CROP SCIENCE

BOARD OF DIRECTORS
CROP SCIENCE SOCIETY OF AMERICA

S. A. EBERHART, *President*
V. L. LECHTENBERG, *President-elect*
C. O. QUALSET, *Past President*
R. F BARNES, *Executive Vice President*

DIVISION OFFICERS

C-1: R. H. BUSCH, *Chair*
H. W. OHM, *Chair-elect*
C. F. MURPHY, *CSSA Bd. Rep.*
C-2: D. G. BLEVINS, *Chair*
R. J. JONES, *Chair-elect*
R. SHIBLES, *CSSA Bd. Rep.*
C-3: J. T. COTHREN, *Chair*
G. L. POSLER, *Chair-elect*
V. B. CARDWELL, *CSSA Bd. Rep.*
C-4: A. D. KNAPP, *Chair*
D. A. BERKEY, *Chair-elect*
M. B. MCDONALD, JR., *CSSA Bd. Rep.*
C-5: T. L.WATSCHKE, *Chair*
W. A. MEYER, *Chair-elect*
R. C. SHEARMAN, *CSSA Bd. Rep.*
C-6: J. H. CHERNEY, *Chair*
J. W. JOHNSON, *Chair-elect*
W. R. OCUMPAUGH, *CSSA Bd. Rep.*
C-7: E. A. WERNSMAN, *Chair*
R. H. SMITH, *Chair-elect*
B. V. CONGER, *CSSA Bd. Rep.*

EDITOR-IN-CHIEF

C. W. STUBER

CROP SCIENCE EDITORIAL BOARD

P. S.BAENZIGER, *Editor, Crop Science*

Technical Editors

H. R. BOERMA, *Div. C-1, C-7*
J. L. GEADELMANN, *Div. C-1, C-7*
E. L. KLEPPER, *Div. C-2, C-4*
D. W. MEYER, *Div. C-3, C-5, C-6*
J. W. RADIN, *Div. C-2*
H. L. SHANDS, *Crop Registrations*
N. W. WIDSTROM, *Div. C-1, C-7*

Associate Editors

F. L. ALLEN
R. J. BAKER
B. L. BURSON
R. G. CANTRELL
J. H. CHERNEY
M. A. COHN
G. B. COLLINS
P. L. CORNELIUS
S. J. CRAFTS-BRANDNER
D. T. DUFF
R. R. DUNCAN
D. S. FISHER
D. F. GRABE
A. E. HALL
N. S. HILL
H. F. HODGES
D. W. ISRAEL
R. J. JONES
D. L. KARLEN
J. KINIRY
R. J. KOHEL
R. C. LEFFEL
D. J. MAJOR
T. J. MCCOY
J. A. MORGAN
E. D. NAFZIGER
D. M. OOSTERHUIS
J. H. ORF
R. G. PALMER
G. L. POSLER
D. E.ROWE
W. K. RUSSELL
S. K. ST. MARTIN
T. L. SETTER
C. C. SHAEFFER
D. A. SLEPER
S. S. SMITH
R. E. STUCKER
R. L. VANDERLIP
D. A. VAN SANFORD
K. P. VOGEL
J. J. VOLENEC
D. J. WEHNER
W. P. WILLIAMS
R. W. YAKLICH

WILLIAM R. LUELLEN, *Managing Editor*
R. F BARNES, *Executive Vice President*
D. M. KRAL, *Vice President—Management and Operations*

GUNDEGA KORSTS, *Assistant Editor*

Published bimonthly by the Crop Science Society of America, Inc. Forms close 20 days prior to issuance of each number. Second class postage paid at Madison, WI, and at additional mailing offices. ISSN (0011-183X).

Subscription rates: $65 per year, $13 per issue. All back volumes available at $78 per volume, $13 per issue. Add $5 per volume, or $1 per issue on orders outside the USA. Cumulative author and subject index for vol. 1-5, vol. 6-10, vol. 11-15, vol. 16-20, and vol. 21-25 available at $3 each. Payment in advance is required on foreign orders for back issues.

New subscriptions, renewals, and new memberships that include *Crop Science* begin with the January-February number of the current volume.

Changes of address should be received by the first of the month in which they are to take effect.

Claims for copies which fail to reach subscribers must be received within 3 months of publication date for domestic subscriptions, and within 6 months of publication date for foreign subscriptions.

Crop Registration Committee

Members of the C852 Crop Registration Committee of the Crop Science Society of America review manuscripts on the registration of crop cultivars, germplasms, and parental lines for publication in *Crop Science*. Authors should direct such manuscripts to the subcommittee member for the specific crop or to the chair, for other crops, at the addresses printed below.

COMMITTEE CHAIR
H. L. Shands
USDA-ARS, Rm. 140 Bldg. 005
Beltsville, MD 20705

SUBCOMMITTEES

Alfalfa
D. E. Brown
Land-O-Lakes Research Farm
Rt. 6, Box 299
Caldwell, ID 83605

Barley
A. E. Foster
Dep. of Crop & Weed Sci.
P.O. Box 5051
North Dakota State Univ.
Fargo, ND 58105

Cotton
F. D. Wilson
USDA-ARS, Western Cotton Res. Lab
4135 E. Broadway Rd.
Phoenix, AZ 85040

Grasses, Other
R. E. Barker
USDA-ARS
Oregon State Univ.
3450 Campus Way
Corvallis, OR 97331

Legumes, Other
N. L. Taylor
Dep. of Agronomy
Univ. of Kentucky
Lexington, KY 40506

Maize
H. Z. Cross
Dep. of Crop & Weed Sci.
North Dakota State Univ.
Fargo, ND 58105

Oat
M. E. Sorrells
252 Emerson Hall
Cornell Univ.
Ithaca, NY 14853

Peanut
T. A. Coffelt
USDA-ARS, Peanut Res. Unit
P.O. Box 7099
Suffolk, VA 23437

Rice
C. N. Bollich
USDA-ARS
Rt. 7, Box 999
Beaumont, TX 77706

Rye/Triticale
R. D. Barnett
Univ. of Florida, NFREC
Rt. 3, Box 4370
Quincy, FL 32351

Sunflower, Castor, Rapeseed, Safflower, and Other Oilseeds
R. D. Brigham
Texas A&M Univ.
Agric. Res. and Ext. Ctr.
Rt. 3, Box 219
Lubbock, TX 79401

Sorghum
R. R. Duncan
Dep. of Agronomy
Univ. of Georgia
Griffin, GA 30223-1797

Soybean
E. E. Hartwig
Delta Branch Exp. Stn.
USDA-ARS
P.O. Box 196
Stoneville, MS 38776

Sugarbeet
R. J. Hecker
USDA-ARS, Crops Res. Lab.
Colorado State Univ.
Fort Collins, CO 80523

Sugarcane
J. D. Miller
USDA-ARS, Sugarcane Field Stn.
Star Route, Box 8
Canal Point, FL 33438

Tobacco
M. T. Nielsen
Dep. of Agronomy
Univ. of Kentucky
Lexington, KY 40506

Wheat
R. E. Allan
USDA-ARS
209 Johnson Hall, Agronomy
Washington State Univ.
Pullman, WA 99164

Subscriptions, renewals, and membership fees for the current volume and orders for back numbers should be sent to the Crop Science Society of America, 677 S. Segoe Rd., Madison, WI 53711. Submit manuscripts to the same address.

Publication charges in *Crop Science* are $70 per page for the first four pages and $75 for each additional half page. Authors may be charged also for the cost of illustrations or tables beyond $15 for each paper.

Trade names are sometimes listed in papers published in this journal. No endorsement of these products by the publisher is intended, nor is any criticism implied of similar products not mentioned.

Copyright © 1990 by the Crop Science Society of America, Inc. Permission for printing and for reprinting the material contained herein has been obtained by the publisher. Other users should request permission from the author(s) and notify the publisher if the "fair use" provision of the U.S. Copyright Law of 1978 (P.L. 94-553) is to be exceeded.