

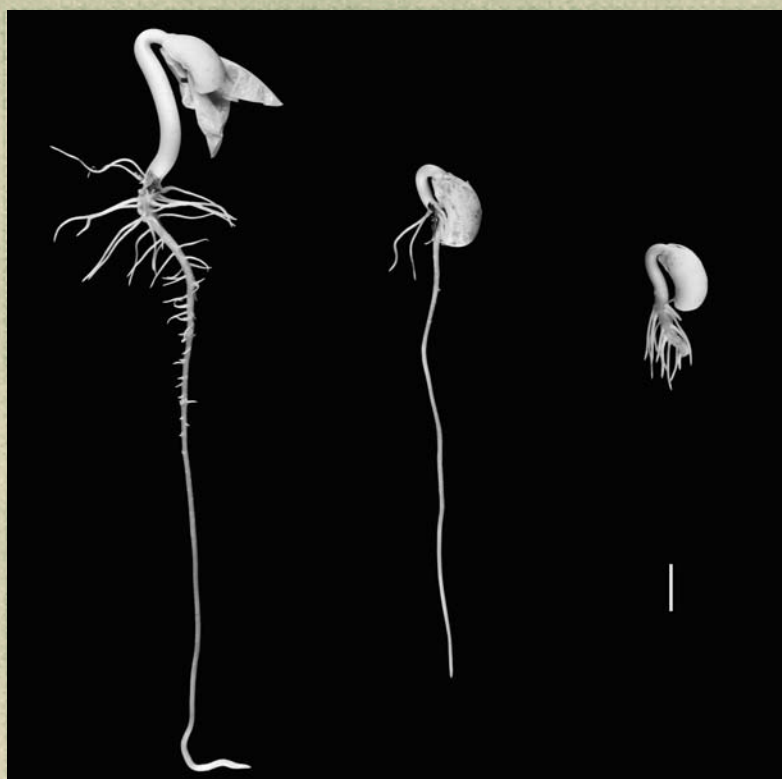
# Seed Technology

*An International Journal Serving Seed Scientists and Technologists*

Volume 34

2012

Number 1



ISSN: 1096-0724

Published Jointly by the Association of Official Seed Analysts  
and the Society of Commercial Seed Technologists

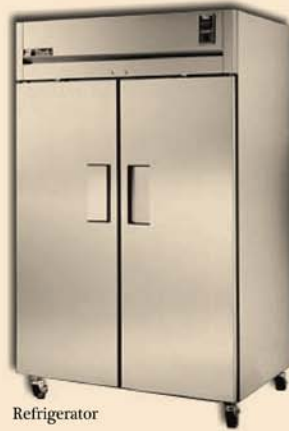


# GENEVA SCIENTIFIC

LAB EQUIPMENT SOLUTIONS



Germinator



Refrigerator

Seed Germinators

Seed Dryers

Plant Growth Chambers

Incubators

Balances

Fume Hoods

Moisture Testers

Laminar Flow Hoods

Refrigerators

Freezers

CO2 Incubators

Ovens



Oven



Moisture  
Balance



Shaker

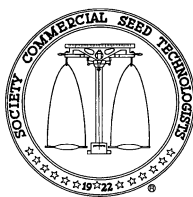
**[www.GENEVA-SCIENTIFIC.com](http://www.GENEVA-SCIENTIFIC.com)**

Contact us: 877-GENEVAS or [Sales@Geneva-Scientific.com](mailto:Sales@Geneva-Scientific.com)

# Seed Technology

*An International Journal  
Serving Seed Scientists and Technologists*

Volume 34, Number 1 • 2012



**Published jointly by:**

ASSOCIATION OF OFFICIAL SEED ANALYSTS  
SOCIETY OF COMMERCIAL SEED TECHNOLOGISTS

**Editor:**

Riad Baalbaki

California Department of Food and Agriculture  
Plant Pest Diagnostics Branch  
3294 Meadowview Road  
Sacramento, CA 95832-1448  
USA

**Assistant-Editor:**

Susan Alvarez, RST  
US Agriseeds

3424 Roberto Court  
San Luis Obispo, CA 93401  
USA

# Seed Technology

**THIS JOURNAL** is co-sponsored by the two predominant organizations in North America with a direct interest in seed technology: the Association of Official Seed Analysts and the Society of Commercial Seed Technologists.

## **ASSOCIATE EDITORS:**

Kristina Connor, USDA-Forest Service, Auburn, AL, USA  
Samuel Contreras, Pontificia Universidad Católica de Chile, Santiago, Chile  
Robert L. Geneve, University of Kentucky, Lexington, KY, USA  
Gwen Koning, Syngenta Crop Protection, Basel, Switzerland  
Deborah Meyer, California State Seed Laboratory, Sacramento, CA, USA  
Gary V. Munkvold, Seed Science Center, Iowa State University, Ames, Iowa, USA  
Amanda Patin, SGS Mid-West Seed Services, Inc., Brookings, SD, USA  
Robert Price, California State Seed Laboratory, Sacramento, CA, USA  
Swati Sen-Mandi, BOSE Institute, Kolkata, West Bengal, India  
Pegadaraju Venkatramana, BioDiagnostics, Inc., River Falls, WI, USA  
Richard Vierling, National Corn Growers Association, St. Louis, MO, USA  
Greg Welbaum, Virginia Tech, Blacksburg, VA, USA  
Yujia Wu, USDA AMS Seed Regulatory and Testing Branch, Gastonia, NC, USA

**AIMS AND SCOPE** – *Seed Technology* is an international journal containing scientific and technological papers in all areas of Seed Science and Technology. The emphasis is on applied and basic research in seed physiology, pathology and biology that may relate to seed development, maturation, germination, dormancy and deterioration. Studies on seed production, sampling, testing, conditioning, distribution and storage are also included. Short communications from seed analysts and technologists are encouraged and will be published as Seed Tech Notes. These notes include new techniques, standardization of laboratory tests and documentation of anatomical and pathological observations of seed and seedling development. The journal also includes timely review articles of seed technology that may relate directly to the seed industry.

**TYPES OF PAPERS** – Original research papers, review articles and Seed Tech Notes are reviewed for publication. All manuscripts should be submitted online. Potential authors should note that there are no page charges and reprints can be ordered directly from the printer at a minimal fee. Refer to the last pages of this volume (Instructions to Authors) for detailed instructions regarding manuscript submissions.

**SUBSCRIPTIONS** – *Seed Technology* is published two times annually. The annual subscription price for individuals is \$75.00 in North America and \$85.00 outside of North America; university and library annual subscriptions are \$125.00 in North America and \$135.00 outside of North America. All subscription prices are in US dollars and include postage. Subscriptions should be sent directly or through a bookseller to: Anita Hall, Executive Director, Society of Commercial Seed Technologists, Inc., 101 East State St., #214, Ithaca, NY 14850, USA, [www.seedtechnology.net](http://www.seedtechnology.net).

SEED TECHNOLOGY typesetting and graphic production by  
Charles Chandler, The Typewright, Lexington, KY ([TheTypewright@me.com](mailto:TheTypewright@me.com))

## EDITORIAL

WE ARE PLEASED that this volume of *Seed Technology* includes a special section entitled 'Seed Science and Technology—Future Trends and Prospects.' In this section, five invited authors with distinguished careers in seed science share their views on subjects ranging from new approaches to seed testing to future needs in research, training and test standardization. The present volume also includes five full-length manuscripts, two Seed Tech Notes and two technical papers covering a broad range of topics in seed biology and technology. *Seed Technology* continues to attract a diversity of authors and readers, and we continue to publish two issues of the journal on a regular annual schedule.

We remain committed to producing a quality publication with a broad scope of original research articles of interest to seed scientists and technologists. As always, the role of the many associate editors and peer reviewers in maintaining the high quality of this publication is greatly appreciated. The Journal Committee's role in promoting the journal and their continued effort to expand the journal's reach and readership are also appreciated. This publication would not be possible without the sponsorship and continued support of the Association of Official Seed Analysts and the Society of Commercial Seed Technologists.

Riad Baalbaki  
Editor

Susan Alvarez  
Assistant Editor

COVER ILLUSTRATION: An illustration of the effect of salinity on cowpea (*Vigna unguiculata* subsp. *unguiculata*) seedling growth and development. Ten-day-old seedlings grown in sand and irrigated with solutions of (left to right) 0, 5 and 14 dS m<sup>-1</sup> NaCl. Scale line = 1 cm. Photo credit: Riad Baalbaki, California Department of Food and Agriculture.

# Friends of the Journal

## **PLATINUM SUPPORTERS**

BioDiagnostics, Inc.

Crookham Seed Company

## **GOLD SUPPORTERS**

Arkansas State Plant Board, Seed Lab

Syngenta Seeds, Inc.

Turf Tech/Seed Doctor

## **SILVER SUPPORTERS**

Dennis TeKrony, PhD

Hulsey Seed Lab, Inc.

Jack Peters, PhD

Pioneer Hi-Bred, a DuPont Business

Wyffels Hybrids

*Seed Science and Technology:*  
***FUTURE TRENDS AND PROSPECTS***

## Seed Technology

# Instructions to Authors

*Seed Technology* is an international journal that publishes original papers, review articles, technical notes and symposia in all areas of seed science and technology. This includes information from applied and basic seed research in physiology, pathology and biology for all plant species. The journal relates to individuals interested in seed production, sampling, testing, conditioning, distribution and storage of agronomic, horticultural and forest seed crops. Papers are accepted on the understanding that they have not been published or submitted to any other scientific journal. The criteria for acceptance are originality, quality of research and interest to readership. Manuscripts are peer-reviewed by two or more anonymous reviewers, with final acceptance resting with the Editorial Board. The journal is published two times per year and is available as paper copies by contacting: Anita Hall, Executive Director, Society of Commercial Seed Technologists, Inc., 101 East State St., #214, Ithaca, NY 14850. Subscription information and order forms are available online at: <http://www.seedtechnology.net/journal.htm>.

Manuscripts must be clearly written using proper English. If English is not the primary language of the author, the manuscript should be reviewed by someone proficient in English prior to submission to the journal. Manuscripts should be submitted online; see “**Guidelines for Submission**” at the end of the instructions. Five types of submissions will be considered for publication:

- a. **Full-length manuscripts** should report new information to the subject area or expand on established knowledge to contribute additional information of value. Manuscripts undergo peer review to determine that adequate scientific methods were applied, that interpretations and conclusions are valid, and that all aspects of the study are adequately presented.
- b. **Seed Tech Notes** are appropriate for the reporting of seed laboratory or seed production research that may not justify a full paper, but provide important information of potential practical importance. This may include new techniques or developments, standardization of old techniques or anatomical, pathological or other documentation of seed or seedling development. The requirements for such notes are described below.
- c. **Technical Papers** presented orally or by poster at the annual meeting of the Association of Official Seed Analysts (AOSA) and Society of Commercial Seed Technologists (SCST) are invited, which cover topics of general interest to the seed biologist or technologist.
- d. **Symposia** or workshops presented to the AOSA/SCST membership may be recorded in the journal for future reference. Organizers should prearrange with the Editor to receive papers from the presenters of symposia and workshops within a specified timeframe for inclusion in a single journal issue.
- e. **Review articles** are welcomed by special prior arrangement with the Editor. Reviews should cover a summary of a seed biology or seed technology topic



or an evaluation of a seed science or technology related publication. The content of reviews should have a strong technical and/or scientific base.

### INSTRUCTIONS FOR FULL LENGTH MANUSCRIPTS

Instructions for full length manuscripts should be carefully reviewed to ensure that the submitted manuscript complies with *Seed Technology* standards and requirements. **If these guidelines are not closely adhered to, papers will be returned to authors for revision or released from further consideration for the journal.**

Manuscripts should be arranged in the following order: **Title** (no separate title page), **Author(s)**, **Abstract**, **Text**, **Acknowledgments**, **References**, **Tables**, **Captions for Figures** (separate page) and **Figures**. Do not include a list of key-words. The title should be concise (10 to 12 words) but informative, containing key words which describe the subject matter for use in abstracting systems. The name of the author(s) should be placed below the title with an asterisk (\*) after the name of the corresponding author.

The **abstract** should concisely summarize the entire scope of the paper including findings and conclusions without reference to text or figures. **All categories of manuscripts or papers submitted to the journal must have an abstract.** It should appear immediately below the title and authors and consist of not more than 250 typed words. **Authors may provide a translation of the abstract in one additional language, which will be printed in the journal following the primary abstract in English.** Availability of abstracts in alternate languages should be discussed with the Editor early in the submission process. Accuracy in regard to content and grammar of the second abstract is the responsibility of the corresponding author. Do not include a list of key words.

The **text** of the manuscript should normally have the subject matter grouped under the following major headings: **Introduction**, **Materials and Methods**, **Results**, **Discussion** (Results and Discussion may be combined), **Acknowledgments** (optional) and **References**. Main headings are centered on each page and capitalized in bold type. Secondary headings begin at the left margin (do not indent) with the first letter capitalized and the entire heading in bold print. Use of a previous issue of the journal as a guide to format is recommended.

**Author-Paper Documentation.** Author-paper documentation is a single paragraph at the bottom of the first page (under abstract). The first sentence lists the authors (without professional titles) and their complete addresses. If the author has moved, provide the current address. Always end the author-paper documentation with: \*Corresponding author (e-mail address of corresponding author). Received \_\_\_\_\_.

**Style Manual.** *Scientific Style and Format: The CBE Manual for Authors, Editors, and Publishers*, 6th edition, prepared by the Style Manual Committee of the Council of Biology Editors and published by the Cambridge University Press should be followed for writing papers submitted to *Seed Technology*. *The Publications Handbook and Style Manual* of the American Society of Agronomy can also be used as a detailed guide for both paper and electronic manuscript preparation and can be accessed online at

<https://www.crops.org/publications/style/>

**Abbreviations.** Use standard abbreviations (for example, Fig., RH, °C) listed in *Scientific Style and Format*, SI units and chemical element symbols without definition. Other abbreviations should be defined at first usage in the abstract or text and may be used thereafter without further definition, and again in every table and figure. Names of states, provinces and countries should be abbreviated following city names, using appropriate abbreviations of the postal service in that country.

**Units.** Metric units must be used for all measurements and the SI system (Système International d'Unités) used insofar as possible.

**Numbers.** Use Arabic numerals for all numbers with two or more digits and for all numbers that appear in conjunction with units of measurement, except when the number is the first word in a sentence. Spell out numbers when they are the first word in a sentence or when they are a single numeral from one to nine and not measurements, except when in a series in which one figure has two or more digits. Decimals should be expressed using a period (5.05, for example). The percentage sign should be used in conjunction with a number (5 %), but percentage should be written in full when used as a noun (germination percentage). Dates should be given as 2 December, 1998, for example.

**Nomenclature.** Species should be described by their scientific (Latin) names. At first mention in the main text the full binomial and authority must be given, but subsequently the genus should be abbreviated to its initial letter and the authority omitted. Authorities are not quoted after Latin names in the title or abstract. At first mention, crop varieties should be identified by single quotation marks, for example, 'Ranger' alfalfa (*Medicago sativa* L.)

**Experimental Design and Data Analyses.** Enough details of experimental conduct and design should be reported for readers to judge the validity of results. Treatment details, number and type of experimental units, factor levels, experimental layout, number of replications, and how measurements were made should be sufficiently described whenever appropriate. A measure of precision, usually standard error of treatment means, should be included with all data. Mean separation procedures should not be misused and authors should be aware of the limitations to the use of multiple comparisons. Treatment comparisons are appropriate when the relevant F value is significant, but should be avoided when treatments have a logical structure, as in factorial designs. In that case, the use of orthogonal contrasts is appropriate.

**Tables.** Tables should be numbered consecutively with Arabic numbers and should be reduced to the simplest form. Each table should be typed on a separate page from the main text. Table headings should be brief but complete and self-contained. Any explanation essential to the understanding of the table should be provided as a footnote at the bottom of the table. Use the following symbols for footnotes, in this order: †, ‡, §, ¶, #. Asterisks are used only to indicate statistical significance, with \* and \*\* representing significance at the 0.05 and 0.01 probability levels, respectively. Do not duplicate table information in figures.

**Figures.** All electronic images should be submitted in their native, highest possible resolution file format without insertion into a .DOC or text file, such as MS Word or WordPerfect. This is necessary because any graphic files embedded into a text file must be extracted for use with layout software during typesetting. Graphic files extracted from a text file are not as useable as the form they were in before insertion. Examples of acceptable graphic file types would be .TIF, .JPG, .BMP and .EPS. Images should be high resolution without compression. Photographs should only be submitted if they are essential for understanding the manuscript. All figures should be of sufficient size and quality to allow for reduction by half or more for printing. Lettering should be kept at a minimum in graphs. All lettering, symbols and lines must be large enough, clear enough and thick enough to still be easily read and prominent after reduction. Preferred symbols for line art figures are black and white open and closed squares, circles and triangles. Do not use colors, shades of gray, or fine screens or patterns to fill bars on graphs or wedges on pie charts. Use solid black or white, well-spaced parallel lines, widely spaced dots, or other black and white line art methods. Any patterns and lines should be able to withstand reduction by half or more. Figure captions should be brief, self contained and listed consecutively on a separate sheet at the end of the manuscript.

**Acknowledgments.** This section lists institutional sponsors with identification of the research project including granting agency recognition, if appropriate. This segment can also be used to thank anyone who was instrumental in or contributed to the completion of this study.

**References.** The author-year notation should be used in the text. Citations by authors in the text should appear as Smith (1996) or (Smith, 1996). Use “et al.” each time when there are three or more authors for a reference in the text, but give all authors in the reference list itself. In the reference list, arrange all published citations alphabetically by author: for example, last name and then initials of the first author, with each subsequent author listing arranged with first name initials first and then last name. Citations should include names of all authors, year, complete title, abbreviated journal title, volume number and inclusive pages. Cite personal communication and unpublished work only in the text, not in the reference list. Examples of acceptable references are:

- AOSA. 2010. Rules for testing seeds, Vol. 1. Principles and procedures. Assoc. Offic. Seed Anal., Ithaca, NY.
- Bernard, R.L. and M.G. Weiss. 1973. Qualitative genetics. p. 117–154. *In Soybeans: improvement, production, and uses*. B.E. Caldwell, R.W. Howell, J.W. Judd and H.W. Johnson (eds.). 1st ed. Agron. Monogr. 16. ASA, CSSA, and SSSA, Madison, WI.
- Engels, J.M.M., H. Dempewolf and V. Henson-Apollonio. 2011. Ethical considerations in agrobiodiversity research, collecting, and use. *J. Agric. Environ. Ethics*. 24(2): 107–126. Retrieved from <http://www.springerlink.com/content/jv26675022010063/> (verified 12 Dec. 2011).
- Fehr, W.R. and C.E. Caviness. 1977. Stages of soybean development. Spec. Rep. 80. Iowa Agric. Home Econ. Exp. Stn., Iowa State Univ., Ames.
- Koning, G., D.M. TeKrony, T.W. Pfeiffer and S.A. Ghabrial. 2001. Infection of soybean with soybean mosaic virus increases susceptibility to *Phomopsis* spp. seed infection. *Crop Sci*. 41: 1850–1856.

McGee, D.C. 1992. Soybean diseases. Am. Phytopathol. Soc., St. Paul, MN.

It is always preferred for papers to have references, but some papers based on presentations or workshops may be acceptable without them by prior arrangement with the Editor.

**Proofs, publication charges and reprints.** One set of page proofs in Adobe Acrobat format will be returned to the corresponding author. Corrections should be restricted to printer's errors and returned to the Editor promptly.

*Seed Technology* does not require page charges. Authors can order reprints, either as hard copies or an electronic copy (PDF), directly from the publisher when returning corrected proofs. For more information on ordering single articles, past issues and order forms, please contact the Editor or Assistant Editor, or go to <http://www.seedtechnology.net/journal.htm>.

### GUIDELINES FOR SUBMISSION

All manuscripts should be submitted online (<http://scst.expressacademic.org/login.php>). New users should first register before logging in. Once logged in, the website will prompt authors through the process. The manuscript should be double spaced with ample margins, line numbers, and numbered pages. Macintosh and Windows versions of MS Word or WordPerfect may be used for submission. Files can also be accepted in MS-Works, RTF, ASCII and other formats if the preferred options are not available.

Address all inquiries **to the Editor or Assistant Editor:**

Riad Baalbaki, Editor  
Senior Seed Botanist  
California Department of Food and Agriculture  
Plant Pest Diagnostics Branch  
3294 Meadowview Road  
Sacramento, CA 95832-1448  
Phone: (916) 262-3292  
Fax: (916) 262-1190

Susan Alvarez, Assistant Editor  
Registered Seed Technologist  
US Agriseeds Laboratory  
3424 Roberto Court  
San Luis Obispo, CA 93401  
Phone: (805) 540-6753  
Fax: (805) 540-6767

### INSTRUCTIONS FOR *SEED TECH NOTES*, TECHNICAL PAPERS AND SYMPOSIA OR WORKSHOPS

The format for *Seed Tech Notes*, technical papers and presentations from symposia or workshops is as for full length papers insofar as practical. The text headings may be the same as a full paper or may be arranged by **Abstract, Experimental Techniques, Results and Discussion, and References**, if that format is more suitable to the presentation of the material. The Experimental Techniques section will include a brief narrative of those elements normally included in the Introduction and Materials and Methods sections of full length papers. *Seed Tech Notes* and technical papers are usually much shorter and may present only preliminary research data compared to full length papers. These papers usually do not exceed four pages of printed text and a maximum of two figures, tables or photographs. Papers presented at committee meetings, symposia and workshops not containing cited references or other conventional journal paper elements may be considered for publication if these presentations

contain information of a practical nature or general interest in seed biology and technology.

### **SYMPOSIA PUBLICATIONS**

Manuscripts resulting from symposia on seed biology or technology topics will be considered for publication in a single volume of *Seed Technology* by prearrangement with the Editor. Manuscripts may originate from symposia sponsored by the Association of Official Seed Analysts or the Society of Commercial Seed Technologists or from appropriate seed symposia sponsored by other organizations. Symposia organizers desiring to publish a set of manuscripts in *Seed Technology* must solicit the Editor with the following information: (i) title, date and location of the symposium, (ii) the organization affiliated with the symposium, (iii) names, addresses, e-mail and telephone numbers of symposium organizers and (iv) titles and abstracts for each paper to be considered for publication. Symposia papers are subject to the usual format described above for *Seed Technology* and will be reviewed by the editorial board prior to acceptance for publication.

---

the **1**  
Power  
of

Your laboratory products supplier

should  
**revolve**  
around

**you.**

*Does your lab spin around your supplier? It shouldn't. You should be the center of your lab supplier's efforts. VWR offers end-to-end solutions that deliver quality product choices and supporting services. Experience counts and VWR has been delivering it for over a century.*

*Need help with an application or technical issue? One call to our team of specialists gets you support in all laboratory research and testing areas.*

*Are services central to your business needs? VWR is always prepared to meet your requirements. We offer a host of services including*

*calibration, desktop delivery, procurement analysis, preventive maintenance, lab start-up support and much more.*

*Don't spin your wheels. With VWR you get the "Power of 1" — one source with a singular focus on your needs. For more information, call 1-800-932-5000 or visit [vwr.com](http://vwr.com) today.*



**vwr.com**  
1.800.932.5000

©2010 VWR International, Inc. VWR, forms of VWR and the VWR logo and/or design are either registered trademarks or trademarks of VWR International, Inc. in the United States and/or other countries.



# Anchor Paper

An Employee Owned, Equal Opportunity, Minority Entitled Company

Providing Seed Germination Papers Since 1928

### In Regular and Heavy Weight Sizes Cut to Your Specifications

- Non-Toxic Blue & White Blotter
- Wax Paper
- Versa-Pak® (KIMPAK®)
- Glassine & Tin Tie Bags
- Re-closeable Zipper Bags
- Shipping Mailers
- Foil Lined Pouches
- Stretch Film
- Labels: Custom & Major Brands
- Packaging Equipment



*We Ship Worldwide*

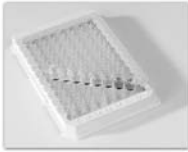
Anchor Paper Company, 480 Broadway, St. Paul, Minnesota 55101 U. S. A.  
Office: 651-298-1311 Toll Free: 1-800-652-9755 Fax: 651-298-0060  
[www.seedpaper.com](http://www.seedpaper.com)

## YOUR PARTNER IN DIAGNOSTICS

- In-house Technical Support
- In-the-field Service and Sales
- Custom assay development



### Test Kits for: Plant Pathology • Mycotoxins • GMOs



*World-leading supplier of GMO test kits*

*The **first** lateral flow device (LFD) for ToMarV*

*The **first** field test for Asian Soybean Rust (SBR)*

**ENVIROLOGIX**  
*Putting Science to the Test*

Toll-free US: **1-866-408-4597**

*or visit*

**[www.envirologix.com](http://www.envirologix.com)**

## Munktell

### Seed Testing and Germination Capacity Test Paper

Munktell seed testing and germination capacity test papers comply with ISTA and AOSA requirements. All seed testing papers have characteristics required for germination substrate filter paper as follows:

- All papers made of pure cellulose with high wet strength and do not contain any substances that may influence the growth of seeding
- High absorption capacity to store enough humidity for the entire test period
- pH value is between 6.0 and 7.5
- Custom cut sizes and standard formats available in white, blue and brown for better contrasts
- Available as sheets, strips, filter discs, folded/pleated papers and towels

Munktell Inc.

7517 Precision Drive, Suite 112 | Raleigh, NC 27617 USA

Ph: 1 919 226 0752 | Fax: 1 919 226 0751

E-mail: [info.us@munktell.com](mailto:info.us@munktell.com)

[www.munktell.com](http://www.munktell.com)

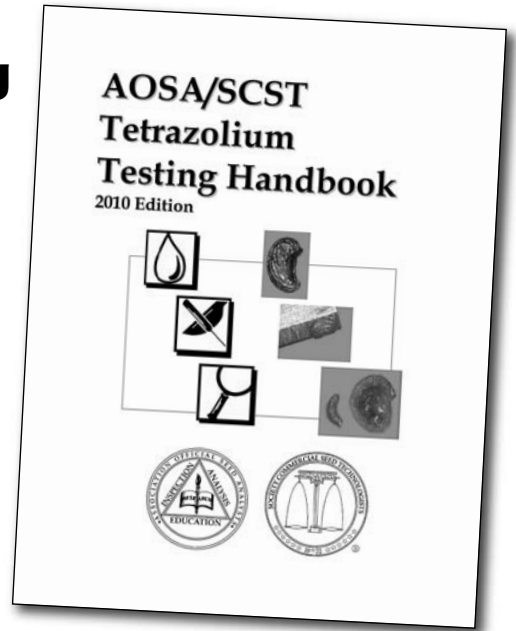


**MUNKTELL**

# AOSA/SCST Tetrazolium Testing Handbook

2010 Edition

This significantly expanded and updated edition of the *Tetrazolium Testing Handbook* is the result of 10+ years of effort by the Tetrazolium Subcommittee with collaboration from analysts of the *Society of Commercial Seed Technologists* and the *Association of Official Seed Analysts*.



A combination of illustrations and photographs are used to describe seed/embryo morphology, preparation/cutting techniques, and TZ staining patterns.

Color photographs covering over 100 plant families, in addition to comprehensive family and genera specific procedures, make this handbook an essential resource for all seed laboratories.

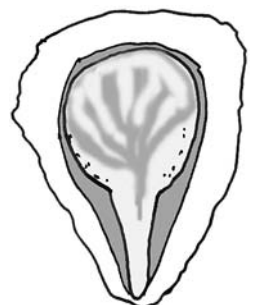
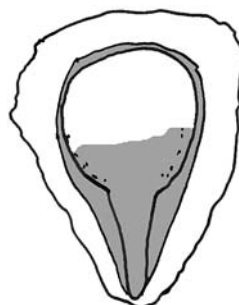
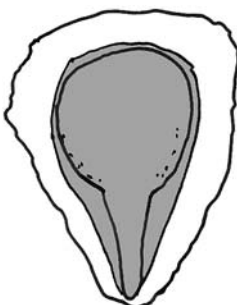
.....  
\$100 FOR A PRINTED COPY in a 3-ring binder  
\$75 FOR A CD OR ELECTRONIC VERSION,  
which includes a license to print one copy  
.....



**To order, visit AOSA's website** [www.aosaseed.com/publications.htm](http://www.aosaseed.com/publications.htm)  
or contact the AOSA office:

Anita Hall, Executive Assistant  
AOSA, Inc.  
101 East State St., #214  
Ithaca, NY 14850 USA

Telephone: 607-256-3313  
Fax: 607-273-1638  
E-mail: [aosa.office@twcny.rr.com](mailto:aosa.office@twcny.rr.com)





# AOSA Seed Vigor Testing Handbook

2009 Edition

This handbook is a comprehensive revision of the 1983 and 2002 versions that set the standard for vigor testing. A methodical and detailed resource, the handbook will be of value to seed technologists, scientists, students, and industry personnel interested in seed vigor and quality.

This 300+ page handbook is divided into four parts:

- Part I focuses on the importance of vigor testing.
- Part II addresses important issues of vigor test standardization.
- Part III focuses on the principles of each vigor test.
- Part IV presents detailed descriptions of every test procedure.

.....  
PRINTED VERSION. 3-ring binder in full color printed on archival quality paper (\$100)

COMPACT DISC. The CD includes one printing license (\$75)  
.....

**Please contact AOSA to order:**

<http://www.aosaseed.com/publications.htm>

AOSA, Inc.

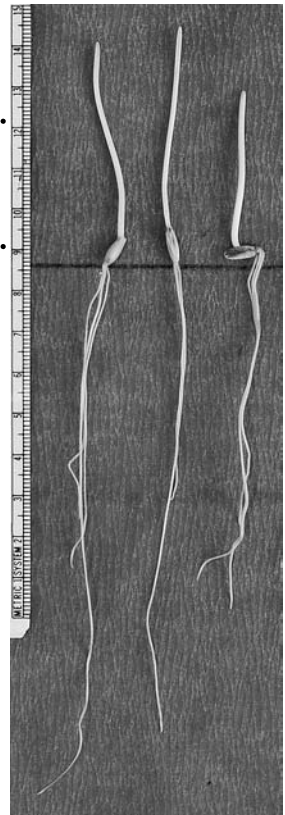
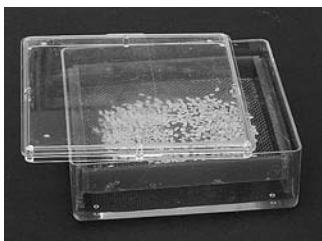
101 East State St., #214

Ithaca, NY 14850 USA

Telephone: 607-256-3313

Fax: 607-273-1638

E-mail: [aosa.office@twcny.rr.com](mailto:aosa.office@twcny.rr.com)



Editorial – Riad Baalbaki and Susan Alvarez . . . . . 3

**SEED SCIENCE AND TECHNOLOGY: Future Trends and Prospects**

- The Future of Seed Technology Testing and Training /**  
Miller B. McDonald . . . . . 7
- Seed Aging/Repair Hypothesis Leads to New Testing Methods /**  
Alison Powell and Stan Matthews . . . . . 15
- A Review: What is the Future for Research and Graduate Training  
in Seed Science and Technology? /** Dennis M. TeKrony . . . . . 27
- Phytopathological Risk Assessment and Molecular Seed Health Tests:  
Time to Make the Connection /** Gary Munkvold . . . . . 35

**FULL-LENGTH PAPERS**

- Priming Effects on Germination and Lipid Peroxidation of  
Chickpea (*Cicer arietinum*) Seedlings Under Salinity Stress /**  
Rozbeh Farhoudi and Maryam Makkizadeh Tafti . . . . . 41
- Planting Date Affects Cowpea Seed Yield and Quality at Southern  
Guinea Savanna, Nigeria /** S.R. Akande, S.A. Olakojo, S.A. Ajayi,  
O.F. Owolade, J.A. Adetumbi, O.N. Adeniyani and B.A. Ogunbodede . . . . . 51
- Sample Size with Finite Populations and Imperfect Diagnostic  
Tests for Pooled Samples /** Osva Antonio Montesinos-López,  
Abelardo Montesinos-López, José Crossa and Kent M. Eskridge. . . . . 61
- Regeneration of Russian Wildrye Foundation Seed  
and its Effect on Genetic Diversity and Linkage Disequilibrium /**  
Ivan W. Mott, Kevin B. Jensen and Steven R. Larson . . . . . 79
- Standard Purity and Germination Laboratory Methods  
for Eastern Gamagrass (*Tripsacum dactyloides*) /**  
C.L.H. Finneseth and R.L. Geneve . . . . . 87

**SEED TECH NOTES**

- Osmoprimer Duration Influence on Germination, Emergence and  
Seedling Growth of Sorghum /** A. Singh, R. Dahiru and M. Musa . . . . . 111
- Assessment of Seed Storage Alternatives for Rivercane  
(*Arundinaria gigantea*) /** D.M. Neal, B.S. Baldwin, G.E. Ervin,  
R.L. Jolley, J.J.N. Campbell, M. Cirtain, J. Seymour and J.W. Neal . . . . . 119

**TECHNICAL PAPERS**

- Seed Treatment of Minor Crops /** Gizele Ingrid Gadotti,  
Candida Renata Jacobsen Farias and Geri Eduardo Meneghello . . . . . 129
- Apical Bud Pinching in Okra (*Abelmoschus esculentus*):  
a Review /** S.W. Patil, B.M. Aher, A.A. Sakure and A.B. Dahake . . . . . 139

Instructions to Authors . . . . . 147