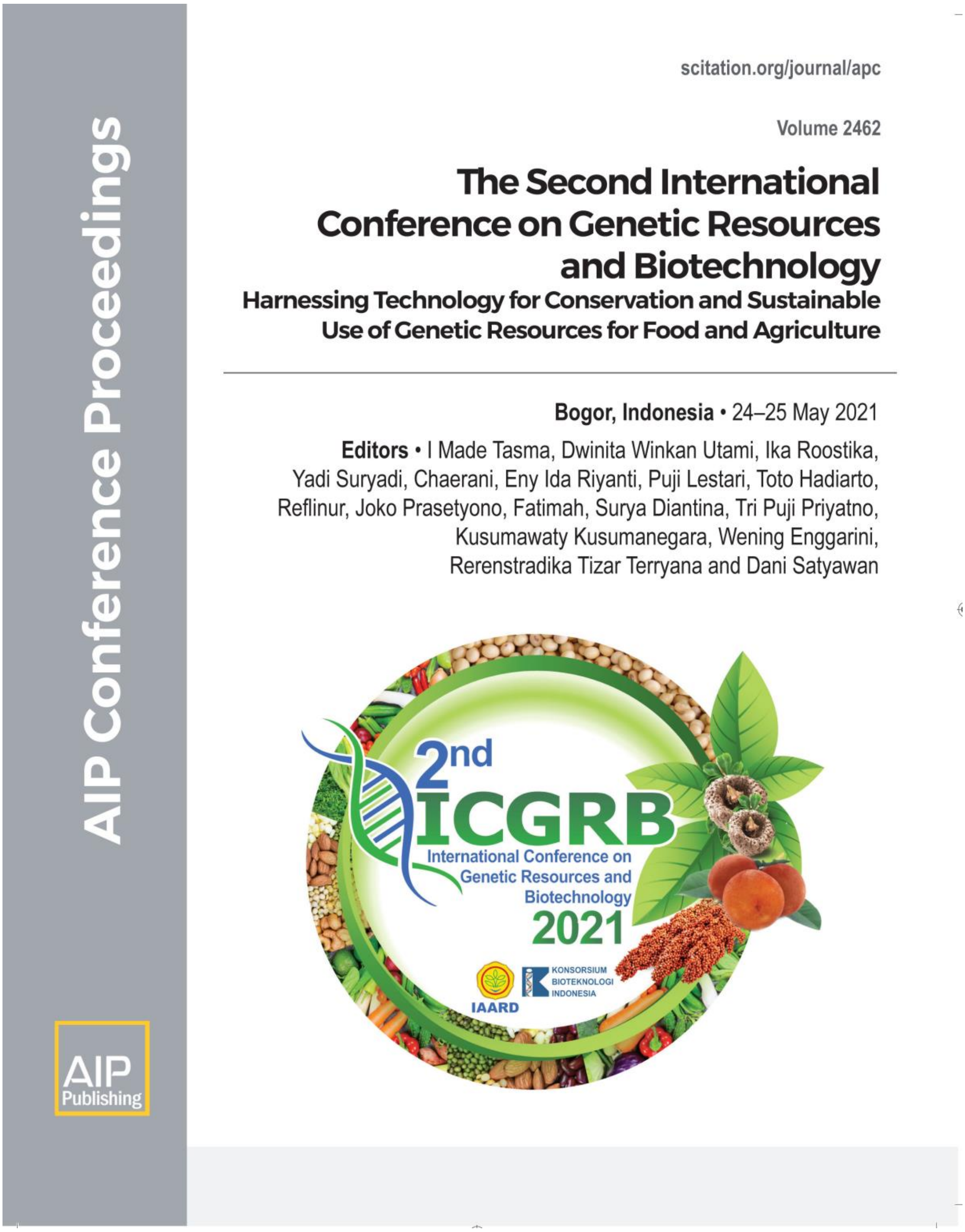

January 2022

THE SECOND INTERNATIONAL CONFERENCE ON GENETIC RESOURCES AND BIOTECHNOLOGY: Harnessing Technology for Conservation and Sustainable Use of Genetic Resources for Food and Agriculture

Committees: The Second International Conference on Genetic Resources and Biotechnology

Cite as: AIP Conference Proceedings **2462**, 010002 (2022); https://doi.org/10.1063/12.0008934
Published Online: 19 January 2022

Steering, Scientific and Organizing Committees

Steering Committee

Chair:

Dr. Ir. Fadjry Djufry, M.Si , *Director General of Indonesian Agency for Agricultural Research and Development (IAARD), Ministry of Agriculture, Indonesia*

Vice Chair:

Ir. Mastur Ph.D, *Director of Indonesian Center for Agricultural Biotechnology and Genetic Resources Research and Development, IAARD, Ministry of Agriculture, Indonesia*

Dr. Siswa Setyahadi, *Head of Indonesian Biotechnology Consortium, Indonesia*

Secretary:

Dr. Sustiprijatno, *Indonesian Center for Agricultural Biotechnology and Genetic Resources Research and Development, IAARD, Ministry of Agriculture, Indonesia*

Scientific Committee

Prof. Dr. M. Sabran, *Indonesian Center for Agricultural Biotechnology and Genetic Resources Research and Development, IAARD, Ministry of Agriculture, Indonesia*

Prof. Dr. Bahagiawati A., *Indonesian Center for Agricultural Biotechnology and Genetic Resources Research and Development, IAARD, Ministry of Agriculture, Indonesia*

Prof. Endang Gati Lestari, *Indonesian Center for Agricultural Biotechnology and Genetic Resources Research and Development, IAARD, Ministry of Agriculture, Indonesia*

Associate Prof. Endang Septiningsih, *Texas A & M University, USA*

Dr. Prakit Somta, *Kasetsart University, Thailand*

Dr. Laosatit Kularb, *Kasetsart University, Thailand*

Dr. Back Ki Kim, *Seoul National University, South Korea*

Dr. Iswari Saraswati Dewi, *Indonesian Center for Agricultural Biotechnology and Genetic Resources Research and Development, IAARD, Ministry of Agriculture, Indonesia*

Dr. Puji Lestari, *Indonesian Center for Rice Research, IAARD, Ministry of Agriculture, Indonesia*

Dr. Dani Satyawan, *Indonesian Center for Agricultural Biotechnology and Genetic Resources Research and Development, IAARD, Ministry of Agriculture, Indonesia*

Dr. Alina Akhdiya, *Indonesian Center for Agricultural Biotechnology and Genetic Resources Research and Development, IAARD, Ministry of Agriculture, Indonesia*

Ir. Tri Puji Priyatno, PhD, *Indonesian Center for Agricultural Biotechnology and Genetic Resources Research and Development, IAARD, Ministry of Agriculture, Indonesia*

Dr. Ir. Ragapadmi Purnamaningsih, *Indonesian Center for Agricultural Biotechnology and Genetic Resources Research and Development, IAARD, Ministry of Agriculture, Indonesia*

Dr. Nurul Hidayatun, *Indonesian Center for Agricultural Biotechnology and Genetic Resources Research and Development, IAARD, Ministry of Agriculture, Indonesia*

The Second International Conference on Genetic Resources and Biotechnology
AIP Conf. Proc. 2462, 010002-1–010002-3; https://doi.org/10.1063/12.0008934
Published by AIP Publishing. 978-0-7354-4172-9/$30.00

Organizing Committee

Chair	:	Dr. Toto Hadiarto
Vice Chair	:	Dr. Dani Satyawan
Secretary	:	Dr. Wening Enggarini
		Rerenstradika Tizar Terryana, M.Si
Treasurer	:	Dra. Sih Parmiyatni
		Ma'sumah, S.Si
Publication and documentation:		
		Dr. Hakim Kurniawan
		Endo Kristiyono, M.T.I.
		Andika Bakti, S.I.Kom
		Ansori
Logistic	:	Wawan, M.Si.
		M. Hasni Zulfikar

Preface: The Second International Conference on Genetic Resources and Biotechnology

Cite as: AIP Conference Proceedings **2462**, 010001 (2022); https://doi.org/10.1063/12.0006897
Published Online: 19 January 2022

Preface: The Second International Conference on Genetic Resources and Biotechnology

The Second International Conference on Genetic Resources and Biotechnology, which is the continuation of the first event held in 2018, focuses on topics related to advances in biotechnology to create more opportunities for effective conservation and sustainable utilization of genetic resources for food and agriculture. This year conference's theme is Harnessing Technology for Conservation and Sustainable Use of Genetic Resources for Food and Agriculture. The conference was organized by Indonesian Agency for Agricultural Research and Development (IAARD), Ministry of Agriculture, Indonesia, in collaboration with Indonesian Biotechnology Consortium and held on 24th-25th of May 2021virtually due to the pandemic of COVID-19.

The conference aims to share and exchange current scientific information and technological developments on biotechnology and their applications for conservation and sustainable use of genetic, to encourage and promote quality, efficiency, and modernization of management and utilization of genetic resources, and to facilitate national and international collaboration among participants. There are five scopes discussed in this conference. They are effective management of conservation and sustainable use of genetic resources for food and agriculture, application of genomics and molecular markers for genetic resource conservation and crop adaptation to climate change, application of innovative crop improvement techniques for conservation and sustainable use of plant genetic resources for food and agriculture, plant cell and tissue culture for conservation and effective utilization of genetic resources, and the use of microbial genetic resources as biological control agents of agricultural pests and diseases, and for soil bioremediation.

Five speakers from the United States of America, Japan, India and Indonesia were invited to discuss about their expertise and knowledge on relevant subjects in the plenary sessions. This conference was attended by more than 100 participants including 75 presenters and 44 listeners worldwide. They came from diverse governmental, private, or academic institutions and also scientific communities. The presented materials have undergone peer review processes and only qualified papers were selected. Furthermore, all papers were subjected to double blind peer-review and expected to meet the scientific criteria of significance and academic excellence to be published in a conference proceedings indexed in a well-known, reputable service.

We would like to express our sincere gratitude to our speakers, presenters and all participants for their contributions in this conference. We would also like to express our appreciation for the generosity of our sponsors that support this conference: PT CropLife, PT ITS Science Indonesia, PT Fajar Mas Murni and PT Prima Instrument Analitika. Lastly, special thanks to all committee members for their exceptional work and contributions in the conference and publication.

Chair of Organizing Committee

Dr. Toto Hadiarto

The Second International Conference on Genetic Resources and Biotechnology
AIP Conf. Proc. 2462, 010001-1–010001-1; https://doi.org/10.1063/12.0006897
Published by AIP Publishing. 978-0-7354-4172-9/$30.00

Table of Contents

THE SECOND INTERNATIONAL CONFERENCE ON GENETIC RESOURCES AND BIOTECHNOLOGY: Harnessing Technology for Conservation and Sustainable Use of Genetic Resources for Food and Agriculture

PREV

Conference date: 24–25 May 2021
Location: Bogor, Indonesia
ISBN: 978-0-7354-4172-9
Editors:
I Made Tasma, Dwinita Winkan Utami, Ika Roostika, Yadi Suryadi, Chaerani, Eny Ida Riyanti, Puji Lestari, Toto Hadiarto, Reflinur, Joko Prasetyono, Fatimah, Surya Diantina, Tru Puji Priyanto, Kusumawaty Kusumanegara, Wening Enggarini, Rerenstradika Tizar Terryana and Dani Satyawan
Volume number: 2462
Published: Jan 19, 2022

DISPLAY :

- 20
- 50
- 100
- all

PRELIMINARY

FreeJanuary 2022

Preface: The Second International Conference on Genetic Resources and Biotechnology

AIP Conference Proceedings **2462**, 010001 (2022); https://doi.org/10.1063/12.0006897

-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Committees: The Second International Conference on Genetic Resources and Biotechnology

AIP Conference Proceedings **2462**, 010002 (2022); https://doi.org/10.1063/12.0008934

-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

EFFECTIVE MANAGEMENT OF CONSERVATION AND SUSTAINABLE USE OF GENETIC RESOURCES FOR FOOD AND AGRICULTURE

FreeJanuary 2022

Harnessing plant genetic resources through biotechnology for food security in Indonesia

Mastur, Reflinur, Nurul Hidayatun, Sustiprijatno, Fatimah, Tri Puji Priyatno and Puji Lestari
AIP Conference Proceedings **2462**, 020001 (2022); https://doi.org/10.1063/5.0075671

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

DNA barcoding of *Vatica bantamensis*, a critically endangered tree endemic to Banten, Indonesia

Muhammad Rifqi Hariri, Iyan Robiansyah, Dipta Sumeru Rinandio, Dodo, Desi Siti Sundari, Cecep H. Sukmawan and Bayuntoro Ardi
AIP Conference Proceedings **2462**, 020002 (2022); https://doi.org/10.1063/5.0075529

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Genetic parameters of agronomic traits in soybean (*Glycine max* [L.] Merrill) genotypes tolerant to drought

Made J. Mejaya, Suhartina, Purwantoro, Novita Nugrahaeni and Titik Sundari
AIP Conference Proceedings **2462**, 020003 (2022); https://doi.org/10.1063/5.0075159

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Yield stability performance of soybean (*Glycine max* [L.] Merrill) lines tolerant to drought

Suhartina, Purwantoro, Novita Nugrahaeni, Abdullah Taufiq and Made Jana Mejaya
AIP Conference Proceedings **2462**, 020004 (2022); https://doi.org/10.1063/5.0075158

- SHOW ABSTRACT
-
  - PDF
  - E-READER

- ADD TO FAVORITES
- SHARE
- EXPORT CITATION

FreeJanuary 2022

Polymorphisms and associations of the *RACK1* genes with antibody response to Newcastle disease in KUB chickens

Ifa Manzila, Puji Lestari, Tike Sartika, Tri Puji Priyatno, Risa Indriani, Kristianto Nugroho and Rerenstradika Tizar Terryana
AIP Conference Proceedings **2462**, 020005 (2022); https://doi.org/10.1063/5.0075622

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Rice grain quality evaluation of promising lines of rice under irrigation and for salinity tolerance

Dody D. Handoko, Nafisah, Aris Hairmansis, Trias Sitaresmi, Heni Safitri, Satoto, Ali Imamuddin, Cucu Gunarsih and Untung Susanto
AIP Conference Proceedings **2462**, 020006 (2022); https://doi.org/10.1063/5.0075956

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Existing diversity profile for kernel characteristics of maize germplasm in IAARD-ICABIOGRAD gene bank

Andari Risliawati, Sobir, Trikoesoemaningtyas, Willy B. Suwarno and Puji Lestari
AIP Conference Proceedings **2462**, 020007 (2022); https://doi.org/10.1063/5.0075178

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Characterization of Japansche citroen rootstock somaclones and *in vitro* selection for aluminium tolerance

Deden Sukmadjaja, Mia Kosmiatin and Tiwi Wati
AIP Conference Proceedings **2462**, 020008 (2022); https://doi.org/10.1063/5.0077888

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Resistance to brown planthoppers (*Nilaparvata lugens* Stål) in rice accessions originated from Sumatra Island, Indonesia

Dodin Koswanudin, Nurul Hidayatun and Muhamad Ace Suhendar
AIP Conference Proceedings **2462**, 020009 (2022); https://doi.org/10.1063/5.0075680

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Morphological identification of underutilized local fruits in Kutai Barat Regency to support their conservation and sustainable use

Fitri Handayani, Nurbani and Asep Pebriandi
AIP Conference Proceedings **2462**, 020010 (2022); https://doi.org/10.1063/5.0075594

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Genetic resources of adlay (*Coix lacryma-jobi* L.) in East Kalimantan as source of functional food

Fitri Handayani, Muhammad Amin and Muhammad Taufiq Ratule
AIP Conference Proceedings **2462**, 020011 (2022); https://doi.org/10.1063/5.0075593

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Screening of soybean genotypes resistance to rust disease (*Phakopsora pachyrhizi*)

Sumartini and Kurnia Paramita Sari
AIP Conference Proceedings **2462**, 020012 (2022); https://doi.org/10.1063/5.0075674

- SHOW ABSTRACT

-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Identification of soybean promising lines resistant to pod-sucking bug, *Riptortus linearis* (Fabricius)

M. Muchlish Adie, Titik Sundari, Kurnia Paramita Sari and Ayda Krisnawati
AIP Conference Proceedings **2462**, 020013 (2022); https://doi.org/10.1063/5.0075343

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Variation in pod shattering resistance among black soybean genotypes associated with agronomic traits

Ayda Krisnawati, Titik Sundari and M. Muchlish Adie
AIP Conference Proceedings **2462**, 020014 (2022); https://doi.org/10.1063/5.0075338

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Preliminary characterization and identification of genetic integrity of velvet bean germplasm in IAARD-ICABIOGRAD gene bank

Nurwita Dewi, Andari Risliawati and Nurul Hidayatun
AIP Conference Proceedings **2462**, 020015 (2022); https://doi.org/10.1063/5.0076355

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Plant parasitic nematodes infesting three minor legumes (velvet bean, lablab bean, and jack bean)

Chaerani, Try Zulchi P. Hariyadi and Nurwita Dewi
AIP Conference Proceedings **2462**, 020016 (2022); https://doi.org/10.1063/5.0075204

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Proactive management approach of seed PGRFA conservation during the pandemic of coronavirus disease (COVID-19) in Indonesia

Nurul Hidayatun, Andari Risliawati, Nurwita Dewi, Lina Herlina and Dodin Koswanudin
AIP Conference Proceedings **2462**, 020017 (2022); https://doi.org/10.1063/5.0075531

- SHOW ABSTRACT

-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Evaluation of mung bean accessions in saline soil based on quantitative morphological characters

Trustinah, Ratri Tri Hapsari, Rudi Iswanto and Rudy Soehendi
AIP Conference Proceedings **2462**, 020018 (2022); https://doi.org/10.1063/5.0075324

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Screening and evaluation of 100 upland rice accessions for developing high-yielding upland rice varieties tolerant against acid soil

Lina Herlina and Yusi N. Andarini
AIP Conference Proceedings **2462**, 020019 (2022); https://doi.org/10.1063/5.0075550

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Morphological characters of sugarcane mutant (*Saccharum officinarum* L.) from *in vitro* selection for drought stress

Rr. Sri Hartati, Sri Suhesti and Nurya Yuniyati
AIP Conference Proceedings **2462**, 020020 (2022); https://doi.org/10.1063/5.0075656

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Identifying potential seedless citrus accessions through floral structure and pollen performance

Baiq Dina Mariana, Anis Andrini and Sri Andayani
AIP Conference Proceedings **2462**, 020021 (2022); https://doi.org/10.1063/5.0076922

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Secondary characters based selection of Indonesian kenaf (*Hibiscus cannabinus* L.) germplasm for developing superior varieties

Taufiq Hidayat R. S., Marjani, Nurindah, Muhammad Rasyidur Ridho, Cynthia Lestari Hertianti and Widya Fatriasari
AIP Conference Proceedings **2462**, 020022 (2022); https://doi.org/10.1063/5.0075716

- SHOW ABSTRACT

-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Genetic relationship of pigmented rice (*Oryza sativa* L.) collected from Eastern Indonesia based on morpho-agronomical traits and SSR markers

Yusi Nurmalita Andarini, Willy Bayuardi Suwarno, Hajrial Aswidinnoor and Hakim Kurniawan
AIP Conference Proceedings **2462**, 020023 (2022); https://doi.org/10.1063/5.0075706

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Rejuvenation and morphological characterization of local rice from the province of Yogyakarta

Setyorini Widyayanti, Sutarno, Endang Wisnu Wiranti and Kristamtini
AIP Conference Proceedings **2462**, 020024 (2022); https://doi.org/10.1063/5.0075721

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Characterization of plant architecture and yield trait of castor (*Ricinus communis* L.) germplasm suitable for mechanical harvesting

Tantri Dyah Ayu Anggraeni and Rully Dyah Purwati
AIP Conference Proceedings **2462**, 020025 (2022); https://doi.org/10.1063/5.0075155

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Characterization and interrelationships of the number of vessel bundles with yield components in various genotypes of soybean (*Glycine max* [L.] Merrill)

Anna S. Karyawati and Dyah P. Fitrawantio
AIP Conference Proceedings **2462**, 020026 (2022); https://doi.org/10.1063/5.0075693

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Tuber starch content of edible canna (*Canna indica* L.) from different geographical origins

Surya Diantina, Randy Sanjaya, Kristina Dwi Atmini, Ace Suhendar and Dodin Koswanudin
AIP Conference Proceedings **2462**, 020027 (2022); https://doi.org/10.1063/5.0075922

- SHOW ABSTRACT

-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

The diversity of morpho-agronomic characters and identification of early maturity cassava (*Manihot esculenta* Crantz.) germplasm

Tinuk Sri Wahyuni, Kartika Noerwijati and Made J. Mejaya
AIP Conference Proceedings **2462**, 020028 (2022); https://doi.org/10.1063/5.0075658

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Radiosensitivity and phenotypic characterization of gamma ray-induced mutant population of four *Capsicum annuum* L. cultivars grown in screen house

Andri Fadillah Martin, Dyah Retno Wulandari, Tri Muji Ermayanti, Betalini Widhi Hapsari, Erwin Al Hafiizh and Laela Sari
AIP Conference Proceedings **2462**, 020029 (2022); https://doi.org/10.1063/5.0075173

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Morphological performances of mutant butterfly pea (*Clitoria ternatea* L.)

Try Zulchi, Ali Husni, Dwinita Wikan Utami, Reflinur, Mia Kosmiatin, Tarkus Suganda and Agung Karuniawan
AIP Conference Proceedings **2462**, 020030 (2022); https://doi.org/10.1063/5.0075592

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Screening of beta carotene and its correlation with tuber flesh color in sweet potato

Kristina Dwi Atmini, Surya Diantina, Muhamad Sabda and Dodin Koswanudin
AIP Conference Proceedings **2462**, 020031 (2022); https://doi.org/10.1063/5.0075618

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Evaluation of morpho-agronomical characters and grain quality of red rice lines

Heni Safitri and Puji Lestari
AIP Conference Proceedings **2462**, 020032 (2022); https://doi.org/10.1063/5.0078807

- SHOW ABSTRACT
-
  - PDF
  - E-READER

- ADD TO FAVORITES
- SHARE
- EXPORT CITATION

FreeJanuary 2022

Growth variation and relationship of clove progenies of high-yielding mother trees collected from various regions in Indonesia

Mariana Susilowati, Sri Wahyuni, Adi Setiadi and Nurliani Bermawie
AIP Conference Proceedings **2462**, 020033 (2022); https://doi.org/10.1063/5.0075824

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Screening on bast fiber plants resistant to spiral stem borer, *Agrilus acutus* (Coleoptera: Buprestidae)

Sujak, Nurindah, Dwi Adi Sunarto, Marjani and Nurul Hidayah
AIP Conference Proceedings **2462**, 020034 (2022); https://doi.org/10.1063/5.0075691

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Characteristic of indigenous *Leuconostoc mesenteroides* EN 17-11 protease and its stability during storage at cold and freezing temperatures

Tatik Khusniati, Ika, Harry Noviardi and Sulistiani
AIP Conference Proceedings **2462**, 020035 (2022); https://doi.org/10.1063/5.0076004

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Performance of introduced lines based on morphological markers for diversity enrichment of Indonesian chili pepper (*Capsicum annuum* L.) varieties

Rinda Kirana, Catur Hermanto, Reflinur and Derek W. Barchenger
AIP Conference Proceedings **2462**, 020036 (2022); https://doi.org/10.1063/5.0075186

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

The growth of garlic internal sprout on different storage condition

Chotimatul Azmi, Imas Rita Saadah, Nazly Aswani and Asih Kartasih Karjadi
AIP Conference Proceedings **2462**, 020037 (2022); https://doi.org/10.1063/5.0075180

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Genetic diversity analysis of *Castanopsis argentea* using random amplified polymorphic DNA markers

Muhammad Imam Surya, Lily Ismaini, Decky Indrawan Junaedi, Aisyah Handayani, Taufikurrahman Nasution, Muhammad Efendi, Andes Hamuraby Rozak, Zaenal Mutaqien, Musyarofah Zuhri, Imawan Wahyu Hidayat, Fitri Kurniawati, Vandra Kurniawan, Dwinda Mariska Putri and Risha Amilia Pratiwi
AIP Conference Proceedings **2462**, 020038 (2022); https://doi.org/10.1063/5.0077390

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

APPLICATION OF GENOMICS AND MOLECULAR MARKERS FOR GENETIC RESOURCE CONSERVATION AND CROP ADAPTATION TO CLIMATE CHANGE

FreeJanuary 2022

Current status of tidal swamp rice varieties and its improvement for Fe toxicity tolerance and biofortification

Muhamad Sabran, Dwinita Wikan Utami and Susilawati
AIP Conference Proceedings **2462**, 030001 (2022); https://doi.org/10.1063/5.0075202

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Agroforensic, a new emerging study using molecular marker technique

Edy Listanto, Ahmad Warsun, Ahmad Dadang, Eny Ida Riyanti, Saptowo Jumali Pardal, Sustiprijatno and Mastur
AIP Conference Proceedings **2462**, 030002 (2022); https://doi.org/10.1063/5.0075164

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Molecular diversity comparison in local rice accessions originated from Kalimantan and other islands of Indonesia

Puji Lestari, Rerenstradika Tizar Terryana, Kristianto Nugroho, Andari Risliawati, Nurul Hidayatun, Priatna Sasmita, Yudhi Sastro, I. Gusti Komang Dana Arsana and Ikhwani
AIP Conference Proceedings **2462**, 030003 (2022); https://doi.org/10.1063/5.0075665

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Genetic variation of Adan, a Krayan local rice mutant, using microsatellite markers

Joko Prasetiyono, Tio Fadel Rafsanjani, Tri Aminingsih, Tasliah and Sugiono Moeljopawiro
AIP Conference Proceedings **2462**, 030004 (2022); https://doi.org/10.1063/5.0075660

- SHOW ABSTRACT

-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

The genome sequence of Ciherang, an Indonesian rice mega variety, revealed the footprints of modern rice breeding

Ida Rosdianti, Dani Satyawan, Muhamad Yunus and Dwinita Wikan Utami
AIP Conference Proceedings **2462**, 030005 (2022); https://doi.org/10.1063/5.0075676

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Field adaptation and molecular characterization of Code-*qTSN4* and Code-*qDTH8* rice lines at two different locations

Tasliah, Kurniawan Rudi Trijatmiko and Joko Prasetiyono
AIP Conference Proceedings **2462**, 030006 (2022); https://doi.org/10.1063/5.0075661

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Hybrid purity assessment in F_1 hybrids segregating for phytophthora root rot resistance genes of chili pepper (*Capsicum annuum* L.)

Fatimah, Reflinur, Joko Prasetiyono, Wartono, Kristianto Nugroho, Rinda Kirana, Dani Satyawan, Rerenstradika Tizar Terryana, Aqwin Polosoro, Puji Lestari and I. Made Tasma
AIP Conference Proceedings **2462**, 030007 (2022); https://doi.org/10.1063/5.0075160

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Characterization of genomic variation on three Indonesian oil palm genotypes analyzed using next-generation sequencing HiSeq

I. Made Tasma, Habib Rijzaani, Dani Satyawan, Ida Rosdianti, Edy Supriyanto and Razak Purba
AIP Conference Proceedings **2462**, 030008 (2022); https://doi.org/10.1063/5.0075392

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Cytological and molecular identifications of seedless tangerine derived from endosperm culture

Chaireni Martasari, Mia Kosmiatin, Ali Husni, Kurniawan Budiarto and Innez Candri Gilang Purnama
AIP Conference Proceedings **2462**, 030009 (2022); https://doi.org/10.1063/5.0076395

- SHOW ABSTRACT

-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Improvement of sex determination of salak plant using sequence characterized amplified regions

Reflinur, Ma’sumah, Namira Nur Arfa, Budi Setiadi Daryono and Azis Natawijaya
AIP Conference Proceedings **2462**, 030010 (2022); https://doi.org/10.1063/5.0075698

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

Table of Contents

THE SECOND INTERNATIONAL CONFERENCE ON GENETIC RESOURCES AND BIOTECHNOLOGY: Harnessing Technology for Conservation and Sustainable Use of Genetic Resources for Food and Agriculture

_PREV

Conference date: 24–25 May 2021
Location: Bogor, Indonesia
ISBN: 978-0-7354-4172-9
Editors:

I Made Tasma, Dwinita Winkan Utami, Ika Roostika, Yadi Suryadi, Chaerani, Eny Ida Riyanti, Puji Lestari, Toto Hadiarto, Reflinur, Joko Prasetyono, Fatimah, Surya Diantina, Tru Puji Priyanto, Kusumawaty Kusumanegara, Wening Enggarini, Rerenstradika Tizar Terryana and Dani Satyawan
Volume number: 2462
Published: Jan 19, 2022
DISPLAY :

- 20
- 50
- 100
- all

APPLICATION OF INNOVATIVE CROP IMPROVEMENT TECHNIQUES FOR CONSERVATION AND SUSTAINABLE USE OF PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

FreeJanuary 2022

Design and *in vitro* test of sgRNA for the CRISPR/Cas9 plasmid construct of the *SQS* gene of *Artemisia annua* L.

Sri Koerniati
AIP Conference Proceedings **2462**, 040001 (2022); https://doi.org/10.1063/5.0075695

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

The efficacy of genetically modified (GM) corn Bt11 against *Ostrinia furnacalis* (Guenee) and *Helicoverpa armigera* (Hubner)

Bahagiawati and Diani Damayanti
AIP Conference Proceedings **2462**, 040002 (2022); https://doi.org/10.1063/5.0075312

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Construction and introduction of OsAER1::LeAlaAT cassette to improve the nitrogen use efficiency in rice cv. Mekongga

Atmitri Sisharmini, Aniversari Apriana, Intan Kamila, Aqwin Polosoro, Wening Enggarini, Tri Joko Santoso, Toto Hadiarto, Bahagiawati A. Husin and Kurniawan Rudi Trijatmiko
AIP Conference Proceedings **2462**, 040003 (2022); https://doi.org/10.1063/5.0075458

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Environmental safety assessment of genetically engineered potato resistant to late blight caused by *Phytophthora infestans*

Alberta Dinar Ambarwati, Eny Ida Riyanti, Edy Listanto, Tri Joko Santoso, Toto Hadiarto and Kusmana
AIP Conference Proceedings **2462**, 040004 (2022); https://doi.org/10.1063/5.0075612

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES

- SHARE
- EXPORT CITATION

FreeJanuary 2022

Backcrossing of soybean lines containing aluminium tolerance gene into superior soybean variety, Biosoy

Saptowo J. Pardal, Amalia Prihaningsih, Suharsono, Ratna Utari and Riri Sundasari
AIP Conference Proceedings **2462**, 040005 (2022); https://doi.org/10.1063/5.0075187

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Phenotypic and genetic stability evaluation of the targeted *GA20ox-2* gene mutation in CRISPR/Cas9 mutant rice derived from Mentong cultivar

Aniversari Apriana, Tri Joko Santoso, Atmitri Sisharmini, Reflinur, A. Dinar Ambarwati, Toto Hadiarto, Sustiprijatno and Nuryati
AIP Conference Proceedings **2462**, 040006 (2022); https://doi.org/10.1063/5.0075603

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Transformation of *csp* gene into tobacco plant mediated by *Agrobacterium tumefaciens*

Sustiprijatno, Seagames Waluyo and Suharsono
AIP Conference Proceedings **2462**, 040007 (2022); https://doi.org/10.1063/5.0075571

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

PLANT CELL AND TISSUE CULTURE FOR CONSERVATION AND EFFECTIVE UTILIZATION OF GENETIC RESOURCES

FreeJanuary 2022

The application of gamma ray irradiation to increase triterpenoid compounds in embryogenic calli of *Centella asiatica* L. Urban

Ika Roostika, Suci Rahayu and Nurliani Bermawie
AIP Conference Proceedings **2462**, 050001 (2022); https://doi.org/10.1063/5.0076402

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

The effect of $FeSO_4$ concentration on the callus growth of two chili (*Capsicum annuum* L.) varieties

Rossa Yunita, Endang Gati Lestari, Iswari S. Dewi, Mastur and Bambang Sapta Purwoko
AIP Conference Proceedings **2462**, 050002 (2022); https://doi.org/10.1063/5.0075223

- SHOW ABSTRACT
-
  - PDF

- E-READER
- ADD TO FAVORITES
- SHARE
- EXPORT CITATION

FreeJanuary 2022

Evaluation of ratooning ability in several sweet sorghum (*Sorghum bicolor* [L.] Moench) mutant lines

Endang Gati Lestari, Iswari Saraswati Dewi, Rossa Yunita and Amin Nur
AIP Conference Proceedings **2462**, 050003 (2022); https://doi.org/10.1063/5.0075542

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Response of gamma ray irradiation derived-cultures of three sugarcane varieties to drought stress induced by polyethylene glycol

Ragapadmi Purnamaningsih and Suci Rahayu
AIP Conference Proceedings **2462**, 050004 (2022); https://doi.org/10.1063/5.0075185

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Sucrose and putrescine increased callus induction in tomato anther culture

Iswari Saraswati Dewi, Imam Nur Kholis, Bambang Sapta Purwoko and Ratna Ningsih
AIP Conference Proceedings **2462**, 050005 (2022); https://doi.org/10.1063/5.0075666

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Field evaluation of elephant grass mutant lines (*Pennisetum purpureum* Schumach.) in highlands

Ali Husni, Muhammad Rifay, Mia Kosmiatin and Vyta W. Hanifah
AIP Conference Proceedings **2462**, 050006 (2022); https://doi.org/10.1063/5.0076418

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Increasing drought tolerance of sugarcane through gamma ray irradiation and *in vitro* selection

Sri Suhesti, Syafaruddin, I. Ketut Ardana, Endang Hadipoentyanti and Rr. Sri Hartati
AIP Conference Proceedings **2462**, 050007 (2022); https://doi.org/10.1063/5.0076155

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Cells density affects cell production of *Citrus limonia* in flask and air-lift bioreactor cultures and limonin farming

Dita Agisimanto, Farida Yulianti and Hidayatul Arisah
AIP Conference Proceedings **2462**, 050008 (2022); https://doi.org/10.1063/5.0075651

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

THE USE OF MICROBIAL GENETIC RESOURCES AS BIOLOGICAL CONTROL AGENTS OF AGRICULTURAL PESTS AND DISEASES, AND FOR SOIL BIOREMEDIATION

FreeJanuary 2022

In Silico functional prediction of CAS2, a protein specifically expressed in appressorium and required for pathogenicity of *Colletotrichum gloeosporioides*

Tri Puji Priyatno, Farah Diba Abu Bakar, Rohaiza Ahmad Redzuan, Abdul Munir Abdul Murad and Ifa Manzila
AIP Conference Proceedings **2462**, 060001 (2022); https://doi.org/10.1063/5.0075625

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Biofertilizer increases nutrient use efficiency (NUE) of nitrogen, phosphorus, and potassium at leaves level of *Artemisia annua* L.

Wiguna Rahman, Arthur A. Lelono, Erwin Al Hafiizh and Tri Muji Ermayanti
AIP Conference Proceedings **2462**, 060002 (2022); https://doi.org/10.1063/5.0075503

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Effect of nitrogen fixation and phosphate solubilizing bacteria on growth and yield of lowland rice in different soil type

Ikhwani, Higa Afza, Siti Yuriyah and Waluyo
AIP Conference Proceedings **2462**, 060003 (2022); https://doi.org/10.1063/5.0077914

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Morphological, physiological, and molecular identification and characterization of yeast isolated from Indonesian fruits and woods

Rerenstradika Tizar Terryana, Nazhirotul Ilmiyah, Inda Setyawati, Titin Haryati, Karden Mulya, Eny Ida Riyanti, Yudi Sastro and Puji Lestari
AIP Conference Proceedings **2462**, 060004 (2022); https://doi.org/10.1063/5.0075170

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

The effect of coating application using chitosan enzymatic depolymerization on anthracnose disease suppression in mango (*Mangifera indica* L.) cv. 'Arumanis'

Yadi Suryadi, Dwi Ningsih Susilowati, I. Made Samudra, Alina Akhdiya and Karsinah
AIP Conference Proceedings **2462**, 060005 (2022); https://doi.org/10.1063/5.0075183

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Understanding yeast tolerance as cell factory for bioethanol production from lignocellulosic biomass

Eny Ida Riyanti and Edy Listanto
AIP Conference Proceedings **2462**, 060006 (2022); https://doi.org/10.1063/5.0075157

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Isolation and pathogenicity test of fusarium basal rot and purple blotch fungal pathogens from shallot and *Allium* spp

Chaerani, Ragapadmi Purnamaningsih and Suci Rahayu
AIP Conference Proceedings **2462**, 060007 (2022); https://doi.org/10.1063/5.0075209

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Morphological characters and efficacy of thirteen entomopathogenic fungi of *Aschersonia aleyrodis* Webber isolates on whitefly (*Bemisia tabaci* Gennadius)

Yusmani Prayogo, Marida Santi Yudha Ika Bayu, Sri Wahyuni Indiati and Made Jana Mejaya
AIP Conference Proceedings **2462**, 060008 (2022); https://doi.org/10.1063/5.0076067

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Physicochemical characteristics of yoghurt from various beans and cereals

Heny Herawati, Diana Nur Afifah, Eni Kusumaningtyas, Sri Usmiati, Agus S. Soemantri, Miskiyah, Elmi Kamsiati and Muchamad Bachtiar
AIP Conference Proceedings **2462**, 060009 (2022); https://doi.org/10.1063/5.0075712

- SHOW ABSTRACT

-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

The potential use of zeolite and exopolysaccharide bacteria for reduction of degradation and carbon emission on oil palm plantation in tropical peatland

Laksmita P. Santi, Haryo T. Prakoso and Donny N. Kalbuadi
AIP Conference Proceedings **2462**, 060010 (2022); https://doi.org/10.1063/5.0075506

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

FreeJanuary 2022

Application of phosphate solubilizing microbes to promote the effectiveness of rock phosphate on cacao seedling growth in acid soil

Kurnia Dewi Sasmita, Iswandi Anas, Syaiful Anwar, Sudirman Yahya and Gunawan Djajakirana
AIP Conference Proceedings **2462**, 060011 (2022); https://doi.org/10.1063/5.0075843

- SHOW ABSTRACT
-
  - PDF
  - E-READER
  - ADD TO FAVORITES
  - SHARE
  - EXPORT CITATION

Agroforensic, a new emerging study using molecular marker technique

Cite as: AIP Conference Proceedings **2462**, 030002 (2022); https://doi.org/10.1063/5.0075164
Published Online: 19 January 2022

Edy Listanto, Ahmad Warsun, Ahmad Dadang, et al.

Agroforensic, a New Emerging Study using Molecular Marker Technique

Edy Listanto[a)], Ahmad Warsun, Ahmad Dadang, Eny Ida Riyanti, Saptowo Jumali Pardal, Sustiprijatno and Mastur

Indonesian Center for Agricultural Biotechnology and Genetic Resources Research and Development, IAARD, Jln. Tentara Pelajar No. 3A, Bogor 16111, West Java, Indonesia

[a)]Corresponding author: edy_listanto@yahoo.com

Abstract. Agroforensic will identify and solve the problem when one case such as genetic diversity of crops should be declared, and in other situation need some confirmation like as detection of genetic modified organism (GMO) on food product or agrobusiness. Identification of DNA fingerprinting in forensics can be presented as DNA pattern profile containing repetitive and varied sequences among the investigated individuals. Several PCR-based technologies have been used in such genetic analysis. This study was conducted based on SSR analysis and GMO detection using a total of 13 SSR markers and 2 specific primers, respectively. The SSR samples consisted of 4 samples of sticky rice, 3 samples of brown rice, 8 samples of white rice, and 2 samples of corn, while GMO detection was conducted on 3 samples of corn flour. The aims of this study were to determine the genetic validity between the tested samples compared to the local control rice based on SSR analysis, to confirm the similarity of corn samples based on SSR analysis, and to identify the GMO content of corn flour sample based on qualitative PCR. The results of SSR analysis on sticky rice, brown rice, and white rice showed that their DNA band patterns were different from the local controls. This result was also supported by NTSys analysis. The results of SSR analysis on corn samples indicated that there were different DNA banding pattern between the control and sample corn based on six SSR primers. The results of GMO detection showed that three samples of corn flour were negative. Agroforensic can be performed using SSR method based on PCR technique.

INTRODUCTION

Forensic identification is one technology to identify specific objects from the trace the evidence in one case of crime. At the first case, forensic identification is related to the disclosure of crimes and in the search for kinship [1]. Identification of DNA fingerprinting in forensics can be presented as DNA chain profile containing repetitive and varied sequences among the investigated individuals [2]. In agriculture or bioscience, this identification will be called agroforensic. Agroforensic will identify and solve the problem when one case such as genetic diversity of crops should be declared, and in other situation need some confirmation like as detection of genetic modified organism (GMO) on food product or agrobusiness.

The discovery of polymerase chain reaction (PCR) by Mullis in 1983 is widely opened in forensic DNA analysis [3], especially related to genetic, phylogenetic, and variations between examined individuals. Together, Sir Alex Jeffreys introduced in the field of forensic genetics this technique by studying a set of DNA fragments that proved to have unique characteristics, which were nonrecurring and inherent for each individual, the only exception being monozygotic twins [4]. The PCR technique opened new ways in DNA analysis in the forensic genetics. The DNA is extracted to be subjected to amplification reactions. The method is an enzymatic process by which regions of the DNA are replicated, generating about one billion (10^9) copies.

In agriculture crops, some of the technologies were used in genetic analysis based on PCR technology, such as restriction fragment length polymorphism (RFLP), amplified fragment length polymorphism (AFLP), random amplified polymorphic DNA (RAPD), inter-simple sequence repeats (ISSR), single nucleotide polymorphism

The Second International Conference on Genetic Resources and Biotechnology
AIP Conf. Proc. 2462, 030002-1–030002-8; https://doi.org/10.1063/5.0075164
Published by AIP Publishing. 978-0-7354-4172-9/$30.00

(SNP), simple sequence repeats (SSR), and others [5]. Microsatellites or SSR have been widely used in many crops, due to their abundance, high degree of polymorphism, locus specificity, reproducibility, and most of all, they are a codominant in nature. These make microsatellites an attractive option for genetic studies in date palms [5–7].

Genetic engineering of plants has developed rapidly as technology advances in molecular biology. This discovery led to promote DNA restriction and cloning in a vector. The next process is the development of transformation plants. After all, the confirmation of the present of DNA should be done using simple method such as PCR technique. Until recently, GM crops still debatable regarding to the perspective of people. In Indonesia, handling GM crops needs to use a precautionary approach to realize environmental, food and/or feed safety based on valid scientific methods and take into account religious, ethical, sociocultural, and aesthetic principles [8]. Along the benefits of GM crops, human health risk, biodiversity, increase of insect resistance, and herbicide tolerance, are the most potential concerns of these food materials. In addition, the human health risk of inserted gene into food materials in general has not been systematically shown in the literature. Thus, their detection and labelling is required for increasing the consumer awareness. Furthermore, due to growing the number of unauthorized GM rice varieties in the market and ethical issues about providing informed choice to the consumer, development of screening methods, and monitoring programs seems to be essential in this scope. DNA-based PCR is the accurate and most widely used method for GMO testing.

Introduction of GM crops and their products in the markets required to be monitored and need to know the presence and type of GM elements. There are three main types of DNA based GMO testing methods, i.e. qualitative PCR, southern blot, and DNA microarray. Qualitative analysis comprises of specific detection of target DNA sequence in test samples. Qualitative results clearly validate the presence or absence of GM elements under study, comparative to suitable controls and within the detection limits of analytical technique used and test portion analyzed [9]. PCR has higher specificity to acquire reliable results [10]. On GMO detection, *Cauliflower mosaic virus* (CaMV) 35S promoter (P-35S) and *Agrobacterium tumefaciens* nopaline synthase terminator (T-nos) DNA sequence elements for the detection of genetically engineered (GE) crop plant material were showed the widespread use for detection GM crop plant material. Almost forty-four testing laboratories around the world have been surveyed and used testing using two elements in qualitative and quantitative PCR methods [11]. GMO detection were used PCR technique to identify CaMV P-35S and *A. tumefaciens* T-nos that are the most common transgenic elements that can be targeted for GMO screening. These genetic elements are frequently used to indicate whether the analyzed sample contains GM ingredient or not [12]. The aims of this study were to determine the genetic validity between the tested samples of sticky rice, brown rice, and white rice compared to the local control rice based on SSR analysis, to confirm the similarity of corn samples based on SSR analysis, and to identify the GMO content of corn flour sample based on qualitative PCR.

MATERIALS AND METHODS

Materials

Two samples of sticky rice (BP1 and BP2), two samples of brown rice (BP7 and BP9), and five samples of white rice (BP3, BP4, BP5, BP6, and BP8) were collected by criminal division of a police office in Northern Jakarta for SSR analysis. KK, KM, and KB samples were used as local controls of sticky rice, brown rice, and white rice, respectively. Sticky rice Matahari (KtM), white rice Ciherang (CH), and white rice Super Ramos (SR) samples were also used in this study.

Sample of corn B (BISI 18 non-Master) was collected by criminal division of a police office in Eastern Java for SSR analysis. BISI 18 Master was used as control of corn (A).

Three samples of corn flour (B1, B2, and B3) were collected from Surya Grain Indonesia for GMO detection. pCambia1301 plasmid was used as positive control for GM material (transgenic element), while H_2O was used as negative control.

DNA Isolation and PCR Analysis

DNA isolation was performed based on the CTAB method by Doyle and Doyle [13] and used for PCR analysis. PCR were performed using thirteen SSR primers (RM23501, RM16253, RM12366, p-bnlg 109, p-bnlg 244, p-umc 1265, p-umc 2039, p-umc 2146, p-umc 2225, p-umc 2279, p-umc 2281, p-umc 2325, and p-umc 2377) to detect polymorphism among rice and corn samples following the method of William *et al*. [14]. Meanwhile, PCR using primers for P-35S and T-nos fragments were performed to detect possible GMO content in the samples following the method of Listanto *et al*. [15, 16].

Each PCR reaction of SSR analysis contained 1× MyTaq mix, 5 μM forward and reverse primers each, and H_2O up to 15 μl in total volume. The PCR reaction was started with pre-denaturation at 95°C for 4 min, followed by 35 cycles of denaturation at 95°C for 15 sec, 55°C for 15 sec, and 72°C for 20 sec, and concluded at 72°C for 5 min. The results of PCR amplification of sticky rice, brown rice, and white rice samples were separated in 8% acrylamide gel, while corn flour samples were separated in 2% agarose gel. All of them were visualized using ChemiDoc imaging system.

Each PCR reaction of GMO detection contained KAPA Plant PCR Buffer 1× (12.5 μl of KAPA Plant PCR Buffer 2× contains $MgCl_2$ and dNTPs), KAPA3G Plant DNA Polymerase 0.75 U, 0,3 μM forward and reverse primers each, 100 ng DNA, and H_2O up to 25 μl in total volume [17]. The PCR reaction was started with pre-denaturation at 95°C for 3 min, followed by 5 cycles of denaturation at 95°C for 15 sec, 60°C for 15 sec, and 72°C for 1 min, followed by 30 cycles of denaturation at 95°C for 15 sec, 55°C for 15 sec, and 72°C for 1 min, and concluded at 72°C for 5 min. The results of PCR amplification of GMO detection were separated in 1.5% agarose gel and visualized using ChemiDoc imaging system.

NTSys Analysis

NTSys analysis used the method of Jamshidi [18]. Data entry from agarose gel reads as 0 or 1 to represent the absence or presence of a DNA band, respectively. Clustering analysis included dendrograms drawing procedure such as phylogenetic trees using UPGMA and NTSYS-pc ver. 2.02e program.

RESULTS AND DISCUSSIONS

Based on the analysis of PCR using SSR primer of RM23501 (Fig. 1), polymorphic bands were produced on all rice samples including the control plants. Further use of additional two different primers (RM16253 and RM12366) on the sticky rice samples showed that the local control of sticky rice (KK) was not in one group with the sticky rice samples of BP1, BP2, and KtM (Fig. 2). They had a similarity level of less than 50% with the local sticky rice according to NTSys analysis. This indicates that all the sticky rice samples were different from the local sticky rice.

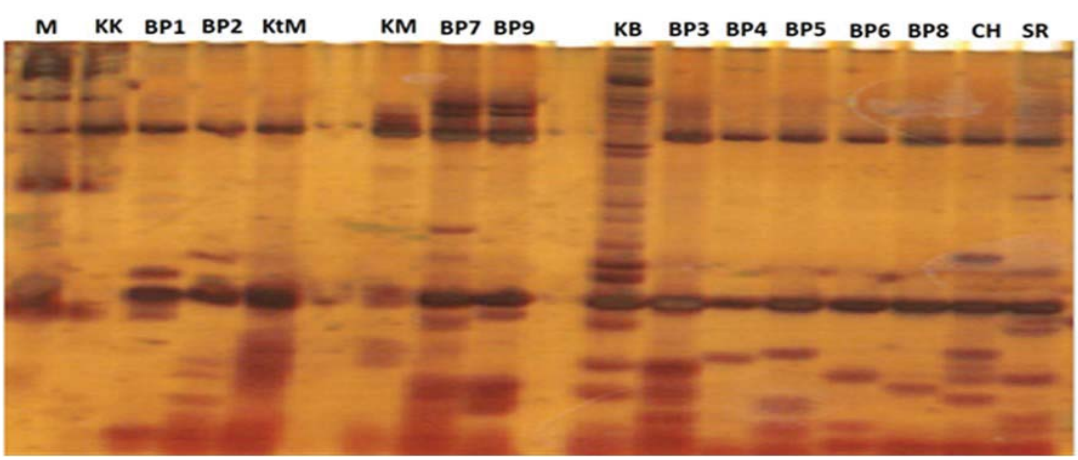

FIGURE 1. The results of 8% acrylamide gel electrophoresis based on the PCR product using SSR primer RM23501. M = 100 bp DNA ladder; KK = local control of sticky rice; BP1 and BP2 = sticky rice samples; KtM = sticky rice Matahari; KM = local control of brown rice; BP7 and BP9 = brown rice samples; KB = local control of white rice; BP3, BP4, BP5, BP6, and BP8 = white rice samples; CH = white rice Ciherang; SR = white rice Super Ramos.

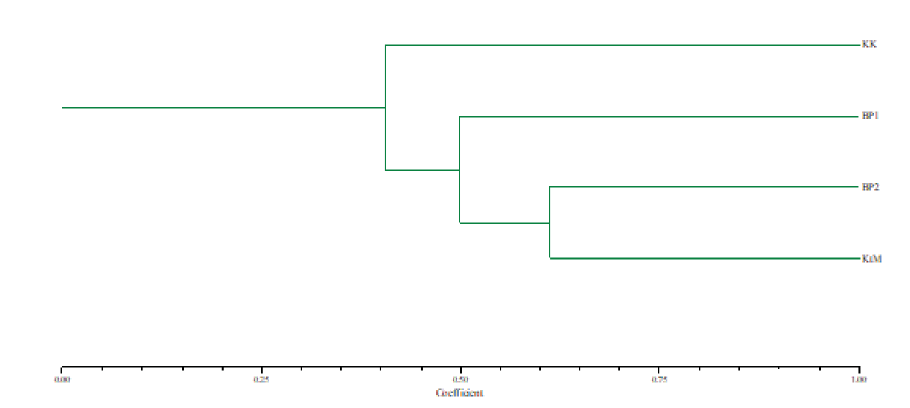

FIGURE 2. Dendrogram of sticky rice samples based on SSR analysis using three different primers (RM23501, RM16253, and RM12366). KK = local control of sticky rice, BP1 and BP2 = sticky rice samples, KtM = sticky rice Matahari.

SSR analysis using primer of RM16253 (Fig. 3) showed that the sticky rice samples (BP1, BP2, and KtM) produced same DNA bands, but they had differences of the DNA banding patterns from the local sticky rice (KK). The samples of the brown rice (KM, BP7, and BP9) showed differences of the DNA banding patterns. Meanwhile, the white rice samples of BP3, BP4, BP5, and BP6 had the similarity of the DNA banding patterns. The white rice samples of BP8, CH, and SR have a similar DNA banding pattern. However, the two groups had different banding patterns.

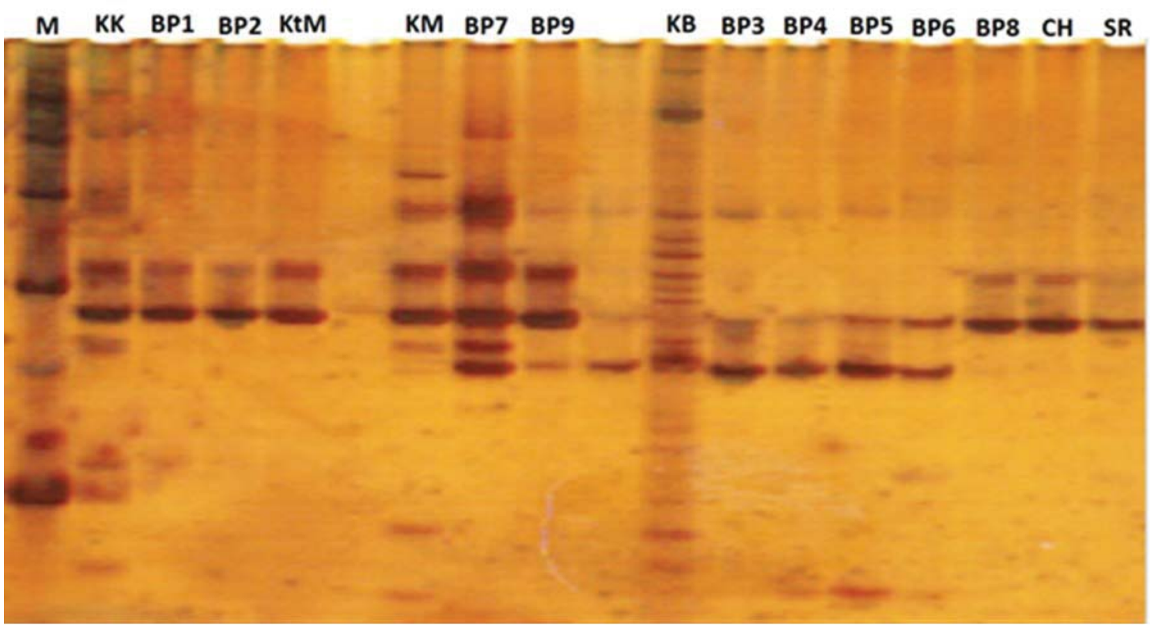

FIGURE 3. The results of 8% acrylamide gel electrophoresis based on the PCR product using SSR primer RM16253. M = 100 bp DNA ladder; KK = local control of sticky rice; BP1 and BP2 = sticky rice samples; KtM = sticky rice Matahari; KM = local control of brown rice; BP7 and BP9 = brown rice samples; KB = local control of white rice; BP3, BP4, BP5, BP6, and BP8 = white rice samples; CH = white rice Ciherang; SR = white rice Super Ramos.

The result of SSR analysis using three different primers (RM23501, RM16253, and RM12366) on the brown rice samples showed that the local brown rice (KM) was not in one group with the sample of brown rice of BP7 and BP9 (Fig. 4). Based on dendrogram of NTSys analysis, they only had a similarity level of less than 50%.

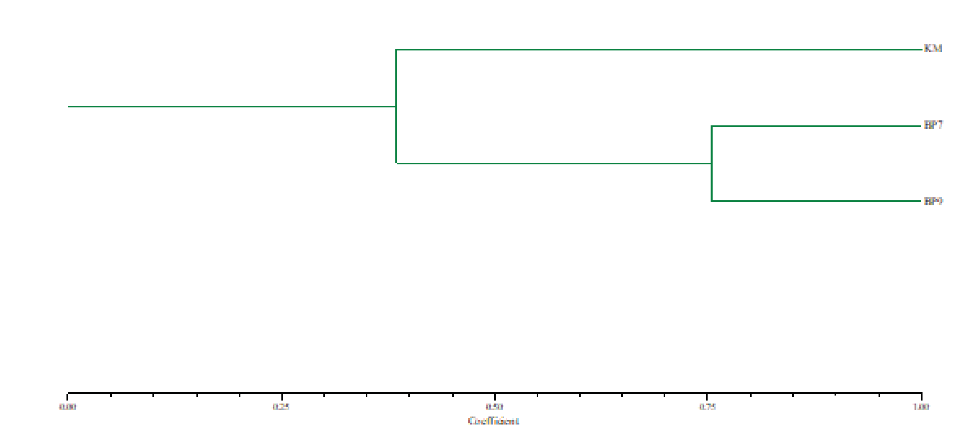

FIGURE 4. Dendrogram of brown rice samples based on SSR analysis using three different primers (RM23501, RM16253, and RM12366). KM = local control of brown rice, BP7 and BP9 = brown rice samples.

The PCR results using SSR primer of RM12366 (Fig. 5) showed that all of the amplified rice samples by PCR were polymorphic. However, BP4 and BP5 samples produced monomorphic bands.

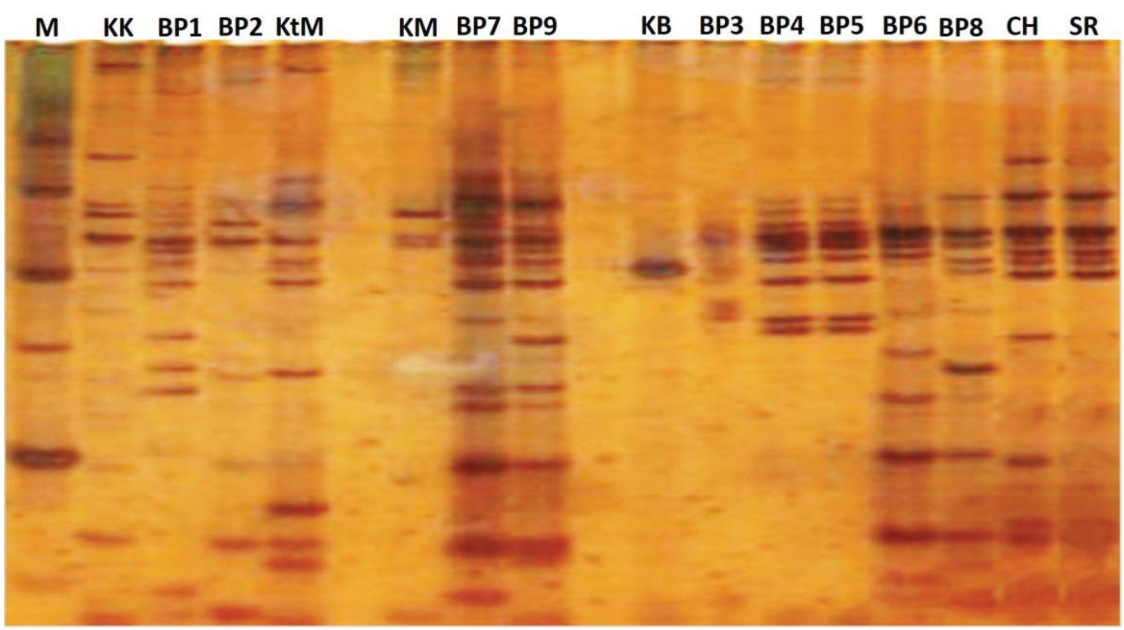

FIGURE 5. The results of 8% acrylamide gel electrophoresis based on the PCR product using SSR primer RM12366. M = 100 bp DNA ladder; KK = local control of sticky rice; BP1 and BP2 = sticky rice samples; KtM = sticky rice Matahari; KM = local control of brown rice; BP7 and BP9 = brown rice samples; KB = local control of white rice; BP3, BP4, BP5, BP6, and BP8 = white rice samples; CH = white rice Ciherang; SR = white rice Super Ramos.

The results of SSR analysis using three different primers (RM23501, RM16253, and RM12366) were presented as a dendrogram on Fig. 6. The local control of white rice (KB) was not in one group with the samples of white rice (BP3, BP4, BP5, BP6, BP8, CH, and SR). The control only had a similarity level of less than 25% with the samples. This analysis showed that all the white rice samples were different from the control (KB). In addition, the genetic distance between the BP4 and BP5 samples analyzed using these three primers was similar to that analyzed using one primer (RM12366).

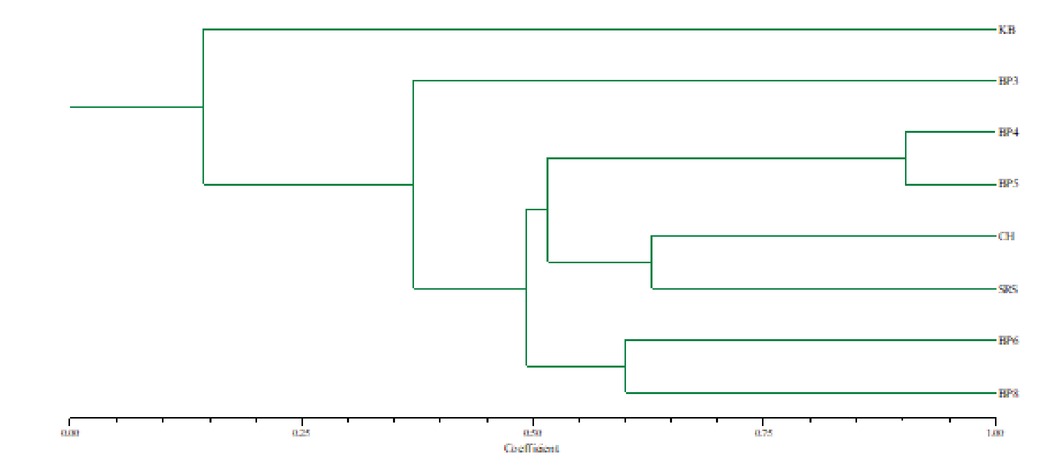

FIGURE 6. Dendrogram of white rice samples based on SSR analysis using three different primers (RM23501, RM16253, and RM12366). KB = local control of white rice; BP3, BP4, BP5, BP6, and BP8 = white rice samples; CH = white rice Ciherang; SR = white rice Super Ramos.

The PCR results of corn samples using 10 SSR primers were shown in Fig. 7. The result of PCR amplification of the corn sample B (BISI 18 non-Master) were polymorphic compared to the control A (BISI 18 Master) when using primers 1, 2, 4, 5, 8, and 9 (p-bnlg 109, p-bnlg 244, p-umc 2039, p-umc 2146, p-umc 2281, and p-umc 2325, respectively). Meanwhile, the PCR results using primers 3, 6, and 10 (p-umc 1265, p-umc 2225, and p-umc 2377, respectively) showed that the sample and the control of corn had a similar of DNA binding pattern. Primer 7 (p-umc 2279) did not produce clear DNA binding patterns.

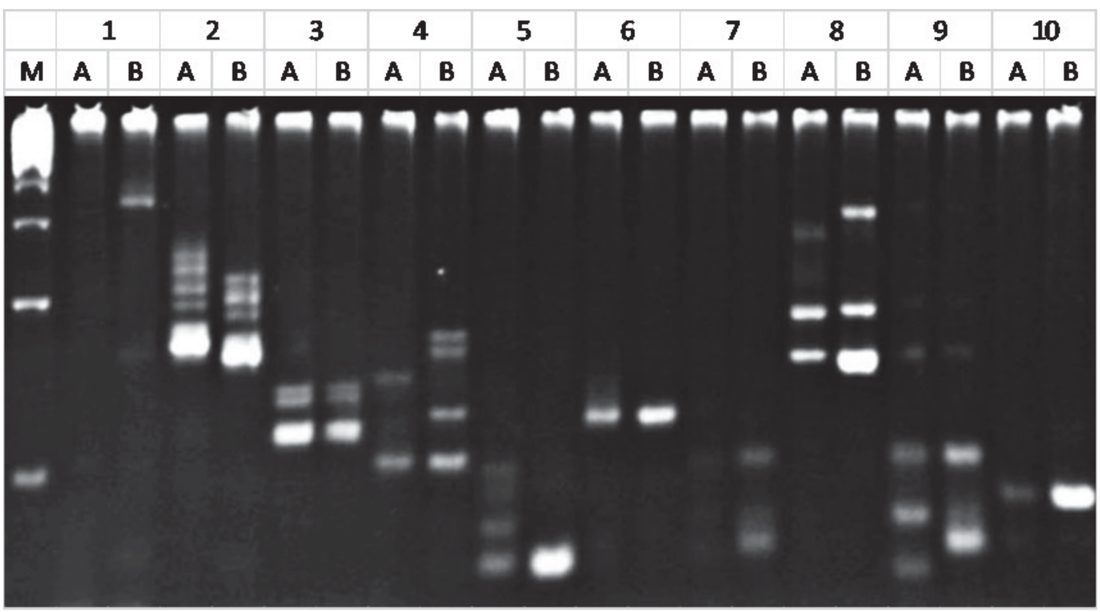

FIGURE 7. The results of 2% agarose gel electrophoresis based on the PCR product using 10 SSR primers. M = 100 bp DNA ladder, A = control of corn (BISI 18 Master), B = sample corn (BISI 18 non-Master), 1 = primer p-bnlg 109, 2 = pimer p-bnlg 244, 3 = primer p-umc 1265, 4 = primer p-umc 2039, 5 = primer p-umc 2146, 6 = primer p-umc 2225, 7 = primer p-umc 2279, 8 = primer p-umc 2281, 9 = primer p-umc 2325, 10 = primer p-umc 2377.

The use of molecular markers in the field of agricultural forensic, especially SSR markers, can be beneficial to trace the existence of evolution and phylogeny. The previous identification of a sample is based on changes in geography and morphology of several organisms, so that the molecular markers can be applied to support phylogeny based on genome sequences which are simple and stable in nature. Molecular markers can also be used to investigate the diversity and superiority of a plant variety, such as SSR used in the investigation of heterotic groups of rice and its patterns. Importantly, molecular markers can be used in the investigation of genetic diversity in a large population of germplasm to group the genetic material. Based on these uses, molecular markers, especially SSR, are capable to determine the truth of an organism genetically or certain genetic grouping [5].

On the GMO detection, identification of the presence of P-35S and T-nos fragments is widely used to detect the GM material (transgenic element) of the tested sample. Based on PCR results on B1, B2, and B3 samples of corn flour using primers for P-35S and T-nos fragments, there was no indication that the three samples contained those fragments (Fig. 8). The use of Zein primer to detect corn samples showed that all samples produced DNA fragment of 250 bp, while pCambia1301 plasmid did not produce it (Fig. 8). This confirmed that the samples used were derived from maize/corn.

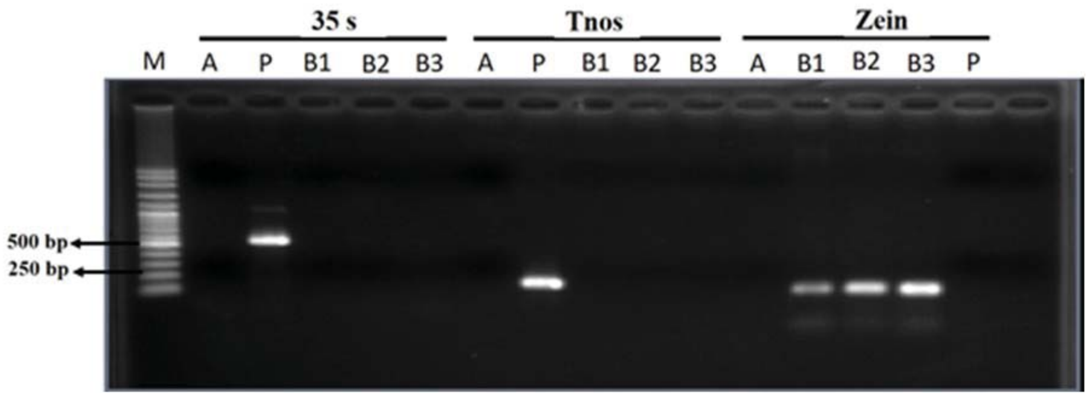

FIGURE 8. The results of 1.5% agarose gel electrophoresis based on the PCR product of the corn flour samples for GMO detection. M = 100 bp DNA ladder; 35s = primer for P-35S fragment; Tnos = primer for T-nos fragment; Zein = primer for Zein fragment; A = H_2O, negative control; P = pCambia1301 plasmid, positive control for GM material (transgenic element); B1, B2, and B3 = corn flour samples.

TABLE 1. Result of GMO detection of the corn flour samples using primers for P-35S, T-nos, and Zein fragments.

Sample	Fragment of P-35S	Fragment of T-nos	Fragment of Zein
B1	Negative	Negative	Positive
B2	Negative	Negative	Positive
B3	Negative	Negative	Positive
pCambia1301*	Positive	Positive	Negative
H_2O**	Negative	Negative	Negative

*Positive control for GM material (transgenic element). **Negative control.

Table 1 summarized the PCR results using primers for P-35S, T-nos, and Zein fragments on the three corn flour samples and two control samples. The PCR based methods were used to detect GMO content because the method is widely applicable. This could be applied for unprocessed and highly processed foods. Two types of PCR could be used to examine the presence of GMO: the traditional PCR and the real-time PCR that is capable not only to detect the GMO content, but also to quantify it [19]. In this study, detection of GM material used screening technique based on the existence of P-35S fragment from CaMV and T-nos fragment from *A. tumefaciens* [20]. This method is the most frequently used method for detecting GM material [12].

Several GMO products contained specific GM material in a product in raw material or their derivatives. The common GM materials on the market was gene fragments for insect resistance and/or herbicide tolerance. The application of PCR method that can be used to detect *cry* gene and *EPSPS* gene has been developed using specific primers to verify the absence or presence of these GM materials for product including raw materials (grains) and their derivatives is needed. In one study, PCR was used to clarify the absence or presence *cry* gene fragment using *cryIAb* primer and herbicide tolerance element using *EPSPS* primer [21].

CONCLUSION

The results of SSR analysis using three primers (RM23501, RM16253, and RM12366) on sticky rice, brown rice, and white rice showed that the DNA banding pattern was different from their local controls. SSR analysis on corn flour samples using 10 primers indicated that 6 primers produced polymorphic patterns among the control and the samples of corn. In the GMO detection, three samples of corn flour showed negative PCR when using primers for P-35S and T-nos fragments. In summary, agroforensic can be performed using PCR-based SSR method.

ACKNOWLEDGMENTS

The authors really thank to Molecular Biology Laboratory of ICABIOGRAD for providing the laboratory facility. This study was a part of Public Services for laboratory analysis in ICABIOGRAD. Special thanks were also addressed to Sukma Wijayanti as a technician in this study.

REFERENCES

1. R. Dumache, V. Ciocan, C. Muresan and A. Enache, "Molecular genetics and its applications in forensic sciences," in *Forensic Analysis – From Death to Justice* (IntechOpen, London, 2016), pp. 87–96.
2. L. Roewer, Investig. Genet. **4(1)**, 1–10 (2013).
3. K. Mullis, F. Faloona, S. Scharf, R. Saiki, G. Horn and H. Erlich, Biotechnol. **24**, 17–27 (1992).
4. T. Amom and P. Nongdam, Int. J. Curr. Res. Rev. **9(17)**, 1–7 (2017).
5. M. A. Nadeem, M. A. Nawaz, M. Q. Shahid, Y. Doğan, G. Comertpay and M. Yıldız, Biotechnol. Equip. **32(2)**, 261–285 (2018).
6. R. Manimekalai, P. Nagarajan and P. M. Kumaran, Trop. Agric. Res. **18**, 1–10 (2004).
7. S. A. Al-Faifi, H. M. Migdadi, S. S. Algamdi, M. A. Khan, M. H. Ammar and R. S. Al-Obeed, Electron J. Biotechnol. **21**, 18–25 (2016).
8. Presiden Republik Indonesia, *Peraturan Pemerintah Republik Indonesia No. 21* (2005).
9. S. Nazir, M. Z. Iqbal and Sajid-ur-Rahman, Gene Ed. Technol. Appl. 1–18 (2019).
10. M. Querci, M. Van Den Bulcke, J. Žel, G. Van Den Eede and H. Broll, Anal. Bioanal. Chem. **396(6)**, 1991–2002 (2010).
11. M. J. Holden, M. Levine, T. Scholdberg, R. J. Haynes and G. R. Jenkins, Anal. Bioanal. Chem. **396(6)**, 2175–2187 (2010).
12. P. Safaei, E. M. Aghaee, G. J. Khaniki, S. A. K. Afshari and S. Rezaie, J. Environ. Heal. Sci. Eng. **17(2)**, 847–851 (2019).
13. J. J. Doyle and J. L. Doyle, Phytochemical Bull. **19(1)**, 11–15 (1987).
14. J. G. K. Williams, A. R. Kubelik, K. J. Livak, J. A. Rafalski and S. V. Tingey, Nucleic Acids Res. **18(22)**, 6531–6535 (1990).
15. E. Listanto, G. A. Wattimena and N. M. Armini, J. Hortik. **19(2)**, 137–147 (2009).
16. E. Listanto, E. I. Riyanti, T. J. Santoso, T. Hadiarto and A. D. Ambarwati, Indones. J. Agric. Sci. **16(2)**, 51–58 (2015).
17. Kapa Biosystems, *https://www.n-genetics.com/products/1104/1023/13695.pdf* (2016).
18. S. S. Jamshidi, Int. Conf. Environ. Comput. Sci. **19,** 165–169 (2011).
19. Y. A. Khidr, M. M. Arafa, S. M. M. Eldemery and R. M. Elsanhoty, Egypt J. Genet. Cytol. **47,** 57–68 (2018).
20. C. Xu, L. Li, W. Jin and Y. Wan, Int. J. Mol. Sci. **15(10)**, 18197–18205 (2014).
21. Bahagiawati, Reflinur and T. J. Santoso, J. AgroBiogen **11(2)**, 65–72 (2015).