


SABRAO JOURNAL OF BREEDING AND GENETICS

pISSN 1029-7073; eISSN 2224-8978

SABRAO Journal of Breeding and Genetics is an international journal of plant breeding and genetics research and is the official publication of the Society for the Advancement of Breeding Research in Asia and Oceania (SABRAO). The journal was first published in 1969. Its objective is to promote the international exchange of research information on plant breeding and genetics by describing new research findings or ideas of a basic or practical nature. It also provides a medium for the exchange of ideas and news regarding members of the Society.

Priority is given to articles that are of direct relevance to plant breeders with an emphasis on the Asian region. Research articles, short communications, methods, reviews, commentaries, and opinion articles will be accepted or invited for publication. Scientific contributions will be refereed and edited to international standards.

The journal mainly publishes articles for SABRAO members, and it is strongly preferred that at least one author should be a current member of the society. However, SABRAO non-members may also publish in the journal. In 2016, the journal became an electronic journal with open access. Although a publication fee is charged for all articles, the journal operates on a not-for-profit basis.

SABRAO WEBSITE
http://sabraojournal.org/

This website contains the most recent and past articles of the SABRAO Journal of Breeding and Genetics in addition to the details of the Editorial Board and publishing team. The website also contains up-to-date information about the Society, information about current officers and regional secretaries, upcoming congresses, and general matters concerning the society.
SABRAO - Executive members 2020

Elected at the 2019 Korean Society of Breeding Science/14th International SABRAO Conference held in Korea (July 2–5, 2019)

President: Prof. Glenn B. Gregorio (SEARCA/UPLB, PHILIPPINES)
Email: gbg@searca.org

First Vice President: Prof. Chen Xin (Institute of Industrial Crops, Jiangsu Academy of Agricultural Sciences, CHINA)
Email: cx@jaas.ac.cn; jaascx@sohu.com

Second Vice President: Dr. Young-Chan Cho (KOREA)

Third Vice President: Dr. Malikarjuna Swamy (IRRI, PHILIPPINES)
Email: m.swamy@irri.org

Secretary General: Dr. Desta Wirnas (Bogor Agricultural University, INDONESIA)
Email: dwirnas@gmail.com

Treasurer: Dr Tonette Laude (University of the Philippines Los Baños, PHILIPPINES)
Email: tplaude@up.edu.ph

Editor-in-Chief: Prof. Naqib Ullah Khan (PAKISTAN)

Deputy Editor-in-Chief: Dr. Sanun Jogloy (THAILAND)

Ex-Officio Members:
- Dr. Peerasak Srinives (THAILAND)
- Dr. Sang-Nag Ahn (KOREA)
- Dr. Bertrand (Bert) Collard (AUSTRALIA)

Member: Dr. B.C. Viraktamath (INDIA)
REGIONAL SECRETARIES

Regional Secretaries are elected by the members in each country. They play an indispensable role in the operations of the Society by

- notifying members of Society announcements;
- recruiting new members;
- organizing other activities, such as local meetings;
- keeping books of account and sending an audited statement to the Treasurer annually;
- providing the Secretary-General with a list of financial members in their region each year.

In 2021, the Regional Secretaries are as follows:

AUSTRALIA
Dr. Bertrand (Bert) Collard
NSW Department of Primary Industries
Email: sabraojournal.editingteam@gmail.com

BANGLADESH
Dr. Abul Kashem Chowdhury
Department of Genetics and Plant Breeding
Patuakhali Science and Technology University
Patuakhali-8602, Bangladesh
Email: kashempstu@yahoo.com

CHINA (PEOPLES’ REPUBLIC OF)
Prof. Cheng Xuzhen
Institute of Crop Sciences
Chinese Academy of Agricultural Sciences
30 Bai Shi Qiao Road, Beijing 100081, China
Email: chengxuzhen@caas.cn

INDIA
Dr. Ramakrishnan M. Nair
Global Plant Breeder - Legumes
World Vegetable Center-South Asia/Central Asia
ICRISAT Campus, Patancheru 502 324
Hyderabad, Andhra Pradesh, India
Email: ramakrishnan.nair@worldveg.org

INDONESIA
Dr. Desta Wirnas
Plant Genetics and Breeding Division
Dept. Agronomy and Horticulture
Faculty of Agriculture, Bogor Agricultural University
Bogor, 16680, Indonesia
Email: dwirnas@gmail.com

KOREA
Dr. Joong-Hyoun Chin
Sejong University, South Korea
Email: Joonghyoun.chin@gmail.com
MALAYSIA
Dr. Abdul Rahim Bin Harun
Malaysian Nuclear Agency
Bangi 43000, Kajang, Selangor, Malaysia
Email: rahim6313@yahoo.com

PAKISTAN
Prof. Naqib Ullah Khan
Department of Plant Breeding and Genetics
University of Agriculture, Peshawar
Khyber Pakhtunkhwa, Pakistan
Email: nukmarwat@yahoo.com, nukmarwat@aup.edu.pk

PHILIPPINES
Prof. Teresita H. Borromeo
Crop Science Cluster
College of Agriculture
University of the Philippines Los Baños
College, Laguna, Philippines
Email: thborromeo@yahoo.com

SRI LANKA
Prof. D.P.S.T.G. (Thilak) Attanayaka
Faculty of Agriculture and Plantation Management
Wayamba University of Sri Lanka
Makandura, Gonawila (NWP), Sri Lanka
Email: dpstga@yahoo.com

TAIWAN, REPUBLIC OF CHINA
Dr. Hsun Tu
Rural Development Foundation,
5F, 7, Section 1, 4 Roosevelt Road, Taipei 100, Taiwan
Email: rdf@ms4.hinet.net

THAILAND
Dr. Suchila Techawongstien
Section of Horticulture, Department of Plant Science and Agricultural Resources
Faculty of Agriculture, Khon Kaen University
KhonKaen, 40002, Thailand
Email: suctec.kku@gmail.com

TURKEY
Dr. Kamile Ulukapi
Department of Plant and Animal Production
Vocational School of Technical Sciences
Akdeniz University, Konyaalti-Antalya, TURKEY
Email: kamileonal@akdeniz.edu.tr

USA/NORTH & SOUTH AMERICA
Dr. Thomas H. Tai
USDA, UC Davis, USA
Email: Thomas.Tai@ars.usda.gov
SABRAO EDITORIAL BOARD

EDITOR-IN-CHIEF

Prof. Dr. Naqib Ullah Khan
Department of Plant Breeding and Genetics
University of Agriculture, Peshawar, Khyber Pakhtunkhwa
PAKISTAN
Email: nukmarwat@yahoo.com, nukmarwat@aup.edu.pk
Area of expertise: Breeding Fiber and Cereal Crops, Quantitative Genetics

DEPUTY EDITOR-IN-CHIEF

Dr. Sanun Jogloy
Department of Plant Science and Agricultural Resources
Faculty of Agriculture, Khon Kaen University, Khon Kaen 40002
THAILAND
Email: sjogloy@gmail.com
Area of expertise: Plant Breeding, Quantitative Genetics, Physiological Traits

ASSOCIATE EDITORS

Dr. Ramakrishnan M. Nair
AVRDC-The World Vegetable Center ICRISAT Campus
Patancheru 502 324, Hyderabad, Andhra Pradesh
INDIA
Email: ramakrishnan.nair@worldveg.org
Area of expertise: Plant Breeding and Genetics Research on Pulses and Pasture Legumes

Dr. Arbind K. Choudhary
ICAR Research Complex for Eastern Region
Patna 800 014 (Bihar)
INDIA
Email: akicar1968@gmail.com; akiipr23@yahoo.com
Area of expertise: Genetics and Breeding of Legumes

Dr. Sambasivam (Sam) Periyannan
Agriculture and Food CSIRO, Canberra, ACT 2601
AUSTRALIA
Email: sambasivam.periyannan@csiro.au
Area of expertise: Molecular Breeding, Disease Resistance, Gene Cloning, Transgenics

Dr. Desta Wirnas
Department of Agronomy and Horticulture
Bogor Agricultural University, Bogor 16680
INDONESIA
Email: dwirnas@gmail.com; desta@ipb.ac.id
Area of expertise: Plant Breeding and Genetics, Quantitative Genetics, Rice, Soybean, and Sorghum
Dr. Akshaya K. Biswal
Biotechnology for Agricultural Development Laboratory
International Maize and Wheat Improvement Center
Carretera México-Veracruz Km. 45, El Batán, Texcoco, C.P. 56237 MEXICO
Email: akbiswal@hotmail.com; a.k.biswal@cgiar.org
Area of expertise: Plant Molecular Genetics and Biology

Dr. Samrin Gul
Department of Plant Breeding and Genetics
College of Agriculture, University of Sargodha, Sargodha - Punjab
PAKISTAN
E-mail: samringulpbg@gmail.com; samringul@yahoo.com
Area of expertise: Breeding Oilseed Crops, Quantitative Genetics

Dr. Himmah Rustiami
Research Center for Biology, Indonesian Institute of Sciences,
Cibinong Science Center, Jin Raya Jakarta Bogor, Cibinong, Bogor
INDONESIA
Email: hrustiami@gmail.com
Area of expertise: Plant Systematics, Ethno-Botany

Prof. Dr. Bambang Sapta Purwoko
Department of Agronomy and Horticulture, Faculty of Agriculture,
Bogor Agricultural University
INDONESIA
Email: bspurwoko@apps.ipb.ac.id
Area of expertise: Breeding for Abiotic Stress, Plant Tissue Culture

Prof. Dr. Kwon, Soon-Wook
Department of Plant Bioscience
College of Natural Resource and Life Sciences
Pusan National University, Miryang 50463 KOREA
Email: swkwon@pusan.ac.kr
Area of expertise: Rice Genetics

Prof. D.P.S.T.G. (Thilak) Attanayaka
Faculty of Agriculture and Plantation Management
Wayamba University of Sri Lanka
Makandura, Gonawila (NWP)
SRI LANKA
Email: dpstga@yahoo.com
Area of expertise: Marker-Assisted Breeding of Rubber, Rice and Cashew, Production of Industrial Enzymes from Microorganisms

Dr. Prakit Somta
Department of Agronomy,
Faculty of Agriculture at Kamphaeng Saen,
Kasetsart University, Kamphaeng Saen Campus, Nakhon Pathom
THAILAND
Email: agrpkss@ku.ac.th
Area of Expertise: Genetics and (Conventional and Molecular), Breeding of Legume Crops
Dr. Aris Hairmansis
Indonesian Center for Rice Research,
Sukamandi, West Jawa
INDONESIA
Email: a.hairmansis@gmail.com; arishairmansis@pertanian.go.id
Area of Expertise: Plant Breeding, Genetics, Molecular Breeding

Dr. Gwen Iris Descalsota-Empleo
Plant Breeding and Genetics Division
College of Agriculture
University of Southern Mindanao, Kabacan, North Cotabato 9407
PHILIPPINES
Email: gidescalsota@gmail.com; gidempleo@usm.edu.ph
Area of expertise: Rice and Cacao Breeding and Genetics, QTL Mapping

Dr. Kamile Ulukapi
Department of Plant and Animal Production
Vocational School of Technical Sciences
Akdeniz University, Konyaalti-Antalya
TURKEY
Email: kamileonal@akdeniz.edu.tr
Area of expertise: Vegetable Production and Breeding, Common Bean

Dr. B.P. Mallikarjuna Swamy
International Rice Research Institute (IRRI), Los Baños, Laguna
PHILIPPINES
Email: m.swamy@irri.org
Area of expertise: Rice Molecular Breeding, Genetics, and Genomics

Prof. Dr. P.I. Prasanthi Perera
Department of Horticulture and Landscape Gardening
Faculty of Agriculture and Plantation Management
Wayamba University of Sri Lanka, Makandura, Gonawila (NWP)
SRI LANKA
Email: panawalageindra@gmail.com, prasanthi@wyb.ac.lk
Area of expertise: Plant Breeding, Plant Tissue Culture, Reproductive Biology

Prof. Dr. Clara R. Azzam
Department of Cell Research
Field Crops Research Institute
Agricultural Research Center, Giza
EGYPT
Email: clara.azzam@arc.sci.eg
Area of expertise: Plant Breeding, Mutation and Molecular Breeding, Plant Tissue Culture

Mr. Benedict Juliano
Advisory Editor
SEARCA, College, Laguna
PHILIPPINES
E-mail: baj@searca.org
Area of expertise: Knowledge Management Operations and Service Delivery
SABRAO PUBLISHING TEAM

SENIOR ASSISTANT EDITOR
Ms. Melanie Ancheta
Email: sabraojournal.editingteam3@gmail.com

ASSISTANT EDITORS
Mr. Joseph “Otep” Vicente
Email: sabraojournal.editingteam2@gmail.com

Mr. Joseph C. Beredo
Email: sabraojournal.editingteam.ph@gmail.com

WEB MANAGER
Ms. Ella “Kaye” Domingo
Email: ekdd14@yahoo.com

PUBLICATION FEE STRUCTURE

Please note that there is a publication fee FOR ALL ARTICLES—including articles from SABRAO members—which must be paid after publication of the article. This requirement covers journal processing costs and website maintenance. Payment can be made to the Regional Secretary (details available above or on SABRAO website) in the local currency equivalent or by contacting the Editor-in-Chief.

In 2022 and onwards, the fee structure will be as follows:

<table>
<thead>
<tr>
<th>Category</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>SABRAO Life Member*</td>
<td>US$ 150</td>
</tr>
<tr>
<td>SABRAO Non-Member</td>
<td>US$ 200</td>
</tr>
</tbody>
</table>

*At least one author should be a ‘LIFE’ SABRAO Member.

The official language of the Journal is English. Manuscripts may be written in British or US English provided the style is consistent throughout the article. Authors are requested to ensure a high standard of English and use professional editing services if necessary.

At first submission of the manuscript, if the standard of English is not satisfactory, SABRAO will use its own editing service before sending for review and will charge a minimum mandatory fee of USD 200. This additional fee is required because manuscripts are sent to external English editing services.

The philosophy of the journal is that publication fees will be kept minimal to ensure publication is available to scientists in developing countries. Therefore, journal publication fees are reviewed annually.

ACKNOWLEDGEMENTS

The Editor-in-Chief would sincerely like to thank the many reviewers for their time and efforts. An updated list of reviewers is maintained on the website.

Thanks to the publishing team for their countless hours of work for this issue.