

## REFERENCES

- Abdallah, R.A.B., S. Mokni-Tlili, A. Nefzi, H. Jabnoun-Khiareddine & M. Daami-Remadi. 2016. Biocontrol of *Fusarium* wilt and growth promotion of tomato plants using endophytic bacteria isolated from *Nicotiana glauca* organs. *Biol. Control*, 97: 80-88.
- Acebo-Guerrero, Y. A. Hernandez-Rodriguez, M. Heydrich-Perez, M. El Jaziri & N. Hernandez-Lauzardo. 2012. Management of black pod rot in cacao (*Theobroma cacao* L.): a review. *Fruits*, 67 (1): 41-48.
- Acebo-Guerrero, Y., A. Hernandez-Rodriguez, O. Vandeputte, Y. Miguelez-Sierra, M. Heydrich-Perez, L. Ye, P. Cornelis, P. Bertin & M. El Jaziri. 2015. Characterization of *Pseudomonas chlororaphis* from *Theobroma cacao* L. rhizosphere with antagonistic activity against *Phytophthora palmivora* (Butler). *J. Appl. Microbiol.*, 119: 1112-1126.
- Adebola, M.O. & J.E. Amadi. 2010a. Antagonistic activities of *Paecilomyces* and *Rhizopus* species against the cocoa black pod pathogen (*Phytophthora palmivora*). *Afr. Sci.*, 11 (4): 235-239.
- Adebola, M.O. & J.E. Amadi. 2010b. Screening three *Aspergillus* species for antagonistic activities against the cocoa black pod organism (*Phytophthora palmivora*). *Agric. Biol. J. N. Am.*, 1 (3): 362-365.
- Adebola, M.O. & J.E. Amadi. 2012a. Screening five fungal isolates as potential antagonists to *Phytophthora palmivora* on cocoa pod pericarp. *IJABR*, 4 (1&2): 78-84.
- Adebola, M.O. & J.E. Amadi. 2012b. Studies on *Penicillium digitatum*, *Botryodiplodia theobromae*, *Alternaria tenuis* and *Trichoderma harzianum* for biocontrol of *Phytophthora palmivora* cocoa black pod disease pathogen. *Am-Euras. J. Agron.*, 5 (2): 30-34.
- Adejumo, T.O. and D.O. Adejoro, 2015. Assessment of bacteria, fungi and protozoa in three *Theobroma cacao* soils in Ondo State, Nigeria. *Int. J. Sci.*, 4 7): 28-33.
- Afoakwa, E.O. 2014. *Cocoa Production and Processing Technology*. CRC Press. Boca Raton. 329 p.
- Afrane, G. & A. Ntiamoah. 2011. Use of pesticides in the cocoa industry and their impact on the environment and the food chain. *In*: M. Stoytcheva (Ed.). *Pesticides in the Modern World - Risks and Benefits*. Intech. Croatia. 51-68.
- Agaras, B.C. & C. Valverde 2018. A novel oligonucleotide pair for genotyping members of the *Pseudomonas* genus by single-round PCR amplification of the *gyrB* gene. *Methods Protoc.*, 1: 24.
- Agbeniyi, S.O., A.R. Adediji & D.O. Adeniyi. 2014. On-farm evaluation of *Trichoderma asperellum* on the suppression of *Phytophthora megakarya*

causing pod rot of *Theobromae cacao* in Nigeria. Br. J. App. Sci. Technol., 4 (22): 3153-3159.

Agrios, G.N. 2005. Plant Pathology. Fifth Edition. Elsevier Academic Press. United Kingdom. 922 p.

Aguilera-Galvez, C., N. Champouret, H. Rietman, X. Lin, D. Wouters, Z. Chu, J.D.G. Jones, J.H. Vossan, R.G.F. Visser, P.J. Wolters & V.G.A.A. Vleeshouwers. 2018. Two different R gene loci co-evolved with Avr2 of *Phytophthora infestans* and confer distinct resistance specificities in potato. Stud. Mycol., 89: 105-115.

Ahanger, R.A., H.A. Bhat & N.A. Dar. 2014. Biocontrol agents and their mechanism in plant disease management. Scientia Acta Xaveriana, 5 (1): 47-58.

Aisyah, N., Rahmansyah, Muslimin, & I.N. Suwastika. 2014. Resistance of several cacao clones against pod rot disease infection based on detached pod assay. Online J. Nat. Sci., 3 (2): 50-56.

Akinferon, O.A. 1968. Production of extracellular enzymes by *Phytophthora palmivora* (Butl.) Butl. J. Gen. Microbiol., 51: 67-74.

Akinferon, O.A. 1969. Factors affecting the production of extracellular pectolytic enzymes by *Phytophthora palmivora* (Butl.) Butl. Ann. Bot., 33 (131): 439-450.

Akrofi, A.Y., F. Govers, R.T. Awuah & J.M. Raaijmakers. 2012. Exploiting microbial diversity in cocoa ecosystems in Ghana to control *Phytophthora* pod rot disease. Glo. Adv. Res. J. Agric. Sci., 1 (10): 305-308.

Akrofi, A.Y., J.L. Terlabie, I. Amoako-Attah & E.K. Asare. 2017. Isolation and characterization of bacteria from different cacao progenies and their antagonistic activity against the black pod disease pathogen, *Phytophthora palmivora*. J. Plant Dis. Prot., 124 (2): 143-152

Alconero, R. & A. Santiago. 1972. Characteristics of asexual sporulation in *Phytophthora palmivora* and *Phytophthora parasitica nicotianae*. Phytopathol., 62 (9): 993-997.

Ali, S.S., J. Shao, D.J. Lary, B.A. Kronmiller, D. Shen, M.D. Strem, I. Amoako-Attah, A.Y. Akrofi, B.A.D. Begoude, G.M. ten Hoopen, K. Coulibaly, B.I. Kebe, R.L. Melnick, M.J. Guiltinan, B.M. Tyler, L.W. Meinhardt & B.A. Bailey. 2017. *Phytophthora megakarya* and *Phytophthora palmivora*, closely related causal agents of cacao black pod rot, underwent increases in genome sizes and gene numbers by different mechanisms. Genome Biol. Evol., 9 (3): 536-557.

Alsultan, W., G. Vadamalai, A. Khairulmazmi, H.M. Saud, A.M. Al-Sadi, O. Rashed, A. K. Mohd Jaaffar & A. Nasehi. 2019. Isolation, identification and characterization of endophytic bacteria antagonistic to *Phytophthora palmivora* causing black pod of cocoa in Malaysia. Eur. J. Plant Pathol., 55: 1077-1091.

- Amudhan, M.S. & S.E. Apshara. 2012. Health effects of cocoa. *In*: S.E. Apsara, S. Sujatha, V.N. Hubballi & K.S. Ananda (Eds.). Cocoa towards Sustainability. Central Plantation Crops Research Institute. Kerala. 55-64.
- Anderson, R.G., D. Deb, K. Fedkenheuer & J.M. McDowell. 2015. Recent progress in *RXLR* effector research. *Mol. Plant-Microbe Interact.*, 28 (10): 1063-1072.
- Andrison, D., J. Avendano-Corcoles, A.M. Cameron, S.F. Carnegie, L.R. Cooke, R. Corbiere, D. Detourne, L.J. Dowley, D. Evans, K. Forisekova, D.G. Griffin, A. Hannukkala, A.K. Lees, R. Lebecka, F. Niepold, Z. Polgar, D.S. Shaw, J. Thompson, B. Trognitz, H.M.G. van Raaij & E. Zimnoch-Guzowska. 2011. Stability and variability of virulence of *Phytophthora infestans* assessed in a ring test across European laboratories. *Plant Pathol.*, 60 (3): 556-565.
- Andrzejuk, A. 2014. The analysis of production and trade patterns in cocoa market worldwide and in Poland. *Sci. J. Warsaw University of Life Sciences – SGGW Problems of World Agriculture*, 14 (4): 5-14.
- Ann, Y.C., A.A. Sallehin, H.A. Roslan, M.M.H. Hussain & S. Lihan. 2015. Antagonistic activity of endophytic *Bacillus* species against *Colletotrichum gloeosporioides* for the control of anthracnose disease in black pepper (*Piper nigrum* L.). *Global J. Biol. Agri. Health Sci.*, 4 (2): 115-123.
- Appiah, A.A., I.Y. Opoku & A.Y. Akrofi. 2004a. Natural occurrence and distribution of stem cankers caused by *Phytophthora megakarya* and *Phytophthora palmivora* on cocoa. *Eur. J. Plant Pathol.*, 110 (10): 983-990.
- Appiah, A.A., J. Flood, P.D. Bridge & S.A. Archer. 2003. Inter- and intraspecific morphometric variation and characterization of *Phytophthora* isolates from cocoa. *Plant Pathol.*, 52 (2): 168-180.
- Appiah, A.A., J. Flood, S.A. Archer & P.D. Bridge. 2004b. Molecular analysis of the major *Phytophthora* species on cocoa. *Plant Pathol.*, 53 (2): 209-219.
- Apshara, S.E. 2012. Cocoa varieties and their potential in crop improvement. *In*: S.E. Apsara, S. Sujatha, V.N. Hubballi & K.S. Ananda (Eds.). Cocoa towards Sustainability. Central Plantation Crops Research Institute. Kerala. 8-23.
- Aregbesola, O.Z & P.T. Owombo. 2014. Approaches to disease management in organic crop production systems: a case of cassava mosaic disease and black pod disease of cocoa. *IOSR-JAVS*, 7 (12): 42-51.
- Ashby, S.F. 1922. Oospores in cultures of *Phytophthora faberi*. *Bull. Misc. Inform. (Royal Botanic Gardens, Kew)*, 1922 (9): 257-262.
- Asbhy, S.F. 1929. Strains and taxonomy of *Phytophthora palmivora* Butler (*P. faberi* Maubl.). *Trans. Br. Mycol. Soc.*, 14 (1-2): 18-38.

- Awuah, R.T. 1994. In vivo use of extracts from *Ocimum gratissimum* and *Cymbopogon citratus* against *Phytophthora palmivora* causing black pod disease of cocoa. Ann. Appl. Biol., 124 (1): 173-178.
- Azis, A.I., A. Rosmana & V.S. Dewi. 2013. Control of *Phytophthora* leaf blight disease on cacao seedling using *Trichoderma asperellum*. J. Fitopatol. Indones., 9 (1): 15-20.
- Azni, I.N.A.M, S. Sundram, V. Ramachandran & A.S. Idris. 2017. An *in vitro* investigation of Malaysian *Phytophthora palmivora* isolates and pathogenicity study on oil palm. J. Phytopathol., 00: 1-13.
- Babu, S.S. 2012. Integrated disease management in cocoa. In: S.E. Aphsara, S. Sujatha, V.N. Hubballi & K.S. Ananda (Eds.). Cocoa towards Sustainability. Central Plantation Crops Research Institute. Kerala. 65-72.
- Backman, P.A. & R.A. Sikora. 2008. Endophytes: An emerging tool for biological control. Biol. Control, 46 (1): 1-3.
- Bae, H., R.C. Sicher, M.S. Kim, S.-H. Kim, M.D. Strem, R.L. Melnick & B.A. Bailey. 2009. The beneficial endophyte *Trichoderma hamatum* isolate DIS 219b promotes growth and delays the onset of the drought response in *Theobroma cacao*. J. Exp. Bot., 60 (11): 3279-3295.
- Bahia, R.d.C., C.I. Aguilar-Vildoso, E.D.M.N. Luz, U.V. Lopes, R.C.R. Machado & R.X. Corrêa. 2015. Resistance to black pod disease in a segregating cacao tree population. Trop. Plant Pathol., 40 (1): 13-18.
- Bailey, B.A., M.D. Strem, H. Bae, G.A. de Mayolo & M.J. Gultinan. 2005. Gene expression in leaves of *Theobroma cacao* in response to mechanical wounding, ethylene, and/or methyl jasmonate. Plant Sci., 168 (5): 1247-1258.
- Bailey, B.A., H. Bae, M.D. Strem, J. Crozier, S.E. Thomas, G.J. Samuels, B.T. Vinyard & K.A. Holmes. 2008. Antibiosis, mycoparasitism, and colonization success for endophytic *Trichoderma* isolates with biological control potential in *Theobroma cacao*. Biol. Control, 46 (1): 24-35.
- Bailey, B.A., M.D. Strem & D. Wood. 2009. *Trichoderma* species form endophytic associations within *Theobroma cacao* trichomes. Mycol. Res., 113 (12): 1365-1376.
- Bailey, B.A., J. Crozier, R.C. Sicher, M.D. Strem, R. Melnick, M.F. Carazzolle, G.G.L. Costa, G.A.G. Pereira, D. Zhang, S. Maximova, M. Gultinan & L. Meinhardt. 2013. Dynamic changes in pod and fungal physiology associated with the shift from biotrophy to necrotrophy during the infection of *Theobroma cacao* by *Moniliophthora roreri*. Physiol. Mol. Plant Pathol., 81: 84-96.
- Balasimha, D. 2012. Impact of climate change on cocoa. In: S.E. Aphsara, S. Sujatha, V.N. Hubballi & K.S. Ananda (Eds.). Cocoa towards Sustainability. Central Plantation Crops Research Institute. Kerala. 46-54.

- Bartley, B.G.D. 2005. The Genetic Diversity of Cacao and Its Utilization. CABI Publishing. United Kingdom. 341 p.
- Blair, J.E., M.D. Coffey, S. Park, D.M. Geiser & S. Kang. 2008. A multi-locus phylogeny for *Phytophthora* utilizing markers derived from complete genome sequences. Fungal Genet. Biol., 45: 266-277.
- Blein, J.-P., P. Coutos-Thévenot, D. Marion & M. Ponchet. 2002. From elicitors to lipid-transfer proteins: a new insight in cell signalling involved in plant defence mechanisms. Trends Plant Sci., 7(7): 293-296.
- Bletter, N. & D.C. Daly. 2006. Cacao and its relatives in South America: An overview of taxonomy, ecology, biogeography, chemistry, and ethnobotany. In: C.L. McNeil (Ed.). Chocolate in Mesoamerica: A Cultural History of Cacao. University Press of Florida. Florida. 31-68.
- Boccas, B. 1972. Genetics of *Phytophthora palmivora* – some preliminary data. ORSTOM Fonds Documentaire. 1-5.
- Bombarely, A., H.G. Rosli, J. Vrebalov, P. Moffett, L.A. Mueller & G.B. Martin. 2012. A draft genome sequence of *Nicotiana benthamiana* to enhance molecular plant-microbe biology research. Mol. Plant-Microbe Interact., 25 (12): 1523-1530.
- Bos, J.I.B., T. Kanneganti, C. Young, C. Cakir, E. Huitema, J. Win, M.R. Armstrong, P.R.J. Birch & S. Kamoun. 2006. The C-terminal half of *Phytophthora infestans* RXLR effector AVR3a is sufficient to trigger R3a-mediated hypersensitivity and suppress INF1-induced cell death in *Nicotiana benthamiana*. Plant J., 48: 165-176.
- Bouws, H. & M.R. Finckh. 2007. Effects of cropping history and origin of seed potatoes on population structure of *Phytophthora infestans*. Eur. J. Plant Pathol., 117: 313-327.
- Bozkurt T.O., S. Schornack, J. Win, T. Shindo, M. Ilyas, R. Oliva, L.M. Cano, A.M. Jones, E. Huitema, R.A.L. van der Hoorn & S. Kamoun. 2011. *Phytophthora infestans* effector AVRblb2 prevents secretion of a plant immune protease at the haustorial interface. Proc. Natl. Acad. Sci. USA, 108 (51): 20832-20837.
- Bozkurt, T.O., S. Schornack, M.J. Banfield & S. Kamoun. 2012. Oomycetes, effectors, and all that jazz. Curr. Opin. Plant Biol., 15: 483-492.
- Brasier, C.M. 1969. Formation of oospores in vivo by *Phytophthora palmivora*. Trans. Br. Mycol. Soc., 52 (2): 273-279.
- Brasier, C.M. 1972. Observations on the sexual mechanism in *Phytophthora palmivora* and related species. Trans. Br. Mycol. Soc., 58 (2): 237-251.
- Brasier, C.M. 1975. Stimulation of sex organ formation in *Phytophthora* by antagonistic species of *Trichoderma*. New Phytol., 74 (2): 183-194.



- Brasier, C.M. & M.J. Griffin. 1979. Taxonomy of *Phytophthora palmivora* on cocoa. Trans. Br. Mycol. Soc., 72 (1): 111-143.
- Braudeau, J. 1974. The cocoa tree: Agronomic aspects. In: P.H. Gregory (Ed.). *Phytophthora* disease of cocoa. The Aberdeen University Press. Great Britain. 1-12.
- Brunda, K.S., S. Jahagirdar & D.N. Kambrekar. 2018. Antagonistic activity of bacterial endophytes against major soilborne pathogens of soybean. J. Entomol. Zool. Stud., 6 (6): 43-46.
- Burdon, J.J. 1993. Genetic variation in pathogen populations and its implications for adaptation to host resistance. In: T.H. Jacobs & J.E. Parlevliet (Eds.). Durability of Disease Resistance. Springer Science Business Media. Wageningen. 41-56.
- Callaghan, S. & D. Guest. 2015. Globalisation, the founder effect, hybrid *Phytophthora* species and rapid evolution: new headaches for biosecurity. Australas. Plant Pathol., 44: 255-262.
- Carella, P., A. Gogleva, M. Tomaselli, C. Alfs & S. Schornack. 2018. *Phytophthora palmivora* establishes tissue-specific intracellular infection structures in the earliest divergent land plant lineage. PNAS, 115 (16): 3846-3855.
- Charan, A.R., V.P. Reddy, P.N. Reddy, S.S. Reddy & S. Sivaramakrishnan. 2011. Assessment of genetic diversity in *Pseudomonas fluorescens* using PCR-based methods. Biorem. Biodiv. Bioavail., 5 (1): 10-16.
- Chen, X., Y. Xing, Y. Li, Y. Tong & J. Xu. 2013. RNA-Seq reveals infection-related gene expression changes in *Phytophthora capsici*. PLoS ONE, 8 (9): e74588.
- Chen, L., H. Shi, J. Heng, D. Wang & K. Bian. 2019. Antimicrobial, plant growth promoting and genomic properties of the peanut endophyte *Bacillus velezensis* LDO2. Microbiol. Res., 218: 41-48.
- Chirapongsatunkul, N., K. U-taynapun, T. Chanwun & N. Churngchow. 2015. Development of multiplex PCR assay for rapid and simultaneous detection of rubber tree pathogens *Phytophthora* spp. and *P. palmivora*. ScienceAsia, 41:170-179.
- Chliyah, M., Y. Rhimini, K. Selmaoui, A.O. Touhami, A. Filali-Maltouf, C. El Modafar, A. Moukhli, A. Oukabli, R. Benkirane & A. Douira. 2014. Geographical distribution of *Phytophthora palmivora* in different olive growing regions in Morocco. Int. J. Plant Anim. Environ. Sci., 4 (1): 297-303.
- Chowdappa, P. & R. Chandramohan. 1997. Occurrence and distribution of mating types of *Phytophthora* species causing black pod disease of cocoa. Indian Phytopathol., 50 (2): 256-260.

- Cikita, D., S. Khotimah & R. Linda. 2016. Uji antagonis *Trichoderma* spp. terhadap *Phytophthora palmivora* Butl. penyebab penyakit busuk buah kakao (*Theobroma cacao* L.). *Protobiont*, 5 (3): 59-65.
- Crozier, J., S.E. Thomas, M.C. Aime, H.C. Evans & K.A. Holmes. 2006. Molecular characterization of fungal endophytic morphospecies isolated from stems and pods of *Theobroma cacao*. *Plant Pathol.*, 55 (6): 783-791.
- Darmono, T.W., I. Jamil & D.A. Santosa, 2006. Pengembangan penanda molekuler untuk deteksi *Phytophthora palmivora* pada tanaman kakao. *Menara Perkebunan*, 74 (2): 86-95.
- Dau, V.T., C.V. Tran, L.T. Pham, H.T. Phan, H.L. Dhang & L.W. Burgess. 2008. Stem and root rot of *Telosma cordata* caused by *Phytophthora palmivora* in Vietnam – a newly recognised disease. *Australas. Plant Dis. Notes*, 3 (1): 135-137.
- de Oliveira, T.A.S., L.E.B. Blum, E.A.A. Duarte, Z.P.M. Moreira & E.D.M.N. Luz. 2016. Variability and aggressiveness and virulence of *Phytophthora palmivora* influencing the severity of papaya fruit rot in postharvest in Bahia, Brazil. *Científica, Jaboticabal*, 44 (2): 185-195.
- de Souza, J.T., A.W.V. Pomella, J.H. Bowers, C.P. Pirovani, L.L. Loguercio & K.P. Hebbar. 2006. Genetic and biological diversity of *Trichoderma stromaticum*, a mycoparasite of the cacao witches'-broom pathogen. *Phytopathol.*, 96 (1): 61-67.
- de Souza, J.T., B.A. Bailey, A.W.V. Pomella, E.F. Erbe, C.A. Murphy & P.K. Hebbar. 2008. Colonization of cacao seedlings by *Trichoderma stromaticum*, a mycoparasite of the witches' broom pathogen, and its influence on plant growth and resistance. *Biol. Control*, 46 (1): 36-45.
- Deenamo, N., A. Kuyyogsuy, K. Khompatara, T. Chanwun, K. Ekchaweng & N. Churngchow. 2018. Salicylic acid induces resistance in rubber tree against *Phytophthora palmivora*. *Int. J. Mol. Sci.*, 19 (1883): 1-22.
- Derevnina, L., Y.F. Dagdas, J.C. de la Concepcion, A. Bialas, R. Kellner, B. Petre, E. Domazakis, J. Du, C.-H. Wu, X. Lin, C. Aguilera-Galvez, N. Cruz-Mireles, V.G.A.A. Vleeshouwers & S. Kamoun. 2016. Nine things to know about elicitors. *New Phytol.*, 212: 888-895.
- Dick, M.W. 2000. *Straminipilous Fungi: Systematics of the peronosporomycetes including accounts of the marine straminipilous protists, the plasmodiophorids and similar organisms*. Kluwer Academic Publishers. London. 575 p.
- Dikin, A., K. Sijam, Z.A. Mior Ahmad & I.A. Seman. 2003. Biological Control of seedborne pathogen of oil palm, *Schizopyllum commune* Fr. with antagonistic bacteria. *Int. J. Agri. Biol.*, 5 (4): 507-512.
- Dikin, A., K. Sijam, J. Kadir & I.A. Seman. 2006. Antagonistic bacteria against *Schizopyllum commune* Fr. in Peninsular Malaysia. *Biotropia*, 13 (2): 111-121.

- Dinh, T.T.M. & D.L.M. Hien. 2013. Screening *Bacillus* strains for antagonistic activity against *Fusarium* sp. and *Phytophthora palmivora* causing diseases in corn (*Zea mays* L.). *Tạp chí KHOA HỌC ĐHSP TPHCM*, 51: 29-36.
- Dinu, A., A. Kumar, R. Aravind & S.J. Eapen. 2007. An improved method for selection of antagonistic bacteria against *Phytophthora capsici* Leonian infections in black pepper (*Piper nigrum* L.). *J. Spice Aromatic Crops*, 16 (1): 1-7.
- Directorate General of Plantation, 2006. Road Map of Cacao Commodity 2005 – 2025. Ministry of Agriculture, Jakarta. 17 p.
- Directorate General of Plantation, 2013. General guidance of national movement for improvement the production and quality of cocoa. Ministry of Agriculture, Jakarta. 63 p.
- Dou, D., S.D. Kale, X. Wang, R.H.Y. Jiang, N.A. Bruce, F.D. Arredondo, X. Zhang & B.M. Tyler. 2008. RXLR-mediated entry of *Phytophthora sojae* effector *Avr1b* into soybean cells does not require pathogen-encoded machinery. *Plant Cell*, 20:1930-1947.
- Drenth, A., E.M. Janssen & F. Govers. 1995 Formation and survival of oospores of *Phytophthora infestans* under natural conditions. *Plant Pathol.*, 44 (1): 86-94.
- Drenth, A. & D.I. Guest. 2004a. *Phytophthora* in the tropics. In: A. Drenth, D.I. Guest (Eds.). *Diversity and Management of Phytophthora in Southeast Asia*. ACIAR Monograph No. 114. Canberra. 30-41.
- Drenth, A. & D.I. Guest. 2004b. Introduction. In: A. Drenth, D.I. Guest (Eds.). *Diversity and Management of Phytophthora in Southeast Asia*. ACIAR Monograph No. 114. Canberra. 7-9.
- Drenth, A. & D.I. Guest. 2004c. Principles of *Phytophthora* disease Management. In: A. Drenth, D.I. Guest (Eds.). *Diversity and Management of Phytophthora in Southeast Asia*. ACIAR Monograph No. 114. Canberra. 154-160.
- Drenth, A. & D.I. Guest. 2016. Fungal and oomycete diseases of tropical tree fruit crops. *Annu. Rev. Phytopathol.*, 54 (4): 373-395.
- Drenth, A. & B. Sendall. 2001. Practical Guide to Detection and Identification of *Phytophthora*. Version. 1.0. CRC for Tropical Plant Protection. Brisbane, Australia. 41 p.
- Drenth, A. & B. Sendall. 2004. Economic impact of *Phytophthora* diseases in Southeast Asia. In: A. Drenth, D.I. Guest (Eds.). *Diversity and Management of Phytophthora in Southeast Asia*. ACIAR Monograph No. 114. Canberra. 10-28.
- Du, Y., R. Weide, Z. Zhao, P. Msimuko, F. Govers & K. Bouwmeester. 2018. RXLR effector diversity in *Phytophthora infestans* isolates determines recognition by potato resistance proteins; the case study AVR1 and R1. *Stud. Mycol.*, 89: 85-93.



- Dwimartina, F., T. Arwiyanto & T. Joko. 2017. Potential of endophytic and rhizobacteria as an effective biocontrol for *Ralstonia syzygii* subsp. *syzygii*. Asian J. Plant Pathol., 11 (4): 191-198.
- D'Ovidio, R., B. Mattei, S. Roberti & D. Bellincampi. 2004. Polygalacturonase, polygalacturonase-inhibiting proteins and pectic oligomers in plant-pathogen interactions. Biochim. Biophys. Acta, 1696: 237-244.
- Edel V, C. Steinberg, I. Avelange, G. Laguerre & C. Alabouvette. 1995. Comparison of three molecular methods for the characterization of *Fusarium oxysporum* strains. Phytopathol., 85 (5): 579-585.
- Engelbrecht, J., T.A. Duong & N.v.d. Berg. 2017. New microsatellite markers for population studies of *Phytophthora cinnamomi*, an important global pathogen. Sci. Rep., 7 (17631): 1-10.
- Ekchaweng, K., E. Evangelisti, S. Schornack, M. Tian & N. Churngchow. 2017. The plant defense and pathogen counterdefense mediated by *Hevea brasiliensis* serine protease *HbSPA* and *Phytophthora palmivora* extracellular protease inhibitor *PpEPI10*. PLoS ONE, 12 (5): e0175795.
- El-Sayed, W.S., A. Akhkha, M.Y. El-Naggar & M. Elbadry. 2014. *In vitro* antagonistic activity, plant growth promoting traits and phylogenetic affiliation of rhizobacteria associated with wild plants grown in arid soil. Front. Microbiol., 5 (651): 1-11.
- EPPO. 2010. Rep-PCR tests for identification of bacteria. EPPO Bulletin, 40: 365-368.
- Erwin, D.C. 1983. Variability within and among species of *Phytophthora*. In: D.C. Erwin, S. Bartnicki-Garcia & P.H. Tsao (Eds.). *Phytophthora: Its biology, taxonomy, ecology and pathology*. APS. St. Paul, Minnesota. 149-165.
- Erwin, D.C. & O.K. Ribero. 1996. *Phytophthora* Diseases Worldwide. APS Press. Minnesota. 592 p.
- Evangelisti, E., A. Gogleva, T. Hainaux, M. Doumane, F. Tulin, C. Quan, T. Yunusov, K. Floch & S. Schornack. 2017. Time-resolved dual transcriptomics reveal early induced *Nicotiana benthamiana* root genes and conserved infection-promoting *Phytophthora palmivora* effectors. BMC Biol., 15 (39): 1-24.
- Evans, H.C., K.A. Holmes & S.E. Thomas. 2003. Endophytes and mycoparasites associated with an indigenous forest tree, *Theobroma gileri*, in Ecuador and a preliminary assessment of their potential as biocontrol agents of cocoa diseases. Mycol. Prog., 2 (2): 149-160.
- Faghobun, E.D. & O.U. Lawal. 2011. A field trial of crude extract from *Phytophthora palmivora*-infected cocoa pods to control black pod disease in a farm in Iworoko Ekiti, Ekiti State. J. Agric. Biotech. Sustain. Dev., 3 (6): 100-104.

- Fan, Z., C. Miao, X. Qiao, Y. Zheng, H. Chen, Y. Chen, L. Xu, L. Zhao & H. Guan. 2016. Diversity, distribution, and antagonistic activities of rhizobacteria of *Panax notoginseng*. J. Ginseng Res., 40: 97-104.
- Falcao, L.L., J.O. Silva-Werneck, B.R. Vilarinho, J.P. da Silva, A.W.V. Pomella & L.H. Marcellino. 2014. Antimicrobial and plant growth-promoting properties of the cacao endophyte *Bacillus subtilis* ALB629. J. App. Microbiol., 116 (6): 1584-1592.
- FAO. 2019. FAOSTAT. [www.fao.org/faostat](http://www.fao.org/faostat). Retrieved at September 18, 2019.
- Fegan M, Prior P (2005) How complex is the “*Ralstonia solanacearum* species complex”? In: Allen C, Prior P, Hayward AC (Eds.). Bacterial wilt disease and the *Ralstonia solanacearum* species complex. APS Publishing. St. Paul, Minnesota. 449-461.
- Fellbrich, G., A. Romanski, A. Varet, B. Blume, F. Brunner, S. Engelhardt, G. Felix, B. Kemmerling, M. Krzymowska & T. Nümborg. 2002. NPP1, a *Phytophthora*-associated trigger of plant defense in parsley and *Arabidopsis*. Plant J., 32:375-390.
- Figueiredo, J.E.F., E.A. Gomes, C.T. Guimaraes, U.G.d. Lana, M.A. Teixeira, G.V.C. Lima & W. Bressan. 2009. Molecular analysis of endophytic bacteria from the genus *Bacillus* isolated from tropical maize (*Zea mays* L.). Braz. J. Microbiol., 40 (3): 522-534.
- Filani, G.A. 1973. The chemical control of *Phytophthora* pod rot in Nigeria: An evaluation of the present situation. Coh. ORSTOM, sér. Biol. ILO, 20: 91-94.
- Foster, H., P. Oudemans & M.D. Coffey. 1990. Mitochondrial and nuclear DNA diversity within six species of *Phytophthora*. Exp. Mycol., 14 (1): 18-31.
- Fulton, R.H. 1989. The cacao disease trilogy: black pod, *Monilia* pod rot, and witches'-broom. Plant Dis., 73 (7): 601-603.
- Gabaze, G.A.A., Y.O. Bernard, A. Kouabenan, C. Klotioloma, K.B. Ismael, G.J. Robert & T.R. Dayal. 2015. *In vitro* assessment of biopesticide *Bacillus thuringiensis* var. *Kurstaki* HD-1 effectiveness on *Phytophthora palmivora*, agent of cocoa black pod rot in Côte d'Ivoire. Eur. Sci. J., 11 (21): 276-292.
- Gagnon, M.-C., N. Feau, A.L. Dale, B. Dhillon, R.C. Hamelin, C.M. Brasier, N.J. Grünwald, S.C. Brière & G.J. Bilodeau. 2017. Development and validation of polymorphic microsatellite loci for the NA2 lineage of *Phytophthora ramorum* from whole genome sequence data. Plant Dis., 101 (5): 666-673.
- Gajbhiye, A., A.R. Ray, S.U. Meshram & A.B. Dongre. 2010. Isolation, evaluation and characterization of *Bacillus subtilis* from cotton rhizospheric soil with biological activity against *Fusarium oxysporum*. World J. Microbiol. Biotechnol., 26 (7): 1187-1194.
- Gallegly, M.E. 1970. Genetics of *Phytophthora*. Phytopathol., 60 (7): 1135-1141.

- Gallegly, M.E. & C. Hong. 2008. *Phytophthora*: Identifying species by morphology and DNA fingerprints. APS Press. St. Paul, Minnesota. 127 p.
- Gappa-Adachi, R., K. Yano, S. Takeuchi, Y. Morita & S. Uematsu. 2012. *Phytophthora* blight of southern star (*Oxypetalum caeruleum*) caused by *Phytophthora palmivora* in Japan. J. Gen. Plant Pathol., 78 (1): 39-42.
- Gerrettson-Cornell, L. 1994. A compendium and classification of the species of the genus *Phytophthora* de Bary by the canons of the traditional taxonomy. Technical Paper No. 45. State Forests of New South Wales. Sidney. 87 p.
- Gómez-Zeledón, J. & O. Spring. 2018. Up-regulated RxLR effector genes of *Plasmopara viticola* in synchronized host-free stages and infected leaves of hosts with different susceptibility. Fungal Biol., 122 (12): 1125-1133.
- Goodin, M.M., D. Zaitlin, R.A. Naidu & S.A. Lommel. 2008. *Nicotiana benthamiana*: its history and future as a model for plant-pathogen interactions. Mol. Plant-Microbe Interact., 21 (8): 1015-1026.
- Goodwin, S.B. 1997. The population genetics of *Phytophthora*. Phytopathol., 87 (4): 462-473.
- Gopal, M. & A. Gupta. 2016. Microbiome selection could spur next-generation plant breeding strategies. Front. Microbiol., 7 (1971): 1-10.
- Grant, B.R., D. Ebert & K.R. Gayler. 1996. Elicitins: proteins in search of a role?. Australas. Plant Pathol., 25: 148-157.
- Guest, D.I. 2004. Nursery practices and orchard management. In: A. Drenth & D.I. Guest (Eds.). Diversity and Management of *Phytophthora* in Southeast Asia. ACIAR Monograph No. 114. Canberra. 160-166.
- Guest, D. 2007. Black pod: diverse pathogens with a global impact on cocoa yield. Phytopathol., 97 (12): 1650-1653.
- Gumtow, R., D. Wu, J. Uchida & M. Tian. 2018. A *Phytophthora palmivora* extracellular cystatin-like protease inhibitor targets papain to contribute to virulence on papaya. Mol. Plant-Microbe Interact., 31 (3): 363-373.
- Ha, T.N. 2010. Using *Trichoderma* species for biological control of plant pathogens in Vietnam. J. ISSAAS, 16 (1):17-21.
- Hafsah, S., Zuyasna & Firdaus. 2015. Screening genotypes of cacao to black pod disease (*Phytophthora palmivora*) in Aceh Besar. J. Floratek., 10 (1): 79-86.
- Hakkar, A.A., A. Rosmana & M.D. Rahim. 2014. Control of *Phytophthora* pod rot disease on cacao using endophytic fungi *Trichoderma asperellum*. J. Fitopatol. Indones., 10 (5): 139-144.
- Hallmann, J., A. Quadt-Hallmann, W.F. Mahaffee & J.W. Kloepper. 1997. Bacterial endophytes in agricultural crops. Can. J. Microbial., 43 (10): 895 -914.

- Hamidah. 2009. Biosistematika *Annona muricata* L., *Annona squamosa* L. dan *Annona reticulata* L. dengan pendekatan numerik. Disertasi. Fakultas Biologi, Universitas Gadjah Mada. Yogyakarta.
- Hamidah, Santoso & R. Kasiamdari. 2012. Biosistematik species *Annona muricata*, *Annona squamosa* dan *Annona reticulata* dengan pendekatan alkaloid. Berk. Penel. Hayati, 17 (2): 153-157.
- Hamzah, A., I. Zubir, E.E.R. Ross & W.S. Aqma. 2017. Antagonistic effect and plant growth hormone produced by endophyte *Bacillus amyloliquefaciens* LKM-UL isolated from cocoa plant. Int. Biosci. Biochem, Bioinforma., 7 (3): 169-176.
- Hanada, R.E., T.d.J. Souza, A.W.V. Pomella, K.P. Hebbar, J.O. Pereira, A. Ismaiel & G.J. Samuels. 2008. *Trichoderma martiale* sp. nov., a new endophyte from sapwood of *Theobroma cacao* with a potential for biological control. Mycol. Res., 112 (11): 1335-1343.
- Hanada, R.E., A.W.V. Pomella, W. Soberanis, L.L. Loguercio & J.O. Pereira. 2009. Biocontrol potential of *Trichoderma martiale* against the black-pod disease (*Phytophthora palmivora*) of cacao. Biol. Control, 50 (2): 143-149.
- Hanada, R.E., A.W.V. Pomella, H.S. Costa, J.L. Bezerra, L.L. Loguercio & J.O. Pereira. 2010. Endophytic fungal diversity in *Theobroma cacao* (cacao) and *T. grandiflorum* (cupuacu) trees and their potential for growth promotion and biocontrol of black-pod disease. Fungal Biol., 114 (11-12): 901-910.
- Hardham, A.R. & D.M. Cahill. 2010. The role of oomycete effectors in plant-pathogen interactions. Funct. Plant Biol., 37: 919-925.
- Harni, R. W. Amaria, Khaerati & E. Taufiq. 2016. Isolation and selection of endophytic fungi from cacao as biocontrol agents of *Phytophthora palmivora* Butl. J. TIDP, 3 (3): 141-150.
- He, R., G. Wang, X. Liu, C. Zhang & F. Lin. 2009. Antagonistic bioactivity of an endophytic bacterium isolated from *Epimedium brevicornu* Maxim. Afr. J. Biotechnol., 8 (2): 191-195.
- Hendra, A. Wibowo & Suryanti. 2019. Fungal pathogens associated with vascular streak dieback (VSD) disease on cacao in Special Region of Yogyakarta Province. Indones. J. Plant Prot., 23 (1): 133-141.
- Herlihy, J., N.R. Ludwig, G.v.d. Ackerveken & J.M. McDowell. 2019. Oomycetes used in Arabidopsis research. The Arabidopsis Book, 17: 1-26.
- Ho, H.H., Y.Y. Zhuang & W.Z. Liang. 1983. Mating types of heterothallic species of *Phytophthora* in China I. Acta Mycol. Sin., 2 (2): 187-191.
- Hung, P.M., P. Wattanachai, K. Soyong & S. Poaim. 2015. Biological control of *Phytophthora palmivora* causing root rot of pomelo using *Chaetomium* spp. Mycobiology, 43 (1): 63-70.

- ICCO. 2008. "Optimal" export taxes in cocoa producing countries. [https://www.icco.org/about-us/international-cocoa-agreements/cat\\_view/30-related-documents/32-consultative-board-on-the-world-cocoa-economy.html](https://www.icco.org/about-us/international-cocoa-agreements/cat_view/30-related-documents/32-consultative-board-on-the-world-cocoa-economy.html) (accessed 31 Januari 2019).
- Inan, K., Y. Bektas, S. Canakci & A.O. Belduz. 2011. Use of *rpoB* sequences and rep-PCR for phylogenetic study of *Anoxybacillus* species. J. Microbiol., 49 (5): 782-790.
- Indonesian Agricultural Quarantine Agency, 2018. Data on transportation of cacao seedlings in Indonesia (2013-2017). Ministry of Agriculture, Republic of Indonesia.
- Jee, H.J., W.G. Kim & W.D. Cho, 1997. First report of *Phytophthora palmivora* isolated from Areca palm and soil in Korea. Korean J. Plant Pathol., 13 (6): 438-441.
- Jiang, R.H.Y., S. Tripathy, F. Govers & B.M. Tyler. 2008. *RXLR* effector reservoir in two *Phytophthora* species is dominated by a single rapidly evolving superfamily with more than 700 members. Proc. Natl. Acad. Sci. USA, 105 (12): 4874-4879.
- Jiang, R.H.Y. I. de Bruijn, B.J. Haas, R. Belmonte, L. Löbach, J. Christie, G. van den Ackerveken, A. Bottin, V. Bulone, S.M. Diaz-Moreno, B. Dumas, L. Fan, E. Gaulin, F. Govers, L.J. Grenville-Briggs, N.R. Horner, J.Z. Levin, M. Mammella, H.J.G. Meijer, P. Morris, C. Nusbaum, S. Oome, A.J. Phillips, D. van Rooyen, E. Rzeszutek, M. Saraiva, C.J. Secombes, M.F. Seidl, B. Snel, J.H.M. Stassen, S. Sykes, S. Tripathy, H. van den Berg, J.C. Vega-Arreguin, S. Wawra, S.K. Young, Q. Zeng, J. Dieguez-Urbeondo, C. Russ, B.M. Tyler & P. van West. 2013. Distinctive expansion of potential virulence genes in the genome of the oomycete fish pathogen *Saprolegnia parasitica*. PLOS Genet., 9 (6): e1003272.
- Jin, F., Y. Ding, W. Ding, M.S. Reddy, W.G.D. Fernando & B. Du. 2011. Genetic diversity and phylogeny of antagonistic bacteria against *Phytophthora nicotianae* isolated from tobacco rhizosphere. Int. J. Mol. Sci., 12: 3055-3071.
- Joko, T., N. Kusumandari & S. Hartono. 2011. Optimization of PCR method for the detection of *Pectobacterium carotovorum*, a causal agent of soft-rot disease on orchid. Indones. J. Plant Prot., 17 (2): 54-59.
- Judelson, H.S. 2007. Genomics of the plant pathogenic oomycete *Phytophthora*: insights into biology and evolution. In: J.C. Dunla (Ed.). Fungal Genomics. Advances in Genetics Volume 57. Elsevier Academic Press. Massachusetts, USA. 97-141.
- Judelson, H.S. 2012. Dynamics and innovations within oomycete genomes: insights into biology, pathology, and evolution. Eukaryot. Cell, 11 (11): 1304-1312.
- Judelson, H.S. & F.A. Blanco. 2005. The spores of *Phytophthora*: Weapons of the plant destroyer. Nat. Rev. Microbiol., 3 (1): 47-58.



- Jung, S.J., N.K. Kim, D.-H. Lee, S.I. Hong & J.K. Lee. 2018. Screening and evaluation of *Streptomyces* species as a potential biological control agent against a wood decay fungus, *Gloeophyllum trabeum*. *Mycobiology*, 46 (2): 138-146.
- Kamoun, S. 2006. A catalogue of the effector secretome of plant pathogenic oomycetes. *Annu. Rev. Phytopathol.*, 44: 41-60.
- Kashyap, P.L., S. Rai, S. Kumar & A.K. Srivastava. 2016. Genetic diversity, mating types and phylogenetic analysis of Indian races of *Fusarium oxysporum* f.sp. *ciceris* from chickpea. *Arch. Phytopathol. Plant Prot.*, 49 (19-20): 533-553.
- Kellam, M.K. & G.A. Zentmeyer. 1986. Morphological, physiological, ecological, and pathological comparisons of *Phytophthora* species isolated from *Theobroma cacao*. *Phytopathol.*, 76 (2): 159-164.
- Keller, H., J.-P. Blein, P. Bonnet & P. Ricci. 1996. Physiological and molecular characteristics of elicitor-induced systemic acquired resistance in tobacco. *Plant Physiol.*, 110: 365-376.
- Khaeruni, A., T. Wijayanto, Darmansyah, R. Arini & G.A.K. Sutariati. 2019. Antagonistic activity of indigenous endophytic bacteria from cocoa plants against *Phytophthora palmivora* Bult the cause of black pod rot disease in cocoa. *Biosci. Res.*, 16 (1): 272-280.
- Khairum, A., O. Poolsawat, P. Pornbungkerd, A. Tharapreuksapong, S. Wongkaew & P.A. Tantasawat. 2018. Effects of culture media on *Phytophthora palmivora* growth,  $\alpha$ -elicitor production and toxicity to *Dendrobium*. *Not. Bot. Horti. Agrobi.*, 46 (2): 630-638.
- Khan, N.I., D.A. Schisler, M.J. Boehm, P.E. Lipps & P.J. Slininger. 2004. Field testing of antagonists of *Fusarium* head blight incited by *Gibberella zeae*. *Biol. Control*, 29: 245-255.
- Khunjan, U., K. Ekchaweng, T. Panrat, M. Tian & N. Churngchow. 2016. Molecular cloning of *HbPR-1* gene from rubber tree, expression of *HbPR-1* gene in *Nicotiana benthamiana* and its inhibition of *Phytophthora palmivora*. *PLoS ONE*, 11(6): e0157591.
- Ko, W.H. 1978. Heterothallic *Phytophthora*: Evidence for hormonal regulation of sexual reproduction. *J. Gen. Microbiol.*, 107 (1): 15-18.
- Ko, W.H. 1980. Hormonal regulation of sexual reproduction in *Phytophthora*. *J. Gen. Microbiol.*, 116 (2): 459-463.
- Ko, W.H. 1988. Hormonal heterothallism and homothallism in *Phytophthora*. *Annu. Rev. Phytopathol.*, 26 (1): 57-73.
- Ko, W.H. 2007. Hormonal regulation of sexual reproduction in *Phytophthora*. *Bot. Stud.*, 48 (4): 365-375.

- Komalasari, I., Suryanti & B. Hadisutrisno. 2018. Identification of causal agent of cocoa pod rot disease from various locations. *Indones. J. Plant Prot.*, 22 (1): 13-19.
- Koranteng, S.L. & R.T. Awuah. 2011. Biological suppression of black pod lesion development on detached cocoa pods. *Afr. J. Agr. Res.*, 6 (1): 67-72.
- Köhl, J., R. Kolnaar & W.J. Ravensberg. 2019. Mode of action of microbial biological control agents against plant diseases: relevance beyond efficacy. *Front. Plant Sci.*, 10: 845.
- Krajaejun, T., R. Khositnithikul, T. Lerksuthirat, T. Lowhnoo, T. Rujirawat, T. Petchthong, W. Yingyong, P. Suriyaphol, N. Smittipat, T. Juthayothin, V. Phuntumart & T.D. Sullivan. 2011. Expressed sequence tags reveal genetic diversity and putative virulence factors of the pathogenic oomycete *Pythium insidiosum*. *Fungal Biol.*, 115 (7): 683-696.
- Krajaejun, T., T. Lerksuthirat, G. Garg, T. Lowhnoo, W. Yingyong, R. Khositnithikul, S. Tangphatsornruang, P. Suriyaphol, S. Ranganathan & T.D. Sullivan. 2014. Transcriptome analysis reveals pathogenicity and evolutionary history of the pathogenic oomycete *Pythium insidiosum*. *Fungal Biol.*, 118 (7): 640-653.
- Krauss, U. & W. Soberanis. 2001. Rehabilitation of diseased cacao fields in Peru through shade regulation and timing of biocontrol measures. *Agroforest. Syst.*, 53 (2): 179-184.
- Krauss, U., G.M. ten Hoopen, E. Hidalgo, A. Martinez, T. Stirrup, C. Arroyo, J. Garcia & M. Palacios. 2006. The effect of cane molasses amendment on biocontrol of frosty pod rot (*Moniliophthora roreri*) and black pod (*Phytophthora* spp.) of cocoa (*Theobroma cacao*) in Panama. *Biol. Control*, 39 (2): 232-239.
- Krauss, U., M. ten Hoopen, R. Rees, T. Stirrup, T. Argyle, A. George, C. Arroyo, E. Corrales & F. Casanoves. 2013. Mycoparasitism by *Clonostachys byssicola* and *Clonostachys rosea* on *Trichoderma* spp. from cocoa (*Theobroma cacao*) and implication for the design of mixed biocontrol agents. *Biol. Control*, 67 (3): 317-327.
- Kroon, L.P.N.M., H. Brouwer, A.W.A.M. de Cock & F. Govers. 2012. The genus *Phytophthora* anno 2012. *Phytopathol.*, 102 (4): 348-364.
- Kueh, T.K. & K.L. Khew. 1982. Survival of *Phytophthora palmivora* in the soil and after passing through alimentary canals of snails. *Plant Dis.*, 66 (10): 897-899.
- Kumar, S., G. Stecher & K. Tamura. 2016. MEGA7: molecular evolutionary genetic analysis version 7.0 for bigger datasets. *Mol. Biol. Evol.*, 33 (7): 1870-1874.
- Kuzdraliński, A, A. Kot, H. Szczerba, M. Nowak & M. Muszyńska. 2017. A review of conventional PCR assay for the detection of selected phytopathogens of wheat. *J. Mol. Microbiol. Biotechnol.*, 27: 175-189.

- Lamour, K.H., J. Win & S. Kamoun. 2007. Oomycete genomics: new insights and future directions. *FEMS Microbiol. Lett.*, 274: 1-8.
- Lamour, K.H. & M.K. Hausbeck. 2000. Mefenoxam insensitivity and the sexual stage of *Phytophthora capsici* in Michigan cucurbit fields. *Phytopathol.*, 90: 396-400.
- Lane, D.J. 1991. 16S/23S rRNA Sequencing. *In*: E. Stackebrandt & M. Goodfellow (Eds.). *Nucleic Acid Techniques in Bacterial Systematic*. John Wiley and Sons. New York. 115-175.
- Lass, R.A. 1985. Maintenance and improvement of mature cocoa farms. *In*: G.A.R. Wood & R.A. Lass (Eds.). *Cocoa (Fourth Edition)*. Blackwell Science. Great Britain. 195-209.
- Le Fevre, R., B. O'Boyle, M.J. Moscou & S. Schornack. 2016. Colonization of barley by the broad-host hemibiotrophic pathogen *Phytophthora palmivora* uncovers a leaf development-dependent involvement of *Mlo*. *Mol. Plant-Microbe Interact.*, 29 (5): 385-395.
- Lee, B.S. & K.Y. Lum. 2004. *Phytophthora* diseases in Malaysia. *In*: A. Drenth & D.I. Guest (Eds.). *Diversity and Management of Phytophthora in Southeast Asia*. ACIAR Monograph No. 114. Canberra. 60-69.
- Lehtinen, A. & A. Hannukkala. 2004. Oospores of *Phytophthora infestans* in soil provide an important new source of primary inoculum in Finland. *Agr. Food Sci.*, 13 (4): 399-410.
- Leonian, L.H. 1925. Physiological studies on the Genus *Phytophthora*. *Am. J. Bot.*, 12 (7): 444-498.
- Legavre, T., M. Ducamp, X. Sabau, X. Agrout, O. Fouet, F. Dedieu, S. Surujdeo-Maharaj, D. Garcia, D. Paulin & C. Lanaud. 2015. Identification of *Theobroma cacao* genes differentially expressed during *Phytophthora megakarya* infection. *Physiol. Mol. Plant Pathol.*, 92: 1-13.
- Li, H., R.K. Singh, P. Singh, Q. Song, Y. Xing, L. Yang & Y. Li. 2017. Genetic diversity of nitrogen-fixing and plant growth promoting *Pseudomonas* species isolated from sugarcane rhizosphere. *Front. Microbiol.*, 8 (1268): 1-20.
- Lima Junior, M.S.C., D.C.R. Zorzenon, M.E.C. Dorval, E.R.J.C. Pontes, E.T. Oshiro, R. Cunha, R. Andreotti & M.F.C. Matos. 2013. Sensitivity of PCR and real-time PCR for the diagnosis of human visceral leishmaniasis using peripheral blood. *Asian Pac. J. Trop. Dis.*, 3 (1): 10-15.
- Liu, L., Y. Zhang, S. Tang, Q. Zhao, Z. Zhang, H. Zhang, L. Dong, H. Guo & Q. Xie. 2010. An efficient system to detect protein ubiquitination by agroinfiltration in *Nicotiana benthamiana*. *Plant J.*, 61: 893-903.
- Liu, D., K. Li, J. Hu, W. Wang, X. Liu & Z. Gao. 2019. Biocontrol and action mechanism of *Bacillus amyloliquefaciens* and *Bacillus subtilis* in soybean *Phytophthora* blight. *Int. J. Mol. Sci.*, 20: 2908.

- Livak, K.J. & T.D. Schmittgen. 2001. Analysis of relative gene expression data using real-time quantitative PCR and the  $2^{-\Delta\Delta C_T}$  method. *Methods*, 25 (4): 402-408.
- Loguercio, L.L., A.C. de Carvalho, G.R. Niella, J.T. de Souza & A.W.V. Pomella. 2009. Selection of *Trichoderma stromaticum* isolates for efficient biological control of witches' broom disease in cacao. *Biol. Control*, 51 (1): 130-139.
- Lolong, A.A. 2012. Alternate host of several isolates of *Phytophthora palmivora* causing coconut budrot. *Bull. Palma* 13 (1): 1-6.
- Lu, X., D. Zhou, X. Chen, J. Zhang, H. Huang & L. Wei. 2017. Isolation and characterization of *Bacillus altitudinis* JSCX-1 as a new potential biocontrol agent against *Phytophthora sojae* in soybean [*Glycine max* (L.) Merr.]. *Plant Soil*, 416: 53-66.
- Macagnan, D., R.S. Romeiro, J.T. de Souza & A.W.V. Pomella. 2006. Isolation of actinomycetes and endospore-forming bacteria from the cacao pod surface and their antagonistic activity against the witches' broom and black pod pathogens. *Phytoparasitica*, 34 (2): 122-132.
- Machado, A.P., V.K. Vivi, J.R. Tavares, F.J.G. Filho & O. Fischman. 2010. Antibiosis and dark-pigments secretion by the phytopathogenic and environmental fungal species after interaction *in vitro* with a *Bacillus subtilis* isolate. *Braz. Arch. Biol. Technol.*, 53 (5): 997-1004.
- Mafurah, J.J., H. Ma, M. Zhang, J. Xu, F. He, T. Ya, D. Shen, Y. Chen, N.A. Rajput & D. Dou. 2015. A virulence essential CRN effector of *Phytophthora capsici* suppresses host defense and induces cell death in plant nucleus. *PLoS ONE*, 10 (5): e0127965.
- Malajczuk, N., H.J. Nesbitt & A.R. Glenn. 1977. A light and electron microscope study of the interaction of soil bacteria with *Phytophthora cinnamomi* Rands. *Can. J. Microbiol.*, 23: 1518-1525.
- Maora, J.S., E.C.Y. Liew & D.I. Guest. 2017. Limited morphological, physiological and genetic diversity of *Phytophthora palmivora* from cocoa in Papua New Guinea. *Plant Pathol.*, 66 (1): 124-130.
- Marpaung, A.E., F.H. Silalahi & E.I.Y. Purba. 2010. Identifikasi patogen penyebab busuk pangkal batang pada tanaman jeruk di Tanah Karo. *J. Hort.*, 20 (3): 262-273.
- Martens, M., P. Dawyndt, R. Coopman, M. Gillis, P. de Vos & A. Willems. 2008. Advantages of multilocus sequence analysis for taxonomic studies: a case study using 10 housekeeping gene in the genus *Ensifer* (including former *Shinorhizobium*). *Int. J. Syst. Evol. Microbiol.*, 58: 200-214.
- Martin, F.N. & P.W. Tooley. 2003. Phylogenetic relationships among *Phytophthora* species from inferred sequence analysis of mitochondrially encoded *cytochrome oxidase I* and *II* genes. *Mycologia*, 95 (2): 269-284.

- Martinelli, F., R. Scalenghe, S. Davino, S. Panno, G. Scuderi, P. Ruissi, P. Villa, D. Stroppiana, M. Boschetti, L.R. Goulart, C.E. Davis & A.M. Dandekar. 2015. Advanced methods of plant disease detection: a review. *Agron. Sustain. Dev.*, 35 (1): 1-25.
- Martins, G., B. Lauga, C. Miot-Sertier, A. Mercier, A. Lonvaud, M.-L. Soulas, G. Soulas & I. Masneuf-Pomarede. 2013. Characterization of epiphytic bacterial communities from grapes, leaves, bark and soil of grapevine plants grown, and their relations. *PLOS One*, 8 (8): 1-9.
- Matar, S.M., S.A. El-Kazzaz, E.E. Wagih & A.I. El-Diwany. 2009. Antagonistic and inhibitory effect of *Bacillus subtilis* against certain plant pathogenic fungi, I. *Biotechnol.*, 8 (1): 53-61.
- McDermott, J.M. & B.A. McDonald. 1993. Gene flow in plant pathosystems. *Annu. Rev. Phytopathol.*, 31 (1): 353-373.
- McGregor, A.J. & J.E. Moxon. 1985. Potential for biological control of tent building species of ants associated with *Phytophthora palmivora* pod rot of cocoa in Papua New Guinea. *Ann. Appl. Biol.*, 107 (2): 271-277.
- Mchau, G.D.R. & M.D. Coffey. 1994. Isozyme diversity in *Phytophthora palmivora*: evidence for a southeast Asian centre of origin. *Mycol. Res.*, 98 (9): 1035-1043.
- McMahon, P.J. & A. Purwantara. 2004. *Phytophthora* on cocoa. In: A. Drenth & D.I. Guest (Eds.). *Diversity and Management of Phytophthora in Southeast Asia*. ACIAR Monograph No. 114. Canberra. 104-115.
- McMahon, P.J., A. Purwantara, A. Wahab, M. Imron, S. Lambert, P.J. Keane. & D.I. Guest. 2010a. Phosphonate applied by trunk injection controls stem canker and decreases *Phytophthora* pod rot (black pod) incidence in cocoa in Sulawesi. *Australas. Plant Pathol.*, 39 (2): 170-175.
- McMahon, P.J., A. Purwantara, A.W. Susilo, S. Sukanto and A. Wahab, H. Purung, M. Hidayat, D. Ismail, T. Taproni, S. Lambert, D. Guest & P. Keane. 2010b. On-farm selection for quality and resistance to pest/diseases of cocoa in Sulawesi: (ii) quality and performance of selections against *Phytophthora* pod rot and vascular-streak dieback. *Int. J. Pest Manage.*, 56 (4): 351-361.
- McNeil, C.L. 2006. Introduction: The biology, antiquity, and modern uses of the chocolate tree (*Theobroma cacao* L.). In: C.L. McNeil (Ed.). *Chocolate in Mesoamerica: A Cultural History of Cacao*. University Press of Florida. Florida. 1-30.
- Mejia, L.C., E.I. Rojas, Z. Maynard, S. Van Bael, A.E. Arnold, P. Hebbbar, G.J. Samuels, N. Robbins & E.A. Herre. 2008. Endophytic fungi as biocontrol agents of *Theobroma cacao* pathogens. *Biol. Control*, 46 (1): 4-14.
- Melnick, R.L., N.K. Zidack, B.A. Bailey, S.N. Maximova, M. Gultinan & P.A. Backman. 2008. Bacterial endophytes: *Bacillus* spp. from annual crops as



potential biological control agents of black pod rot of cacao. Biol. Control, 46 (1): 46-56.

- Melnick, R.L., C. Suarez, B.A. Bailey & P.A. Backman. 2011. Isolation of endophytic endospore-forming bacteria from *Theobroma cacao* as potential biological control agents of cacao diseases. Biol. Control, 57: 236-245.
- Melnick, R.L., J.-P. Marelli, R.C. Sicher, M.D. Strem & B.A. Bailey. 2012. The interaction of *Theobroma cacao* and *Moniliophthora perniciosa*, the causal agent of witches' broom disease, during parthenocarpy. Tree Genet. Genomes, 8 (6):1261-1279.
- Mendez-Bravo, A., E.M. Cortazar-Murillo, E. Guevara-Avendano, O. Ceballos-Luna, B. Rodriguez-Haas, A.L. Kiel-Martinez, O. Hernandez-Cristobal, J.A. Guererro-Analco & F. Reverchon. 2018. Plant growth-promoting rhizobacteria associated with avocado display antagonistic activity against *Phytophthora cinnamomi* through volatile emissions. PloS ONE, 13 (3): 1-18.
- Mestre, P., M.-C. Piron & D. Merdinoglu. 2012. Identification of effector genes from the phytopathogenic oomycete *Plasmopara viticola* through the analysis of gene expression in germinated zoospores. Fungal Biol., 116 (7): 825-835.
- Metsalu, T. & J. Vilo. 2015. ClustVis: a web tool for visualizing clustering of multivariate data using principal component analysis and heatmap. Nucleic Acids Res., 43: W566-W570.
- Meyer, F.E., L.S. Shuey, S. Naidoo, T. Mamni, D.K. Berger, A.A. Myburg, N. van den Berg & S. Naidoo. 2016. Dual RNA-sequencing of *Eucalyptus nitens* during *Phytophthora cinnamomi* challenge reveals pathogen and host factors influencing compatibility. Front. Plant Sci., 7 (191): 1-15.
- Milgroom, M.G. & W.E. Fry. 1997. Contributions of population genetics to plant disease epidemiology and management. Adv. Bot. Res., 24: 1-30.
- Miliute, I., O. Buzaitė, D. Baniulis & V. Stanys. 2015. Bacterial endophytes in agricultural crops and their role in stress tolerance: a review. Zemdirbyste-Agriculture, 102 (4): 465-478.
- Minifie, B.W. 1989. Chocolate, Cocoa, and Confectionary: Science and Technology. (Third Edition). Van Nostrand Reinhold. New York. 904 p.
- Miyage, N. & H. Nagai. 2019. Pathogenicity of *Phytophthora palmivora* to fig fruits after its long-term storage in water. J. Gen. Plant Pathol., 85 (4): 251-256.
- Mohammed, M.S., M. Dickinson & I.A. Seman. 2015. Analysis of genetic variation in *Phytophthora palmivora*, the causal agent of bud rot disease of oil palm. In: Proceedings of MPOB oil palm congress and exhibition; Agriculture, biotechnology and Sustainability; Oil palm: powering the world, sustaining the future. Kuala Lumpur, October 6-8, 2015. MPOB. Kuala Lumpur. 156-163.

- Mohd Jaaffar, A.K. 2004. Antagonistic activities of epiphytic bacteria on black pod disease of cocoa. Master Thesis. University Putra Malaysia, Selangor Darul Ehsan (Malaysia).
- Morgan, W. & S. Kamoun. 2007. *RXL*R effectors of plant pathogenic oomycetes. *Curr. Opin. Microbiol.*, 10: 332-338.
- Mota, M.S., C.B. Gomes, I.T.S. Júnior & A.B. Moura. 2017. Bacterial selection for biological control of plant disease: criterion determination and validation. *Braz. J. Microbiol.*, 48 (1): 62-70.
- Motulo, H.F.J., M.S. Sinaga, S. Mandang & A. Tjahjoleksono. 2004. Genetic diversity of some *Phytophthora palmivora* isolates causes nut fall disease on coconut plantation based on the random amplified polymorphic DNA (RAPD). *J. Littri*, 10 (4): 154-158.
- Motulo, H.F.J., M.S. Sinaga, A. Hartana, G. Suastika & H. Aswidinnoor, 2007. Karakter morfologi dan molekuler isolat *Phytophthora palmivora* asal kelapa dan kakao. *J. Littri*, 13 (3): 111-118.
- Motulo, H.F.J. 2008. Keragaman genetik dan virulensi isolat *Phytophthora palmivora* asal kelapa dan asal kakao. Disertasi. Institut Pertanian Bogor. Bogor.
- Mpika, J. I.B. Kebe, A.E. Issali, F.K. N'Guessan, S. Druzhinina, M. Komon-Zelazowska, C.P. Kubicek & S. Ake. 2009. Antagonist potential of *Trichoderma* indigenous isolates for biological control of *Phytophthora palmivora* the causative agent of black pod disease on cocoa (*Theobroma cacao* L.) in Côte d'Ivoire. *Afr. J. Biotechnol.*, 8 (20): 5280-5293.
- Mpika, J., I.B. Kebe & F.K. N'Guessan. 2011. Isolation and identification of indigenous microorganisms of cocoa farms in Côte d'Ivoire and assessment of their antagonistic effect vis-a-vis *Phytophthora palmivora*, the causal agent of the black pod disease. *In: O. Grillo (Ed.). Biodiversity Loss in a Changing Planet*. Intech. Croatia. 303-318.
- Muzuni, R. Indradewi & Baharudin. 2015. Resistance of cacao plant to attack *Phytophthora palmivora* and *Oncobasidium theobromae* in Konawe Regency Southeast Sulawesi. *Paradigma*, 19 (1): 67-82.
- Nath, V.S., M. Senthil, V.M. Hegde, M.L. Jeeva, R.S. Misra, S.S. Veena & M. Raj. 2013. Genetic diversity of *Phytophthora colocasiae* isolates in India based on AFLP analysis. *Biotech.*, 3: 297-305.
- Nirwanto, H. 2007. Pengantar Epidemi dan Manajemen Penyakit Tanaman. UPN "Veteran" Jawa Timur. Surabaya. 129 p.
- Nur Amin, M. Salam, M. Junaid, Asman & M.S. Baco. 2014. Isolation and identification of endophytic fungi from cocoa plant resistente VSD M.05 and cocoa plant susceptible VSD M.01 in South Sulawesi, Indonesia. *Int. J. Curr. Microbiol. App. Sci.*, 3 (2): 459-467.

- Nyasse, S., C. Cilas, C. Herail & G. Blaha. 1995. Leaf inoculation as an early screening test for cocoa (*Theobroma cacao* L.) resistance to *Phytophthora* black pod disease. *Crop Prot.*, 14 (8): 657-863.
- Oh, S.-K., S. Kamoun & D. Choi. 2010. Oomycetes *RXL*R effectors function as both activator and suppressor of plant immunity. *Plant Pathol. J.*, 26 (3): 209-215.
- Oliveira, E.J., J.G. Pádua, M.I. Zucchi, R. Vencovsky & M.L.C. Vieira. 2006. Origin, evolution and genome distribution of microsatellites. *Genet. Mol. Biol.*, 29 (2): 294-307.
- Olsson, D., A. Marquez, J.S. Tellechea, P.H. Carvalho, A.N. Pereira & W. Norbis. 2019. Genetic and morphometric analyzes of *Paralichthys* species confirm the presence of *P. brasiliensis* in the Uruguayan waters. *Neotrop. Biodivers.*, 5 (1): 30-35.
- Onomo, P.E., J.M. Ndjaga, M.L. Ondobo, J.C.D. Kouam & P.F. Djocgoue. 2017. Virulence test of some *Phytophthora megakarya* isolates on cocoa (*Theobroma cacao* L.) hybrid pods. *IOSR J. Biotechnol. Biochem.*, 3 (1): 73-81.
- Othman, A.S., M.S. Samsiah, Z. Ishak & N. Russman. 2008. Endophytic fungi in *Theobroma cacao* L. leaves (clones PBC123 and KKM22). *Malays. Cocoa J.*, 4: 6-12.
- O’Gara, E., S. Sangchote, L. Fitzgerald, D. Wood, A.C. Seng & D.I. Guest. 2004. Infection biology of *Phytophthora palmivora* Butl. in *Durio zibethinus* L. (Durian) and responses induced by phosphonate. In: A. Drenth, D.I. Guest (Eds.). *Diversity and Management of Phytophthora in Southeast Asia*. ACIAR Monograph No. 114. Canberra. 42-52.
- Pangestu, E., I. Suswanto & Supriyanto. 2014. The use of coconut shell liquid smoke for controlling *Phytophthora* sp. causing cocoa fruit rot disease *in vitro*. *J. Perkebunan & Lahan Tropika*, 4 (2): 39-44.
- Paul, N.C., S.H. Ji, J.X. Deng & S.H. Yu. 2013. Assemblages of endophytic bacteria in chili pepper (*Capsicum annum* L.) and their antifungal activity against phytopathogens *in vitro*. *Plant Omics J.*, 6 (6): 441-448.
- Peter, P.K. & R. Chandramohan. 2014. Integrated management of black pod disease of cocoa caused by *Phytophthora palmivora*. *Int. J. Plant Prot.*, 7 (1): 107-110.
- Phae, C.-G., M. Sasaki, M. Shoda & H. Kubota. 1990. Characteristics of *Bacillus subtilis* isolated from composts suppressing phytopathogenic microorganisms. *Soil Sci. Plant Nutr.*, 36 (4): 575-586.
- Ploetz. R.C. 2007. Cacao diseases: Important threats to chocolate production worldwide. *Phytopathol.*, 97 (12): 1634-1639.

- Ploetz, R. 2016. The impact of diseases on cacao production: A global overview. *In: B.A. Bailey & L.W. Meinhardt (Eds.). Cacao Diseases A History of Old Enemies and New Encounters. Springer. Switzerland. 33-62.*
- Pohlan, H.A.J. & V.D. Perez. 2010. Growth and production of cacao. *In: W.H. Verheye (Ed.) Soils plant growth and crop production in Encyclopedia of Life Support Systems (EOLSS). Developed under the Auspices of the UNESCO. Eolss Publishers. Oxford. United Kingdom.*
- Ponchet, M., F. Panabieres, M.-L. Milat, V. Mikes, J.-L. Montillet, L. Suty, C. Triantaphylides, Y. Tirilly & J.-P. Blein. 1999. Are elicitors cryptogams in plant-oomycetes communications? *CMLS Cell. Mol. Life Sci.*, 56: 1020-1047.
- Pongpisutta, R. & S. Sangchote. 2004. Morphological and host range variability in *Phytophthora palmivora* from Durian in Thailand. *In: A. Drenth & D.I. Guest (Eds.). Diversity and Management of *Phytophthora* in Southeast Asia. ACIAR Monograph No. 114. Canberra. 53-58.*
- Pratama, S.W., S. Sukanto, I.N. Asyiah & Y. V. Ervina. 2013. Growth inhibition of cocoa pod rot fungus *Phytophthora palmivora* by *Pseudomonas fluorescence* and *Bacillus subtilis* bacteria. *A Coffee and Cocoa Res. J.*, 29 (2): 120-127.
- Pratama, S.W. & N.P. Sari. 2015. Application of lime and urea and its effect on development of *Phytophthora palmivora*. *A Coffee and Cocoa Res. J.*, 31 (1): 41-48.
- Prince, D.C., G. Rallapalli, D. Xu, H.-j. Schoonbeek, V. Çevik, S. Asai, E. Kemen, N. Cruz-Mireles, A. Kemen, K. Belhaj, S. Schornack, S. Kamoun, E.B. Holub, B.A. Halkier & J.D.G. Jones. 2017. Albugo-imposed changes to tryptophan-derived antimicrobial metabolite biosynthesis may contribute to suppression of non-host resistance to *Phytophthora infestans* in *Arabidopsis thaliana*. *BMC Biol.*, 15: 20.
- Purnomo, E., Mukarlina & Rahmawati. 2017. Uji antagonis bakteri *Streptomyces* spp. terhadap jamur *Phytophthora palmivora* BBK01 penyebab busuk buah pada tanaman kakao. *Protobiont*, 6 (3): 1-7.
- Purwantara, A., D. Manohara & J.S. Warokka. 2004. *Phytophthora* diseases in Indonesia. *In: A. Drenth & D.I. Guest (Eds.). Diversity and Management of *Phytophthora* in Southeast Asia. ACIAR Monograph No. 114. Canberra. 70-76.*
- Purwantara, A., P. McMahon, A.W. Susilo, S. Sukanto, S. Mulia, Nurlaila, A. Saftar, H. Purung, S. Lambert, P. Keane & D. Guest, 2015. Testing local cocoa selections in Sulawesi: (ii) resistance to stem canker and pod rot (black rot) caused by *Phytophthora palmivora*. *Crop Prot.*, 77: 18-26.
- Purwantara, A. & A. Umayah, 2010. Analisis keragaman genetik *Phytophthora palmivora* dari tanaman kakao di Indonesia menggunakan AFLP. *Menara Perkebunan*, 78 (2): 61-69.

- Qutob, D., S. Kamoun & M. Gijzen. 2002. Expression of a *Phytophthora sojae* necrosis-inducing protein occurs during transition from biotrophy to necrotrophy. *Plant J.*, 32:361-373.
- Rahma & H.F.J. Motulo. 2014. Pemanfaatan cendawan antagonis untuk pengendalian penyakit gugur buah kelapa. *Bull. Palma*, 15 (2): 120-127.
- Rahman, M.Z., S. Uematsu, M.D. Coffey, S. Uzuhashi, H. Suga & K. Kageyama. 2014. Re-evaluation of Japanese *Phytophthora* isolates based on molecular phylogenetic analyses. *Mycoscience*, 55 (4): 314-327.
- Rahman, M.Z., S. Uematsu, H. Suga & K. Kageyama. 2015. Diversity of *Phytophthora* species newly reported from Japanese horticultural production. *Mycoscience*, 56 (4): 443-459.
- Rameshkumar, N., N. Ayyadurai, N. Kayalvizhi & P. Gunasekaran. 2012. Genotypic and phenotypic diversity of PGPR fluorescent pseudomonads isolated from the rhizosphere of sugarcane (*Saccharum officinarum* L.). *J. Microbiol. Biotechnol.*, 22: 13-24.
- Rao, V.G. 1970. Influence of temperature upon growth and sporulation in two species of *Phytophthora*. *Mycopathol. Mycol. Appl.*, 42 (1-2): 39-48.
- Ribeiro, O.K. 2013. A historical perspective of *Phytophthora*. In: K. Lamour (Ed.). *Phytophthora: A Global Perspective*. CABI Publishing. United Kingdom. 1-10.
- Rifin, A & D. Naully. 2013. The effect of export tax on Indonesia's cocoa export competitiveness. In: 57th AARES Annual Conference, Sydney, New South Wales, 5th-8th February 2013. Australian Agricultural & Resource Economics Society. 1-10.
- Rosenblueth, M. & E. Martinez-Romero. 2006. Bacterial endophytes and their interactions with hosts. *Mol. Plant Microbe Interact.*, 19 (8): 827-837.
- Rosmana, A., G.J. Samuels, A. Ismaiel, E.S. Ibrahim, P. Chaverri, Y. Herawati & A. Asman. 2015. *Trichoderma asperellum*: a dominant endophyte species in cacao grown in Sulawesi with potential for controlling vascular streak dieback disease. *Trop. Plant Pathol.*, 40 (1): 19-25.
- Roy, S.G. & N.J. Grunwald. 2014. The plant destroyer genus *Phytophthora* in the 21<sup>st</sup> century. *Rev. Plant Pathol.*, 6: 387-412.
- Rubini, M.R., R.T. Silva-Ribeiro, A.W.V. Pemella, C.S. Maki, W.A. Araujo, D.R. dos Santos & J.L. Azevedo. 2005. Diversity of endophytic fungal community of cacao (*Theobroma cacao* L.) and biological control of *Crinipellis pernicios*, causal agents of witches' broom disease. *Int. J. Biol. Sci.*, 1 (1): 24-33.
- Rubiyo, A. Purwantara, D. Suhendi, Trikoesoemaningtyas, S. Ilyas & Sudarsono. 2008a. Cacao (*Theobroma cacao* L.) resistance evaluation against black pod disease and effectiveness of inoculation methods. *A Coffee and Cocoa Res. J.*, 24 (2): 95-113.



- Rubiyo, A. Purwantara, S. Sukamto & Sudarsono. 2008b. Isolation of indigenous *Phytophthora palmivora* from Indonesia, their morphological and pathogenicity characterization. A Coffee and Cocoa Res. J., 24 (1): 35-48.
- Rubiyo, A. Purwantara & Sudarsono. 2010. Resistance of 35 cocoa clones against *Phytophthora palmivora* Butl. infection based on detached pod assays. J. Littri, 16 (4): 172-178.
- Ryan, R.P., K. Germaine, A. Franks, D.J. Ryan & D.N. Dowling. 2007. Bacterial endophytes: recent developments and applications. FEMS Microbiol. Lett., 278 (1): 1-9.
- Rytter, J.L., F.L. Lukezic, R. Craig and G.W. Moorman. 1989. Biological control of geranium rust by *Bacillus subtilis*. Phytopathol., 79 (3): 367-370.
- Salehan, N.M., S. Meon & I.S. Ismail. 2013. Antifungal activity of *Cosmos caudatus* extracts against seven economically important plant pathogens. Int. J. Agric. Biol., 15 (5): 864-870.
- Samuels, G.J., C. Suarez, K. Solis, K.A. Holmes, S.E. Thomas, A. Ismaiel & H.C. Evans. 2006. *Trichoderma theobromicola* and *T. paucisporum*: two new species isolated from cacao in South America. Mycol. Res., 110 (4): 381-392.
- Samuels, G.J., A. Ismaiel, A. Rosmana, M. Junaid, D. Guest, P. McMahon, P. Keane, A. Purwantara, S. Lambert, M. Rodriguez-Carres & M.A. Cubeta. 2012. Vascular streak dieback of cacao in Southeast Asia and Melanesia: *in planta* detection of the pathogen and a new taxonomy. Fungal Biol., 116 (1): 11-23.
- Santini, A. & L. Ghelardini. 2015. Plant pathogen evolution and climate change. CAB Rev., 10 (035): 1-8.
- Santoso, P.J., I.N.P. Aryantha, A. Pancoro & S. Suhandono. 2015. Identification of *Pythium* and *Phytophthora* associated with durian (*Durio* sp.) in Indonesia: their molecular and morphological characteristics and distribution. Asian J. Plant Pathol., 9 (2): 59-71.
- Schena, L., L. Cardle & D.E. Cooke. 2008. Use of genome sequence data in the design and testing of SSR markers for *Phytophthora* species. BMC Genomics, 9 (620): 1-23.
- Schlüter, P.M. & S.A. Harris. 2006. Analysis of multilocus fingerprinting data sets containing missing data. Mol. Ecol. Resour., 6 (2): 569-572.
- Semagn, K., A. Bjørnstad & M.N. Ndjioudjop. 2006. An overview of molecular marker methods for plants. Afr. J. Biotechnol., 5 (25): 2540-2568.
- Setyowati, P.L., A. Wibowo & T. Arwiyanto. 2019. Penapisan bakteri antagonis dari buah kakao untuk menekan perkembangan penyakit busuk buah kakao. *In*: Prosiding Seminar Nasional IX Perhimpunan Fitopatologi Indonesia, Yogyakarta, 6 Oktober 2018. PFI Komda Joglosemar. 31-42

- Shaik, S.P. & P. Thomas. 2019. *In vitro* activation of seed-transmitted cultivation-recalcitrant endophytic bacteria in tomato and host-endophyte mutualism. *Microorganisms*, 7: 132.
- Shen, D., Q. Li, P. Sun, M. Zhang & D. Dou. 2017. Intrinsic disorder is a common structural characteristic of RxLR effectors in oomycete pathogens. *Fungal Biol.*, 121 (11): 911-919.
- Sharma, A., V.D. Diwevidi, S. Singh, K.K Pawar, M. Jerman, L.B. Singh, S. Singh & D. Srivastawa. 2013. Biological control and its Important in agriculture. *Int. J. Biotechnol Bioeng. Res.*, 4 (3): 175-180.
- Sharma, N. 1990. Aseptic germination of oospores of *Phytophthora palmivora*. *Can. J. Bot.*, 68 (12): 2548-2552.
- Slamet, A.R. 1991. Pathogenicity test of three isolates of *Phytophthora palmivora* on black pepper, coconut, cacao and vanilla. *Bul. Littro*, 6 (1): 33-38.
- Soladoye, M.O., M.A. Sonibare & E.C. Chukwuma. 2010. Morphometric study of the genus *Indigofera* Linn. (Leguminosae-Papilionoideae) in South-Western Nigeria. *Int. J. Botany*, 6 (3): 343-350.
- Somowiyarjo, S., D.P. Sriyanti, Mulyadi, Suryanti, Y.M.S. Maryudani & B. Hadisutrisno. 1999. The use of monoclonal antibodies in indirect enzyme linked immunosorbent assay for detecting the pathogen of coconut bud rot (*Phytophthora palmivora*). *Indones. J. Plant Prot.*, 5 (2): 120-126.
- Somowiyarjo, S., S. Sulandari, S. Hartono, Y.B. Paradisa & T.M. Aji. 2014. Etiology of shoot twig malformation on cocoa at Kulon Progo, Special Province of Yogyakarta and Segayung, Central Java. *Indones. J. Plant Prot.*, 18 (2): 95-102.
- Song, M., H.Y. Yun & Y.H. Kim. 2014. Antagonistic *Bacillus* species as a biological control of ginseng root rot caused by *Fusarium* cf. *incarnatum*. *J. Ginseng Res.*, 38: 136-145.
- Sopheareth, M., S. Chan, K.W. Naing, Y.S. Lee, H.N. Hyun, Y.C. Kim & K.Y. Kim. 2013. Biocontrol of late blight (*Phytophthora capsici*) disease and growth promotion of pepper by *Burkholderia cepacia* MPC-7. *Plant Pathol. J.*, 29 (1): 67-76.
- Soytong, K., S. Kanokmedhakul, V. Kukongviriyapa & M. Isobe. 2001. Application of *Chaetomium* species (Ketomium®) as a new broad-spectrum biological fungicide for plant disease control: a review article. *Fungal Divers.*, 7: 1-15.
- Spence, J.A. 1961. Black-pod disease of cocoa. II. A study of host-parasite relations. *Ann. Appl. Biol.*, 49: 723-734.
- Sriwati, R. & R. Muarif. 2012. Characteristic symptoms of *Phytophthora palmivora* on cocoa leaves. *J. Nat.*, 12 (2): 30-34.

- Sriwati, R., R.L. Melnick, R. Muarif, M.D. Strem, G.J. Samuels & B.A. Bailey. 2015. *Trichoderma* from Aceh Sumatra reduce *Phytophthora* lesions on pods and cacao seedlings. Biol. Control, 89: 33-41.
- Stam, R., J. Jupe, A.J.M. Howden, J.A. Morris, P.C. Boevink, P.E. Hedley & E. Huitema. 2013. Identification and characterisation *CRN* effectors in *Phytophthora capsici* shows modularity and functional diversity. PLoS ONE, 8 (3): 1-13.
- Statistics Indonesia, 2019. Statistics Indonesia. [www.bps.go.id](http://www.bps.go.id). Retrieved at December 17, 2019.
- Strange, R.N. 2003. Introduction to Plant Pathology. John Wiley & Sons Ltd. England. 464 p.
- Sturz, A.V., B.R. Christie & J. Nowak. 2000. Bacterial endophytes: potential role in developing sustainable systems of crop production. Crit. Rev. Plant Sci., 19 (1): 1-30.
- Sudarma, I.M., N.M. Puspawati & I.K. Suada. 2017. The potency of endophytic fungi in cocoa as biological agent to control cocoa pod disease caused by *Phytophthora palmivora* (Butler) Butler. J. Adv. Trop. Biodivers. Environ. Sci., 1 (1): 6-11.
- Sudheesh, K.G. & V.B. Sreekumar. 2006. Genetic variability in *Phytophthora palmivora* Butl. using RAPD markers. J. Phytopathol., 154 (9): 542-544.
- Sumardiyono, C., N. Pusposendjojo & S. Trisnowati. 1995. Ketahanan beberapa jamur patogen terhadap fungisida. Indones. J. Plant Prot., 1 (1): 51-55.
- Sun, W.X., Y.J. Jia, B.Z. Feng, N.R. O'Neill, X.P. Zhu, B.Y. Xie & X.G. Zhang. 2009. Functional analysis of *Pcpg2* from the straminopilous plant pathogen *Phytophthora capsici*. Genesis, 47: 535-544.
- Surudjeo-Maharaj, S., T.N. Sreenivasan, L.A. Motilal & P. Umarahan. 2016. Black pod and other *phytophthora* induced diseases of cacao: history, biology, and control. In: B.A. Bailey & L.W. Meinhardt (Eds.). Cacao Diseases: A History of Old Enemies and New Encounters. Springer. Switzerland. 213-266.
- Susilo, A.W. 2007. Akselerasi program pemuliaan kakao (*Theobroma cacao* L.) melalui pemanfaatan penanda molekuler dalam proses seleksi. Warta Pusat Penelitian Kopi dan Kakao Indonesia, 23 (1): 11-24.
- Susilo, A.W., D. Zhang, L.A. Motilal, S. Mischke & L.W. Meinhardt. 2011. Assessing genetic diversity in Java fine-flavor cocoa (*Theobroma cacao* L.) germplasm by using simple sequence repeat (SSR) markers. Trop. Agr. Develop., 55 (2): 84-92.
- Tashiro, N., S. Uematsu, Y. Ide & M. Matsuzaki, 2012. First report of *Phytophthora palmivora* a causal pathogen of citrus brown rot in Japan. J. Gen. Plant Pathol., 78 (3): 233-236.

- ten Hoopen, G.M., R. Rees, P. Aisa, T. Stirrup & U. Krauss. 2003. Population dynamics of epiphytic mycoparasites of the genera *Clonostachys* and *Fusarium* for the biocontrol of black pod (*Phytophthora palmivora*) and moniliasis (*Moniliophthora roreri*) on cocoa (*Theobroma cacao*). Mycol. Res., 107 (5): 587-596.
- Tchinda, R.A.M., T. Boudjeko, A.-M. Simao-Beaunoir, S. Lerat, É. Tsala, E. Monga & C. Beaulieu. 2016. Morphological, physiological, and taxonomic characterization of actinobacterial isolates living as endophytes of cacao pods and cacao seeds. Microbes Environ., 31 (1): 56-62.
- Thomas, L., A. Gupta, M. Gopal & R. Chandramohan. 2011. Evaluation of rhizospheric and endophytic *Bacillus* spp. and fluorescent *Pseudomonas* spp. isolated from *Theobroma cacao* L. for antagonistic reaction to *Phytophthora palmivora*, the causal organism of black pod disease of cocoa. J. Plantation Crops, 39 (3): 370-376.
- Thomas, S.E., J. Crozier, M.C. Aime, H.C. Evans & K.A. Holmes. 2008. Molecular characterisation of fungal endophytic morphospecies associated with the indigenous forest tree, *Theobroma gileri*, in Ecuador. Mycol. Res., 112 (7): 852-860.
- Thorold, C.A. 1952. Airborne dispersal of *Phytophthora palmivora*, causing black-pod disease of *Theobroma cacao*. Nature, 170 (4330): 718-719.
- Timmusk, S., P. van West, N.A.R. Gow & R.P. Huffstutler. 2009. *Paenibacillus polymyxa* antagonizes oomycete plant pathogens *Phytophthora palmivora* and *Pythium aphanidermatum*. J. App. Microbiol., 106 (5): 1473-1481.
- Tondje, P.R., K.P. Hebbar, G. Samuels, J.H. Bowers, S. Weise, E. Nyemb, D. Begoude, J. Foko & D. Fontem. 2006. Bioassay of *Geniculosporium* species for *Phytophthora megakarya* biological control on cacao pod husk pieces. Afr. J. Biotechnol., 5 (8): 648-652.
- Tondje, P.R., D.P. Roberts, M.C. Bon, T. Widmer, G.J. Samuels, A. Ismaiel, A.D. Begoude, T. Tchana, E. Nyemb-Tshomb, M. Ndoumbe-Nkeng, R. Bateman, D. Fontem & K.P. Hebbar. 2007. Isolation and identification of mycoparasitic isolates of *Trichoderma asperellum* with potential for suppression of black pod disease of cacao in Cameroon. Biol. Control, 43 (2): 202-212.
- Torto, T.A., S. Li, A. Styer, E. Huitema, A. Testa, N.A.R. Gow, P. van West & S. Kamoun. 2003. EST mining and functional expression assays identify extracellular proteins from the plant pathogen *Phytophthora*. Genome Res., 13: 1675-1685.
- Torres-Londono, G.A. 2016. Morphological characterization, virulence and fungicide sensitivity evaluation of *Phytophthora palmivora*. Doctoral Dissertation. Michigan State University. USA.
- Torres, M.J., C.P. Brandan, G. Petroselli, R. Erra-Balsells & M.C. Audisio. 2016. Antagonistic effects of *Bacillus subtilis* subsp. *subtilis* and *B. amyloliquefaciens* against *Macrophomina phaseolina*: SEM study of fungal

changes and UV-MALDI-TOF MS analysis of their bioactive compounds. Microbiol. Res., 182: 31-39.

- Toxopeus, H. 1985. Botany, types and populations. In: G.A.R. Wood & R.A. Lass (Eds.). Cocoa (Fourth Edition). Blackwell Science. Great Britain. 11-37.
- Turkensteen, L.J., W.G. Flier, R. Wanningen & A. Mulder. 2000. Production, survival and infectivity of oospores of *Phytophthora infestans*. Plant Pathol., 49 (6): 688-696.
- Turner, G.J. 1973. Pathogenic variation in isolates of *Phytophthora palmivora* from *Piper nigrum*. Trans. Br. Mycol. Soc., 60 (3): 583-585.
- Truong, N.V., E.C.Y. Liew & L.W. Burgess. 2010. Characterisation of *Phytophthora capsici* isolates from black pepper in Vietnam. Fungal Biol., 114 (2-3): 160-170.
- Tyler, B.M., S. Tripathy, X. Zhang, P. Dehal, R.H.Y. Jiang, A. Aerts, F.D. Arredondo, L. Baxter, D. Bensasson, J.L. Beynon, J. Chapman, C.M.B. Damasceno, A.E. Dorrance, D. Dou, A.W. Dickerman, I.L. Dubchak, M. Garbelotto, M. Gijzen, S.G. Gordon, F. Govers, N.J. Grunwald, W. Huang, K.L. Ivors, R.W. Jones, S. Kamoun, K. Krampis, K.H. Lamour, M.-K. Lee, W.H. McDonald, M. Medina, H.J.G. Meijer, E.K. Nordberg, D.J. Maclean, M.D. Ospina-Giraldo, P.F. Morris, V. Phuntumart, N.H. Putnam, S. Rash, J.K.C. Rose, Y. Sakihama, A.A. Salamov, A. Savidor, C.F. Scheuring, B.M. Smith, B.W.S. Sobral, A. Terry, T.A. Torto-Alalibo, J. Win, Z. Xu, H. Zhang, I.V. Grigoriev, D.S. Rokshar & J.L. Boore. 2006. *Phytophthora* genom sequences uncover evolutionary origins and mechanisms of pathogenesis. Sci., 313 (5791): 1261-1266.
- Umayah, A. & A. Purwantara. 2006. Identifikasi isolat *Phytophthora* asal kakao. Menara Perkebunan, 74 (2): 76-85.
- Umayah, A., M.S. Sinaga, S. Sastrosumarjo, S.M. Sumaraw & A. Purwantara, 2007. Keragaman genetik isolat *Phytophthora palmivora* dari tanaman kakao di Indonesia. Pelita Perkebunan, 23 (2): 129-138.
- Umrah, T. Anggraeni, R.R. Esyanti & I.N.P. Aryantha. 2009. The antagonistic and effectiveness of *Trichoderma* sp. in controlling *Phytophthora palmivora* on cocoa pod. J. Agroland, 16 (1): 9-16.
- Urbanelli, S., V.R. Rosa, C. Fanelli, A.A. Fabbri & M. Reverberri. 2003. Genetic diversity and population structure of the Italian fungi belonging to the taxa *Pleurotus eryngii* (DC.:Fr.) Quel and *P. ferulae* (DC.:Fr.) Quel). Heredity, 90 (3): 253-259.
- Vanegtern, B. M. Rogers & S. Nelson. 2015. Black pod rot of cacao caused by *Phytophthora palmivora*. Plant Dis., 108: 1-5.
- van Hall, C. J. J. 1932. Cacao (2<sup>nd</sup> edition). Macmillan and Co. Limited. London. 514 p.



- Verna, R. 2013. The history and science of chocolate. *Malays. J. Pathol.*, 35 (2): 111-121.
- Versalovic, J., T. Koeuth & J.R. Lupski. 1991. Distribution of repetitive DNA sequences in eubacteria and application to fingerprinting of bacterial genomes. *Nucleic Acids Res.*, 19 (24): 6823-6831.
- Versalovic, J., V. Kapur, Jr. E.O. Mason, U. Shah, T. Koeuth, J.R. Lupski & J.M. Musser. 1993. Penicillin-resistant *Streptococcus pneumonia* strains recovered in Houston: identification and molecular characterization of multiple clones. *J. Infect. Dis.*, 167 (4): 850-856.
- Versalovic, J, M. Schneider, F.J. de Bruijn & J.R. Lupski. 1994. Genomic fingerprinting of bacteria using repetitive sequence-based polymerase chain reaction. *Methods Mol. Cell. Biol.*, 5 (1): 25-40.
- Vieira, M.L.C., L. Santini, A.L. Diniz & C.F. Munhoz. 2016. Microsatellite markers: what they mean and why they are so useful. *Genet. Mol. Biol.*, 39 (3): 312-328.
- Wahyudi, T. & Misnawi. 2008. The world scenario of cocoa production and consumption. *In: Proceeding of the 2nd international plantation industry conference and exhibition (IPiCEX)*. Shah Alam, November 18-21, 2008. UiTM. Selangor. 1-39.
- Wahyudi, T. & Misnawi. 2015. Sejarah, perkembangan penelitian, dan prospek kakao. *In: T. Wahyudi, Pujiyanto & Misnawi (Eds.). Kakao: Sejarah, Botani, Proses Produksi, Pengolahan, dan Perdagangan*. Gadjah Mada University Press. Yogyakarta. 1-18.
- Wahyuni, S. 2006. Kekerabatan plasma nutfah jambu mete berdasar sifat morfologi. *J. Littri*, 12 (2): 58-66.
- Wahyuno, D., D. Manohara & D.N. Susilowati. 2007. Variasi morfologi dan virulensi *Phytophthora capsici* asal lada. *Bull. Plasma Nutfah*, 13 (2): 70-81.
- Wang, Z., D.B. Langston, A.S. Csinos, R.D. Gitaitis, R.R. Walcott & P. Ji. 2009. Development of an improved isolation approach and simple sequence repeat markers to characterize *Phytophthora capsici* populations in irrigation ponds in Southern Georgia. *App. Environ. Microbiol.*, 75 (17): 5467-5473.
- Wang, Q., C. Han, A.O. Ferreira, X. Yu, W. Ye, S. Tripathy, S.D. Kale, B. Gu, Y. Sheng, Y. Sui, X. Wang, Z. Zhang, B. Cheng, S. Dong, W. Shan, X. Zheng, D. Dou, B.M. Tyler & Y. Wang. 2011. Transcriptional programming and functional interactions within the *Phytophthora sojae* RXLR effector repertoire. *Plant Cell*, 23: 2064-2086.
- Wang, H., Y. Ren, J. Zhou, J. Du, J. Hou, R. Jiang, H. Wang, Z. Tian & C. Xie. 2017. The cell death triggered by the nuclear localized RXLR effector PITG\_22798 from *Phytophthora infestans* is suppressed by the effector AVR3b. *Int. J. Mol. Sci.*, 18 (409): 1-14.

- Waterhouse, G. M. 1963. Key to the species of *Phytophthora* de Bary. Mycological Papers, no. 92. Commonwealth Mycological Institute. Kew, England. 22 p.
- Whisson, S.C., P.C. Boevink, L. Moleleki, A.O. Avrova, J.G. Morales, E.M. Gilroy, M.R. Armstrong, S. Grouffaud, P. van West, S. Chapman, I. Hein, I.K. Toth, L. Pritchard & P.R.J. Birch. 2007. A translocation signal for delivery of oomycete effector proteins into host plant cells. *Nature*, 450:115-118.
- Wibowo, O.A., I.M. Sudarma & N.M. Puspawati. 2017. *In vitro* inhibition test of exophytic fungi against *Phytophthora palmivora* (Butler) Butler the cause black pod disease on cocoa. *E-Jurnal Agroekoteknologi Tropika*, 6 (3): 279-289.
- Widiastuti, A., A. Wibowo, A.B. Prakoso & Hendra. 2018. Current status of emerging vascular-streak dieback (VSD) disease on cacao in Yogyakarta, Indonesia. *In*: A.C. Sukartiko, T.R. Nuringtyas, S.N. Marliana & A. Isnansetyo (Eds.). *Proceeding of the 2nd international conference on tropical agriculture*. Yogyakarta, October 26-27, 2017. Springer Nature. Switzerland. 133-139.
- Widmer, T.L. & N. Laurent. 2006. Plant extracts containing caffeic acid and rosmarinic acid inhibit zoospore germination of *Phytophthora* spp. pathogenic to *Theobroma cacao*. *Eur. J. Plant Pathol.*, 115 (4): 377-388.
- Wood, G.A.R. 1985. History and development. *In*: G.A.R. Wood & R.A. Lass (Eds.). *Cocoa* (Fourth Edition). Blackwell Science. Great Britain. 1-10.
- Wydro, M., E. Kozubek & P. Lehmann. 2006. Optimization of transient *Agrobacterium*-mediated gene expression system in leaves of *Nicotiana benthamiana*. *Acta Biochim.Pol.*, 53 (2): 289-298.
- Xia, Z., M.L. Johansson, Y. Gao, L. Zhang, G.D. Haffner, H.J. MacIsaac & A. Zhan. 2018. Conventional versus real-time quantitative PCR for rare species detection. *Ecol. Evol.*, 8: 11799-11807.
- Yamamoto, S. & S. Harayama. 1995. PCR amplification and direct sequencing of *gyrB* genes with universal primers and their application to the detection and taxonomic analysis of *Pseudomonas putida* strains. *Appl. Environ. Microbiol.*, 61 (3): 1104-1109.
- Yang, R., X. Fan, X. Cai & F. Hu. 2015. The inhibitory mechanisms by mixtures of two endophytic bacterial strains isolated from *Ginkgo biloba* against pepper *Phytophthora* blight. *Biol. Control*, 85: 59-67.
- Yin, H., H. Cao, M. Xie, Q. Chen, G. Qiu, J. Zhou, L. Wu, D. Wang & W. Liu. 2008. Bacterial diversity based on 16S rRNA and *gyrB* genes at Yishan mine, China. *Syst. Appl. Microbiol.*, 31: 302-311.
- Yu, L.M. 1995. Elicitins from *Phytophthora* and basic resistance in tobacco. *Proc. Natl. Acad. Sci. USA*, 92: 4088-4094.

- Yuliar, Suciati, D. Supriyati & M. Rahmansyah. 2013. Biodiversity of endophytic bacteria and their antagonistic activity to *Rhizoctonia solani* and *Fusarium oxysporum*. Global J. Biol. Agri. Health Sci., 2 (4): 111-118
- Zaccardelli, M., F. Campanile, C. Moretti & R. Buonauro. 2008. Characterization of Italian populations of *Xanthomonas campestris* pv. *campestris* using primers based on DNA repetitive sequences. J. Plant Pathol., 90 (2): 375-381.
- Zadoks, J.C. & R.D. Schein. 1980. Epidemiology and plant disease management, the known and the needed. In: J. Palti & J. Kranz (Eds.). Comparative Epidemiology, A Tool for Better Disease Management. PUDOC. Wageningen, The Netherlands. 1-17.
- Zemtsova, G.E., M. Montgomery & L.M. Levin. 2015. Relative sensitivity of conventional and real time PCR assays for detection of SFG *Rickettsia* in blood and tissue samples from laboratory animals. PLoS One, 10: e0116658.
- Zentmyer, G.A., D.J. Mitchell, L. Jefferson, J. Roheim & D. Carnes. 1973. Distribution of mating types of *Phytophthora palmivora*. Phytopathol., 63 (6): 663-667.
- Zhang, D. & L. Motilal. 2016. Origin, dispersal, and current global distribution of cacao genetic diversity. In: B.A. Bailey & L.W. Meinhardt (Eds.). Cacao Diseases: A History of Old Enemies and New Encounters. Springer. Switzerland. 3-32.
- Zhang, H., M. Ali, X. Feng, J. Jin, L. Huang, A. Khan, J. Lv, S. Gao, D. Lou & Z. Gong. 2019. A novel transcription factor *CaSBP12* gene negatively regulates the defense response against *Phytophthora capsici* in pepper (*Capsicum annuum* L.). Int. J. Mol. Sci., 20 (48): 1-20.
- Zhao, Z.J., J.F. Cao, M.Y. Yang, D.W. Sun, X.P. Li & W.L. Yang. 2008. Genetic diversity of *Phytophthora infestans* of potato in Yunnan based on two microsatellite (SSR) markers. Sci. Agric. Sin., 11: 3610-3617.
- Zhao, Y., J.N. Selvaraj, F. Xing, L. Zhou, Y. Wang, H. Song, X. Tan, L. Sun, L. Sangare, Y.M.E. Folly & Y. Liu. 2014. Antagonistic action of *Bacillus subtilis* strain SG6 on *Fusarium graminearum*. PLoS ONE, 9 (3): e92486.
- Zhou, X., Z. Lu, F. Lv, H. Zhao, Y. Wang & X. Bie. 2011. Antagonistic action of *Bacillus subtilis* strain fmbj on the postharvest pathogen *Rhizopus stolonifer*. J. Food Sci., 76 (5): 254-259.
- Zuluaga, A.P., J.C. Vega-Arreguin, Z. Fei, L. Ponnala, S.J. Lee, A.J. Matas, S. Patev, W.E. Fry & J.K.C. Rose. 2016. Transcriptional dynamics of *Phytophthora infestans* during sequential stages of hemibiotrophic infection of tomato. Mol. Plant Pathol., 17 (1): 29-41.