury	kPa	0.2953
6.4516	inch ²	cm ²	0.1550
0.0645	inch ²	dm ²	15.5000
645.1600	inch ²	mm ²	0.0016
69.4444	inch ² /ft ²	cm ² ·m ⁻²	0.0144
0.2276	inch ² /oz	cm ² ·g ⁻¹	4.3942
16.3871	inch ³	cm ³	0.0610
18.0636	inch ³ /ton	μL·kg ⁻¹	0.0554
4.1868	kilocalorie(s)	MJ	0.2388
0.0450	kilocalorie(s)/ft ²	MJ·m ⁻²	22.2044

To convert US unit to SI unit, multiply US unit by:	US unit	SI unit	To convert SI unit to US unit, multiply SI unit by:
0.5144	knot(s)	m·s ⁻¹	1.9438
3.6000	kWh	MJ	0.2778
38.7501	kWh/ft ²	MJ·m ⁻²	0.0258
0.0418	langley(s)	MJ·m ⁻²	23.9006
0.4536	lb	kg	2.2046
488.2430	lb/100 ft ²	kg·ha ⁻¹	0.0020
1.1983	lb/100 gal	g·L ⁻¹	0.8345
0.0015	lb/1000 ft	kg·m ⁻¹	671.9658
4.8824	lb/1000 ft ²	g·m ⁻²	0.2048
48.8243	lb/1000 ft ²	kg·ha ⁻¹	0.0205
0.4882	lb/1000 ft ²	kg/100 m ²	2.0482
1.1209	lb/acre	kg·ha ⁻¹	0.8922
1.4882	lb/ft	kg·m ⁻¹	0.6720
4.8824	lb/ft ²	kg·m ⁻²	0.2048
0.0160	lb/ft ³	g·cm ⁻³	62.4274
16.0185	lb/ft ³	kg·m ⁻³	0.0624
119.8264	lb/gal	g·L ⁻¹	0.0083
0.1198	lb/gal	kg·L ⁻¹	8.3454
0.0703	lb/inch ²	kg·cm ⁻²	14.2233
0.5	lb/ton	kg·Mg ⁻¹	2
0.5	lb/ton	kg·t ⁻¹	2
0.5425	lb/yard ²	kg·m ⁻²	1.8433
0.5933	lb/yard ³	kg·m ⁻³	1.6856
4.4482	lbf	N	0.2248
0.1751	lbf/inch	N·mm ⁻¹	5.7101
1.3558	lbf ft	N·m	0.7376
1	meq/g	mol·kg ⁻¹	1

To convert US unit to SI unit, multiply US unit by:	US unit	SI unit	To convert SI unit to US unit, multiply SI unit by:
1	meq/kg	mmol·kg ⁻¹	1
1	meq/L	mmol·L ⁻¹	1
1	meq/100 g	cmol·kg ⁻¹	1
10	meq/100 g	mmol·kg ⁻¹	0.1
1	micron(s)	µm	1
25.4	mil(s)	µm	0.0394
0.0254	mil(s)	mm	39.3701
1.6093	mile(s)	km	0.6214
2.5900	mile ²	km ²	0.3861
1	µmho/cm	µS·cm ⁻¹	1
0.0010	µmho/cm	mS·cm ⁻¹	1000
1000	mmho/cm	µS·cm ⁻¹	0.0010
1	mmho/cm	dS·m ⁻¹	1
1	mmho/cm	mS·cm ⁻¹	1
0.1333	mm Hg	kPa	7.5006
0.1333	mm mercury	kPa	7.5006
1.6093	mph	km·h ⁻¹	0.6214
0.4470	mph	m·s ⁻¹	2.2369
28.3495	oz	g	0.0353
28,350	oz	mg	3.5274 × 10 ⁻⁵
30.5152	oz/100 ft ²	kg·ha ⁻¹	0.0328
3.0515	oz/1000 ft ²	kg·ha ⁻¹	0.3277
0.0749	oz/100 gal	g·L ⁻¹	13.3526
62.5000	oz/100 lb	g/100 kg	0.0160
70.0532	oz/acre	g·ha ⁻¹	0.0143
0.0701	oz/acre	kg·ha ⁻¹	14.2749
70.0532	oz/acre	g·ha ⁻¹	0.0143

To convert US unit to SI unit, multiply US unit by:	US unit	SI unit	To convert SI unit to US unit, multiply SI unit by:
305.1517	oz/ft ²	g·m ⁻²	0.0033
1001.1539	oz/ft ³	g·m ⁻³	0.0010
0.0010	oz/ft ³	g·cm ⁻³	998.8379
1.0012	oz/ft ³	kg·m ⁻³	0.9988
0.7489	oz/gal	g/100 mL	1.3353
7.4892	oz/gal	g·L ⁻¹	0.1335
1.1161 × 10 ⁷	oz/inch	μg·cm ⁻¹	8.96 × 10 ⁻⁸
11.1612	oz/inch	g·cm ⁻¹	0.0896
1.1161	oz/inch	g·mm ⁻¹	0.8960
4.3942 × 10 ⁶	oz/inch ²	μg·cm ⁻²	2.2757 × 10 ⁻⁷
4.3942	oz/inch ²	g·cm ⁻²	0.2276
1.7300	oz/inch ³	g·cm ⁻³	0.5780
62.5000	oz/lb	g·kg ⁻¹	0.0160
6.2500	oz/lb	g/100 g	0.1600
33.9057	oz/yard ²	g·m ⁻²	0.0295
37.0798	oz/yard ³	g·m ⁻³	0.0270
1	ppb	ng·g ⁻¹	1
1	ppb	nL·L ⁻¹	1
1	ppb	μg·kg ⁻¹	1
1	ppb	μg·L ⁻¹	1
0.001	ppm	g·kg ⁻¹	1000
0.001	ppm	g·L ⁻¹	1000
0.0001	ppm	g/100 mL	10,000
1	ppm	g/1000 L	1
0.1	ppm	mg/100 g	10
0.1	ppm	mg/100 mL	10
0.001	ppm	mg·g ⁻¹	1000

To convert US unit to SI unit, multiply US unit by:	US unit	SI unit	To convert SI unit to US unit, multiply SI unit by:
1	ppm	mg·kg ⁻¹	1
1	ppm	mg·L ⁻¹	1
1	ppm	μg·g ⁻¹	1
1	ppm	μg·cm ⁻³	1
1	ppm	μg·mL ⁻¹	1
0.001	ppm	mL·L ⁻¹	1000
1	ppm	μL·L ⁻¹	1
1	ppm	ng·μL ⁻¹	1
1	ppt	ng·kg ⁻¹	1
1	ppt	ng·L ⁻¹	1
1	ppt	pg·g ⁻¹	1
6.8948	psi	kPa	0.1450
0.0069	psi	MPa	145.0377
0.0703	psi	kg·cm ⁻²	14.2233
0.4732	pt	L	2.1134
473.1765	pt	mL	0.0021
0.0509	pt/100 ft ²	L·m ⁻²	19.6339
50.9323	pt/100 ft ²	mL·m ⁻²	0.0196
1.2500	pt/100 gal	mL·L ⁻¹	0.8000
1.1692	pt/acre	L·ha ⁻¹	0.8553
0.9464	qt	L	1.0567
0.1019	qt/100 ft ²	L·m ⁻²	9.8170
101.8646	qt/100 ft ²	mL·m ⁻²	0.0098
101.8646	qt/1000 ft ²	L·ha ⁻¹	0.0098
2.5000	qt/100 gal	mL·L ⁻¹	0.4000
2.3385	qt/acre	L·ha ⁻¹	0.4276
14.7868	tablespoon(s)	cm ³	0.0676

To convert US unit to SI unit, multiply US unit by:	US unit	SI unit	To convert SI unit to US unit, multiply SI unit by:
14.7868	tablespoon(s)	mL	0.0676
4.9289	teaspoon(s)	cm ³	0.2029
4.9289	teaspoon(s)	mL	0.2029
105.4804	therm	MJ	0.0095
907.1847	ton(s)	kg	0.0011
0.9072	ton(s)	Mg	1.1023
0.9072	ton(s)	t	1.1023
2241.7023	ton(s)/acre	kg·ha ⁻¹	0.0004
2.2417	ton(s)/acre	Mg·ha ⁻¹	0.4461
2.2417	ton(s)/acre	t·ha ⁻¹	0.4461
10.7639	W/ft ²	W·m ⁻²	0.0929
0.9144	yard(s)	m	1.0936
0.8361	yard ²	m ²	1.1960
0.7646	yard ³	m ³	1.3080
1.8893	yard ³ /acre	m ³ ·ha ⁻¹	0.5293
0.5556	Δ °F	Δ °C	1.8
(°F - 32) ÷ 1.8	°F	°C	(°C x 1.8) + 32
(°F ÷ 1.8) + 255.37	°F	K	(K - 255.37) x 1.8

Appendix Table 18-2. List of common units of measurement, abbreviations, and symbols with guidelines for use in ASHS journals. Abbreviations of units of measurement must always be preceded by a numeral.

Measurement	Units of measure	Accepted usage of unit of measurement or abbreviation
acre	acre(s)	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS.
acre-foot, acre-feet	acre-ft	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS. Use only with numerals.
acre-inch	acre-inch(es)	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS.
atmosphere	atmosphere(s)	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS.
bar	bar(s)	Use unit of measurement only in HortTechnology, do not use in HortScience or JASHS.
becquerel	Bq	Use term or abbreviation as a derived SI unit for radioactive disintegrations per second.
becquerel	Bq	Use term or abbreviation as a derived SI unit for radioactive disintegrations per second.
British thermal unit	Btu	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS. Use only with numerals.
Brix	°Brix	Use only for syrups and only with numerals; use soluble solids concentration (percent) for juices extracted from plant tissue.
bushel	bushel(s)	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS; define by weight or volume on first use; spell out.
calorie	calorie(s)	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS.
Celsius	°C	Abbreviation without definition acceptable in all stand-alone sections.
centibar	cbar	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS.
centimeter	cm	Use abbreviation only with numerals.
colony-forming unit	cfu	Define at first use.

Measurement	Units of measure	Accepted usage of unit of measurement or abbreviation
cubic centimeter	cm ³	Use abbreviation only with numerals.
cubic decimeter	dm ³	Use only with numerals.
cubic foot, cubic feet	ft ³	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS. Use only with numerals.
cubic inch	inch ³	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS. Use only with numerals.
cubic meter	m ³	Use only with numerals.
cubic millimeter	mm ³	Use only with numerals.
cubic yard	yard ³	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS. Use only with numerals.
curie	Ci	Do not use; convert to gigabecquerels (GBq).
dalton	Da	Use the SI unit u (unified atomic mass unit), which is exactly equivalent to the dalton. Define at first use.
day	d	Use only with numerals; spell out in the Abstract.
degree (angular)	°	Use only with numerals.
degrees of freedom	df	Use for statistical reporting.
decisiemen	dS	Use only with numerals.
decimeter	dm	Use only with numerals.
disintegrations per minute	dpm	Do not use; see becquerel.
eigen volt	eV	Use only with numerals.
einstein	E	Do not use; E is a discarded unit for mole of photons; use mol (moles).
Fahrenheit	°F	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS. Use only with numerals.
fluid ounce	fl oz	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS. Use only with numerals.
foot, feet	ft	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS. Use only with numerals.
foot-candle	fc	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS. Use only with numerals.
foot-pound	ft-lb	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS. Use only with numerals.
gallon	gal	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS. Use only with numerals.

Measurement	Units of measure	Accepted usage of unit of measurement or abbreviation
gauge	gauge	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS. Use only with numerals.
gram	g	Use only with numerals.
gravity	gn	Use for force of gravity (average of earth's surface for centrifugation; italicize only the g; no multiplication symbol (\times) needed.
gray	Gy	Acceptable for all uses; SI-derived unit for absorbed radiation dose; equivalent to $\text{J}\cdot\text{kg}^{-1}$.
hectare	ha	Use only with numerals.
hertz	Hz	Use only with numerals.
horsepower	horsepower	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS; spell out.
hour (unit)	h	Use only with numerals; spell out in the Abstract.
hour (24-h time)	HR	Use only with clock time.
hundredweight	cwt	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS; use only with numerals.
inch	inch(es)	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS; spell out.
joule	J	Use only with numerals.
kelvin	K	Do not use $^{\circ}\text{K}$.
kilocalorie	kilocalorie(s)	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS; spell out.
kilodalton	kDa	Use only with numerals.
kilogram	kg	Use only with numerals.
kilolux	klx	Use only with numerals.
kilometer	km	Use only with numerals.
kilovolt	kV	Use only with numerals.
knot	knot(s)	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS; spell out.
krad	krad	Do not use; see Gray.
langley	langley(s)	Use only in HortTechnology; spell out. The langley is a unit of heat transmission, especially used to express the rate of solar radiation.
liter	L	Use only with numerals.

Measurement	Units of measure	Accepted usage of unit of measurement or abbreviation
lux	lx	Use only with numerals.
megagram	Mg	Use only with numerals; equivalent to metric ton.
meter	m	Use only with numerals.
metric ton (megagram or tonne)	Mg or t	Use only with numerals; do not report "metric ton(s)."
microequivalent	µeq	Use only with numerals.
microgram	µg	Use only with numerals.
microliter	µL	Use only with numerals.
micrometer	µm	Use only with numerals; equivalent to micron.
micromho	µmho	Use only in HortTechnology; only with numerals.
micromolar	µM	Use only with numerals.
micromole	µmol	Use only with numerals.
micron	micron(s)	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS; spell out; equivalent to micrometer (µm).
mil	mil(s)	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS; spell out.
mile	mile(s)	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS; spell out.
mile per hour	mph	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS; only with numerals.
millibar	mbar	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS; only with numerals.
milliequivalent	meq	Use only with numerals.
milligram	mg	Use only with numerals.
milliliter	mL	Use only with numerals.
millimeter	mm	Use only with numerals.
millimho	mmho	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS; only with numerals.
millimolar	mM	Use only with numerals.
millimole	mmol	Use only with numerals.
millivolt	mV	Use only with numerals.
minute (time)	min	Use only with numerals; may be used with SI, but use the second (s) whenever appropriate; spell out in the Abstract.

Measurement	Units of measure	Accepted usage of unit of measurement or abbreviation
molar	M	Use only with numerals.
mole	mol	Use only with numerals.
nanoliter	nL	Use only with numerals.
nanometer	nm	Use only with numerals.
nanometer	nm ⁻¹	Use for spectral irradiance (moles of photons) per unit wavelength within a specified range.
nanosecond	ns	Use only with numerals.
newton	N	Use only with numerals as a derived SI unit for force; do not use kilogram per unit area.
normal (gram equivalents per liter)	N	Use only with numerals.
osmotic potential	Ψ	Define at first use.
ounce	oz	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS; only with numerals.
ounce (fluid)	fl oz	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS; only with numerals.
parts per billion	ppb	Use only with numerals.
parts per million	ppm	Use only with numerals.
parts per trillion	ppt	Use only with numerals.
pascal	Pa	Use only with numerals.
pint	pt	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS; only with numerals.
pound	lb	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS; only with numerals.
pound-force	lbf	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS; only with numerals.
pound per square inch	psi	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS; only with numerals.
quart	qt	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS; only with numerals.
rad	rad	Do not use; this is an obsolete unit for radiation; see gray.
revolution(s)	r	Use only with numerals.
rotations per minute	rpm	Acceptable for all legitimate uses; do not use for centrifuge rotations, use force of gravity (g_n).

Measurement	Units of measure	Accepted usage of unit of measurement or abbreviation
second (time)	s	Use only with numerals; spell out in the Abstract.
square centimeter	cm ²	Use only with numerals.
square decimeter	dm ²	Use only with numerals.
square inch	inch ²	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS. Use only with numerals.
square kilometer	km ²	Use only with numerals.
square meter	m ²	Use only with numerals.
square mile	mile ²	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS. Use only with numerals.
square millimeter	mm ²	Use only with numerals.
square yard	yard ²	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS; only with numerals.
therm	therm	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS; spell out.
ton (i.e., US short ton)	ton(s)	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS; only with numerals.
tonne	t	Use in only with numerals; equivalent to metric ton.
volt	V	Use only with numerals.
watt	W	Use only with numerals.
week	week(s)	Always spell out; may be used with negative super-scripts (e.g., 2.5 g·week ⁻¹).
yard	yard(s)	Use unit of measurement only in HortTechnology; do not use in HortScience or JASHS; spell out.
year	yr	Use abbreviation only in tables and figures.

Appendix Table 18-3. List of variables, units of measurement, and additional factor requirements for reporting environmental parameters in ASHS journals.

Parameter	Units of measurement	Additional factor requirements
Air circulation	$\text{m} \cdot \text{s}^{-1}$	<ul style="list-style-type: none"> • Mean and standard deviation. • Design of circulation system. Predominant direction of flow. • Number of measurement points and their location relative to the plant canopy. • Greenhouse type (open or closed).
Air speed	$\text{m} \cdot \text{s}^{-1}$	
Air temperature	$^{\circ}\text{C}$	<ul style="list-style-type: none"> • Mean and standard deviation for light and dark periods. Number of locations.
Atmospheric CO_2 concentration	μmol^{-1}	<ul style="list-style-type: none"> • Mean and standard deviation. • Number of measurement points and their location relative to the plant canopy.
Atmospheric moisture: relative humidity or vapor pressure deficit (VPD)	% or kPa	<ul style="list-style-type: none"> • Mean and standard deviation for light and dark periods. • Number of locations.
Dissolved oxygen	$\text{mg} \cdot \text{L}^{-1}$	<ul style="list-style-type: none"> • Mean and standard deviation. • Location of measurement(s).
Electrical conductivity	$\text{S} \cdot \text{m}^{-1}$	<ul style="list-style-type: none"> • Mean and standard deviation. • Location of measurement(s).
Nutrition liquid media	$\text{mmol} \cdot \text{L}^{-1}$	<ul style="list-style-type: none"> • Ionic concentration in added solution. • Frequency of additions. • Aeration, if any.
Nutrition solid media	$\text{mol} \cdot \text{kg}^{-1}$	<ul style="list-style-type: none"> • Nutrients and their form added to soil media. • Frequency of additions.
pH	pH	<ul style="list-style-type: none"> • Mean and standard deviation. • Location of measurement(s).
Photoperiod	h	<ul style="list-style-type: none"> • Duration of light period (including any night interruption).

Parameter	Units of measurement	Additional factor requirements
Plant alignment		<ul style="list-style-type: none"> Number of plants per unit area and number of relocations.
Radiation (integral)	$\text{MJ}\cdot\text{m}^{-2}$ or $\text{mol}\cdot\text{m}^{-2}\cdot\text{d}^{-1}$	<ul style="list-style-type: none"> Accumulated (typically daily) values. Relative contributions of supplementary and solar radiation to (daily) integral.
Radiation (net)	$\text{W}\cdot\text{m}^{-2}$	<ul style="list-style-type: none"> Mean and standard deviation. If measured, also report solar radiation so that (net) long wave radiation can be determined.
Radiation (PAR)	$\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$	<ul style="list-style-type: none"> Mean and standard deviation. Number of measurement locations. When used, supplementary radiation sources (type, model, and manufacturer, distribution, energy consumption, conversion efficiency), and duration of operation.
Radiation (spectral)	$\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}\cdot\text{nm}^{-1}$	<ul style="list-style-type: none"> Mean and standard deviation. Absolute or relative contribution of a specific wavelength or waveband to the overall radiation.
Substrate water content	% or kPa	<ul style="list-style-type: none"> Mean and standard deviation. Number of measurement locations. (Volumetric or gravimetric water content, or matric potential).
Surface temperature	$^{\circ}\text{C}$	
Substrate temperature	$^{\circ}\text{C}$	<ul style="list-style-type: none"> Mean and standard deviation for light and dark periods. Number of locations.
Watering	L	<ul style="list-style-type: none"> Frequency, amount, duration, and type of water added per unit area or per plant.

Appendix Table 18-4. Plastic film thickness conversion chart from mils (original unit) to inches (derived unit), micrometers (converted unit), and millimeters (converted unit).

Mil(s)	Inch	Micrometers (μm)	Millimeter (mm)
0.10	0.00010	2.54	0.00254
0.20	0.00020	5.08	0.00508
0.30	0.00030	7.62	0.00762
0.35	0.00035	8.89	0.00889
0.40	0.00040	10.16	0.01016
0.45	0.00045	11.43	0.01143
0.50	0.00050	12.70	0.01270
0.55	0.00055	13.97	0.01397
0.60	0.00060	15.24	0.01524
0.65	0.00065	16.51	0.01651
0.70	0.00070	17.78	0.01778
0.75	0.00075	19.05	0.01905
0.80	0.00080	20.32	0.02032
0.85	0.00085	21.59	0.02159
0.90	0.00090	22.86	0.02286
0.95	0.00095	24.13	0.02413
1.00	0.00100	25.40	0.02540
1.10	0.00110	27.94	0.02794
1.20	0.00120	30.48	0.03048
1.30	0.00130	33.02	0.03302
1.40	0.00140	35.56	0.03556
1.50	0.00150	38.09	0.03809
1.60	0.00160	40.64	0.04064
1.70	0.00170	43.18	0.04318
1.80	0.00180	45.72	0.04572
1.90	0.00190	48.26	0.04826
2.00	0.00200	50.80	0.0508

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