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1st Universitas Lampung International Conference on Science and Technology 2020
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Prof. Karomani, M.Si.
University of Lampung, Indonesia
Prof. Suharso, Ph.D.
University of Lampung, Indonesia
Prof. Rizalman Mamat
University Malaysia Pahang, Malaysia
Dr. Md. Golam Mahbood
Bangladesh Agricultural Research Institute, Bangladesh
Korhan Cengiz, Ph.D.
Trakya University, Edirne, Turkey
CALL FOR PAPER
The topics presented in this conference will include:
1. Sustainable Development
2. Enviromental Science
3. Remote Sensing and GIS
4. Natural Science
5. Climate Change
6. Renewable Energy
CONFERENCES FEE
• Presenter & Participant: Free
Publication:
• National : IDR 1,500,000
• International : 150 USD
All Presented Papers will be Published in:
IOP Conference Series: Earth and Environmental Science (Scopus and Web of Science)
IMPORTANT DATES
October 16th, 2020 (Full Papers Submission Due)
October 23rd, 2020 (Notification of Acceptance)
November 11th, 2020 (Final Revision Due)
November 18-19th, 2020 (Conference Date)
• Registration: bit.ly/ULICOSTE2020
• Visit our Website: ulicoste.unila.ac.id
Conference will be held by ZOOM November 18-19th, 2020
zoom
CONTACT PERSON:
Mr. Kevin : +6281271471188
Miss. Bunga : +6281271471133
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BUKTI KORESPONDENSI IOP

1st Universitas Lampung International Conference on Science and Technology 2020

Judul : Plant-Based Pesticide Using Citronella (*Cymbopogon nardus* L.) Extract To Control Insect Pests On Rice Plan

- SUBMIT (16 Oktober 2020)
- ACCEPTED WITH REVISION (28 Oktober 2020)
- REVISI (29 November 2020)
- ACCEPTED PAPER (31 Maret 2021)
- TERBIT DI IOP (26 April 2021)

Daftar Lampiran

SUBMISION AND ACCEPTED WITH REVISION

(28 OKTOBER 2020)

READY TO CONFERENCE

Reminder of Payment

International conference <ulicoste01@kpa.unila.ac.id> 28 Oktober 2020 02.37
Kepada: fajri.mulya@uii.ac.id, axauam@gmail.com, Oka Mahagangga I Gusti Agung <okamahagangga@unud.ac.id>, arifah.politani@gmail.com, abdul mutolib <abdul.mutolib@fp.unila.ac.id>, lizrossler@ung.ac.id, ali rahmat <ali.rahmat@fp.unila.ac.id>, three.atmoko@gmail.com, adityo.ds@fisip.untan.ac.id, andi@mercubuana.ac.id, SAMSUL BAKRI <samsul.bakri@fp.unila.ac.id>, meisforester76@gmail.com, rjlahay@ung.ac.id, ktut.murniati@fp.unila.ac.id, FX ARINTO SETYAWAN <fx.arinto@eng.unila.ac.id>, eva.rachmawatisolihin@gmail.com, adinugrahahamdan@gmail.com, iisdewiratih@gmail.com, hari_harjanto@yahoo.com, maulana.yudinugroho@mail.ugm.ac.id, dedeliazariatin@univpancasila.ac.id, achmad.diansyukma@mail.ugm.ac.id, marelitelaumbanua@gmail.com, yatisetiati@uinsgd.ac.id, ceceuziafauzia@gmail.com, yusrinaamaliah@gmail.com, aditpart4@gmail.com, subandi sainstek <mhd.subandi@uinsgd.ac.id>, listyo.fis@um.ac.id, Sundari@unkhair.ac.id, hendrisampali@gmail.com, khadijahmurad867@gmail.com, suwarsono81@ui.ac.id, maesti_m@yahoo.com

Dear Authors

Based on Editorial Screening your article was accepted to present in our 1st Universitas Lampung International Conference on Science, Technology and Environment 2020. The details information already published in our website Ulicoste.unila.ac.id and in the attached file. Following the committee policy, the editorial will start reviewing the article after payment processing is done. The bank account details are as follows in the attached file.Moreover, if you already do payment please resend to this email. Thank you very much for your cooperation.

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2 lampiran

Appendix 1. List of Accepted Paper for ULICOSTE 2020 Session 1(1).pdf
444K

ANNOUNCEMENT OF ACCEPTED PAPER FOR ULICOSTE 2020 SESSION 1.pdf
380K

Gmail

Mareli Telaumbanua <marelitelaumbanua@gmail.com>

Review results

International conference <ulicoste01@kpa.unila.ac.id> 29 November 2020 14.22
Kepada: marelitelaumbanua@gmail.com, mareli telaumbanua <mareli.telaumbanua@fp.unila.ac.id>

Dear Authors

The reviewer team has already examined your article.
Please revise your article following the suggestion. However, if you do not agree with the suggestion please send us the reason. Please send the revised article on 3 December 2020 as a deadline.

Thank you very much for your cooperation

Sincerely

Team Editorial ULICOSTE 2020

3 lampiran

Full_Paper_Guidance_-_Ulicoste FIX (2).docx
541K

Review Form Ulicoste000.docx
95K

ULICOSTE062_TELAUMBANUA_UNILA.docx
2552K

Appendix 1
THE LIST OF ACCEPTED FULL PAPER FOR ULICOSTE 2020
(First Session)

No	CODE OF ARTICLE	AUTHORS	AFFILIATION	TITLE	DECISION
1	ULICOSTE001	Fajri Mulya Iresha, Kasam, Dony Hermansyah, Rofiqul Umam, and Ali Rahmat	Islamic University of Indonesia University of Lampung Kwansei Gakuin University	Quality of Compost by vermicomposting process on food waste media	Accepted with Revision
2	ULICOSTE006	M Rizky Febriansyah, Liska Mutiara Septiana, Supriatin and Abdul Kadir Salam	University of Lampung	The Patterns of Lead and Copper Distributions in the Vicinity of Heavy Metal Sources in Lampung, the Southern Part of Sumatra, Indonesia	Accepted with Revision
3	ULICOSTE007	IGAO. Mahagangga, IP. Anom, IB. Suryawan, T. Koesbardiati, IGAA. Wulandari	University of Udayana University of Airlangga University of Warmadewa	Traditional Myth and Sustainable Development (A Qualitative Approach to Balinese Tourism)	Accepted with Revision
4	ULICOSTE008	Arifah, D Salman, A Yassi, and EB Demmallino	Hasanuddin University Pangkep State of Polytehcnic of Agriculture	Farmer's perception of climate change and the impacts on livelihood in South Sulawesi	Accepted with Revision
5	ULICOSTE009	Abdul Mutolib, Ali Rahmat, Helvi Yanfika	University of Lampung	Income Analysis, Knowledge and Impact of Climate Change on Fishermen Household in Limau District, Tanggamus Regency	Accepted with Revision
6	ULICOSTE011	M F R Hasan, C D Fransiska, D A Suaidi, H Wisodo and N Martina	Politeknik Negeri Jakarta State University of Malang	Identification of sea water intrusion using geoelectrical resistivity method at the Goa Cina Beach Malang, Indonesia	Accepted with Revision
7	ULICOSTE013	Lis M.Yapanto, Dahniar Th. Musa, Citra Panigoro, Sutianto Pratama Suherman	State University of Gorontalo Tanjungpura University	The alternative income of coastal communities (Case study in Bone Bolango District, Gorontalo Province, Indonesia)	Accepted with Revision
8	ULICOSTE016	Fairuz Iqbal Maulana, Febby Chandra Pratama	Bina Nusantara University	The Sustainable Development Goals (SDGs) in Boon Pring Tourism Village Turen Malang	Accepted with Revision

No	CODE OF ARTICLE	AUTHORS	AFFILIATION	TITLE	DECISION
				with SWOT Methode	
9	ULICOSTE017	R A D Widyatuti, A Rahmat, M K Zaki, B Prasetyo, and FM Iresha	University of Lampung Gifu University UIN Raden Intan Lampung Universitas Islam Indonesia	Chemical content of waste composting by black soldier fly (Hermetia illucens)	Accepted with Revision
10	ULICOSTE018	A Rahmat, W S Ramadhani, D Prasetyo, S N Aini, A Mutolib, and H Yanfika	University of Lampung	The composition of micro nutrients and toxic elements in agricultural waste compost uses black soldier fly larvae (Hermetia illucens)	Accepted with Revision
11	ULICOSTE020	A Aswandi and C R Kholibrina	Environment and Forestry Research Development and Innovation Institute of Aek Nauli, North Sumatra	New insights into Sumatran camphor (Dryobalanops aromatica Gaertn) management and conservation in western coast Sumatra, Indonesia	Accepted with Revision
12	ULICOSTE021	N Martina, Rinawati, M F R Hasan, Y Setiawan and E Yanuarini	Politeknik Negeri Jakarta	Analysis of the use of rubber waste to improve the performance of the asphalt concrete mixture against roob floods	Accepted with Revision
13	ULICOSTE023	Habib Burrahman and Nia Klaudia Ginting	Sekolah Tinggi Meteorologi Klimatologi Geofisika	Study of the Influence of Cempaka Tropical Cyclone on the height of Sea Waves in the South Java Sea using the Deft 3D Application	Accepted with Revision
14	ULICOSTE024	T Atmoko, A Mardiastuti, M Bismark, L B Prasetyo, and E Iskandar	Institute for Natural Resources Conservation Technology IPB University Forest Research and Development Center	The land cover and type of proboscis monkey habitat in Berau Delta, East Kalimantan	Accepted with Revision
15	ULICOSTE026	P D Kasi, E P Tenriawaru, S Cambaba, and B Triana	Universitas Cokroaminoto Palopo Brawijaya University	The abundance and diversity of Basidiomycetes fungi in sago bark waste	Accepted with Revision
16	ULICOSTE027	Netty Herawati, Lina Sunyata, and Adityo Darmawan Sudagung	Universitas Tanjungpura	Communication Model of Musyawarah and Role of Traditional Leaders in Building Public Acceptance to Support Nuclear Powerplant Development Plan at Bengkayang Regency	Accepted with Revision

No	CODE OF ARTICLE	AUTHORS	AFFILIATION	TITLE	DECISION
17	ULICOSTE028	Mizu Istianto dan Deni Emilda	Indonesian Tropical Fruit Research Institute	The Potency of Citronella Oil and Clove Oil for Pest and Disease Control in Tropical Fruit Plants	Accepted with Revision
18	ULICOSTE029	Jalu Tejo Nugroho, Desy Nurfitriani, Suwarsono, Atriyon Julzarika, Galdita Aruba Chulafak, Argo Galih Suhadha, Rudi Budi Agung, Johannes Manalu and Sri Harini	Indonesian National Institute of Aeronautics and Space Gajah Mada University Sumatera Institute of Technology	Rainfall anomalies assessment during drought episodes of 2015 in Indonesia using CHIRPS Data	Accepted with Revision
19	ULICOSTE030	M R Nugraha and A Adriansyah	Universitas Mercu Buana	Optimization of Sensor Model for Solar Radiation Measurement with Shading Device	Accepted with Revision
20	ULICOSTE031	Kustiyo, Rokhmatuloh, Adhi Harmoko Saputro, Dony Kushardono	University of Indonesia National Institute of Aeronautics and Space (LAPAN)	Speckle Noise Reduction of Sentinel-1 SAR Data using Fast Fourier Transform Temporal Filtering to Monitor Paddy Field Area	Accepted with Revision
21	ULICOSTE032	Samsul Bakri, Karomani, and Abdul Firman Ashaf	University of Lampung	The Role of Extention Participation on Risk Taking Behavior of Local Elites and the Coffee Agroforestry Farmer‘S Income: Study at Social Forest Community on Batutegi Forest Mangement Unit-Lampung Province-Indonesia	Accepted with Revision
22	ULICOSTE033	Messalina L Salampessy, I G Febryano, D Zulfiani, I.G.A.Manik.Widhyastini	University of Nusa Bangsa University of Lampung University of Mulawarman	Public Perception on the Utilization of Cisadane's Watershed Natural Resources	Accepted with Revision
23	ULICOSTE035	Winih Sekaringtyas Ramadhani, Soemarno, Ali Rahmat, Priyo Cahyono	University of Lampung Brawijaya University PT. Great Giant Pineapple	Improvement of Ultisol Soil Fertility under Pineapple Plantation Using Banana Cavendish rotation in Central Lampung, Indonesia	Accepted with Revision
24	ULICOSTE036	A Hamni, A Y T Panuju, and D A S Ambarwati	University of Lampung	Understanding Consumers’ Behavior for Improving Sustainability Through Product Design – A Study Case of Combustion	Accepted with Revision

No	CODE OF ARTICLE	AUTHORS	AFFILIATION	TITLE	DECISION
				Engine Based Vehicles Usage in Indonesia	
25	ULICOSTE037	R J Lahay and S Koem	Universitas Negeri Gorontalo	Implementation of Google Earth Engine in Automatic Detection of Changes in Limboto Lake Inundation	Accepted with Revision
26	ULICOSTE040	Novika Ayu Eko Kusumastuty, Tumiar Katarina Manik, and Paul Benyamin Timotiwu	Indonesian Agency for Meteorology, Climatology and Geophisics University of Lampung	Identification of Temperature and Rainfall Pattern in Bandar Lampung and the 2020 - 2049 Projection	Accepted with Revision
27	ULICOSTE041	Murniati K, W A Zakaria, T Endaryanto, and L S M Indah	University of Lampung	Analysis of production efficiency and income to support sustainability of cassava farming in Lampung Tengah District, Lampung Province	Accepted with Revision
28	ULICOSTE042	Muhammad Abdul Qirom	Banjarbaru Environmental and Forestry Research Development Institute	The impact of land covers on carbon stock potential in South Kalimantan	Accepted with Revision
29	ULICOSTE043	Catur Rakhmad Handoko and Mukhtasor	Sepuluh Nopember Institute of Technology (ITS)	Power Take-off Technology in Wave Energy Converter Systems: State of The Art	Accepted with Revision
30	ULICOSTE044	Retno Yunilawati, Windri Handayani, Agustina Arianita Cahyaningtyas and Cuk Imawan	Universitas Indonesia Badan Penelitian dan Pengembangan Industri, Kementerian Perindustrian	Peppermint oil loaded on recycled paper as an antibacterial label for shrimp	Accepted with Revision
31	ULICOSTE045	Nambi Anasta, FX Arinto Setyawan, and Helmy Fitriawan	Universitas Lampung	Disease detection in banana trees using an image processing-based thermal camera	Accepted with Revision
32	ULICOSTE046	M.M. Mutiara, E Rachmawati and A. Sunkar	IPB University	Effectivity Assessment of Interpretive Signs for Biodiversity Conservation	Accepted with Revision
33	ULICOSTE047	Hamdan A. Adinugraha, D. Setiadi, H. B. Santoso, and N.K. Kartikawati	Balai Besar Penelitian dan Pengembangan Bioteknologi dan Pemuliaan Tanaman Hutan	Growth Performance and Fruiting of Breadfruit Clonal Plantation at Vertic Soil Area in Gunungkidul,	Accepted with Revision

No	CODE OF ARTICLE	AUTHORS	AFFILIATION	TITLE	DECISION
				Yogyakarta	
34	ULICOSTE049	Iis Dewi Ratih, Sri Mumpuni Retnaningsih, and Vivi Mentari Dewi	Institut Teknologi Sepuluh Nopember	Classification of Soil Quality using K Nearest Neighbors	Accepted with Revision
35	ULICOSTE050	M M Harfadli and M Ulimaz	Institut Teknologi Kalimantan	Analysis of the Sustainability of Water Supply in Balikpapan City Using Multi-Dimensional Scaling	Accepted with Revision
36	ULICOSTE051	H H Setiawan, M Nuryana, B Susantyo, A B Purwanto, M B Sulubere and Delfirman	Research end Development Center of Social Welfare, Ministry of Social Affairs	Poverty alleviation for the Beneficiaries of the Program Keluarga Harapan (PKH) through Social Entrepreneurship	Accepted with Revision
37	ULICOSTE052	S Apriyani, A Kurnia, M T Sutriadi	Indonesian Agricultural Environment Research Institute, Pati, Indonesia	Diversity of Insect on Cowpea Cropping in Rainfed Land	Accepted with Revision
38	ULICOSTE053	M Yudinugroho and C A Rokhmana	Universitas Gadjah Mada	Detection of Surface Deformation in Opak Fault Yogyakarta Using Quasi Persistent Scatter Interferometry Synthetic Aperture Radar	Accepted with Revision
39	ULICOSTE054	Anhar Solichin, Niniek Widyorini, and Arif Rahman	Universitas Diponegoro	Biological Aspects of Tilapia (Oreochromis niloticus) in The Jatibarang Reservoir, Central Java	Accepted with Revision
40	ULICOSTE055	D.L Zariatin, Ansor S. Siregar, A. Suwandi, and Ralf Föster	Universitas Pancasila Beuth University of Applied Sciences, Germany	The Effect of Chemical Extraction with Heat on the Bamboo Fibre Strength	Accepted with Revision
41	ULICOSTE057	Kasam, Fajri Mulya Iresha, Rofiqul Umam, and Ali Rahmat	Islamic University of Indonesia University of Lampung Kwansei Gakuin University	Study of Organic Market Waste Processing Using Continuous Flow Bin Vermicomposting Meet Several Nutrient Parameters	Accepted with Revision
42	ULICOSTE058	Yulius Ferry, Sunjaya Putra, and Suci Wulandari	Indonesian Industry and Freshner Crops Research Institute, and Indonesian Center for Estate Crops Research and Development	The amelioration of tidal Peatland to Improve Liberica Coffee Productivity in Jambi	Accepted with Revision

No	CODE OF ARTICLE	AUTHORS	AFFILIATION	TITLE	DECISION
43	ULICOSTE060	Achmad Diansyukma	Universitas Gadjah Mada and PT Pertamina Hulu Mahakam	Analysis of Clean Water Supply for Remote Area (Study Case: Sepatin Village, Kutai Kartanegara Regency)	Accepted with Revision
44	ULICOSTE062	M Telaumbanua, E A Savitri, T Wahyuningsih, Jumari, S Suharyatun, F K Wisnu, and A Haryanto	University of Lampung Food and Horticultural Crops Protection Laboratory, Agriculture Service, Pringsewu Regency	Plant-Based Pesticide using Citronella (Cymbopogon nardus L.) Extract to Control Insect Pests on Rice Plants	Accepted with Revision
45	ULICOSTE064	Adjat Sudrajat, Yati Setiati Rachmawati, Cut Nafisyah N Q	UIN Sunan Gunung Djati	The effect of the type of planting medium and the dosage of vermicompost fertilizer on the growth and yield of bean (Phaseolus vulgaris L.) kenya varieties	Accepted with Revision
46	ULICOSTE067	Adelia Rachmaniar, Hasyimi Pradana, Aditya Prastian Supriyadi, and Aris Mustriadi	TELKOM University Universitas Brawijaya LBH PERADI Malang Raya	Carbon Trading System as a Climate Mitigation Scheme: Why Indonesia Should Adopt it	Accepted with Revision
57	ULICOSTE068	SF Rochmah, Rahmat Safe'i, Afif Bintoro, and Hari Kaskoyo	University of Lampung	The Effect of Forest Health on Social Conditions of the Community	Accepted with Revision
48	ULICOSTE069	E Antriyandarti, Agustono, E Rusdiyana, and S W Ani	Universitas Sebelas Maret,	The dynamics of the relationship between household residence and decision making where to purchase rice: a case study in urban and rural Indonesia	Accepted with Revision
49	ULICOSTE071	D Vidayanti and T G A Nadia	Universitas Mercubuana	Liquefaction Phenomenon Analysis Due To Palu-Donggala Earthquake, September 2018	Accepted with Revision
50	ULICOSTE072	Yusrina Amaliah and Mega Ulimaz	Urban and Regional Planning, Kalimantan Institute of Technology	Spatial modeling on the influence of social network and infrastructure accessibility on the number of poverty alleviation program recipients in Budaya Pampang Sub-District	Accepted with Revision
51	ULICOSTE073	Aditya Prastian Supriyadi, Aris Mustriadi, Hasyimi	Universitas Brawijaya LBH PERADI Malang Raya	Optimization of Novel Renewable Energy as Resources for Environmentally Friendly	Accepted with Revision

No	CODE OF ARTICLE	AUTHORS	AFFILIATION	TITLE	DECISION
		Pradana, and Adelia Rachmaniar	LBH PERADI Malang Raya	National Energy Security: The Existence and the Readiness of the Regulatory Framework	
52	ULICOSTE075	Alfi Muntafi I, M. Subandi, and Budy Frasetya TQ.	UIN Sunan Gunung Djati	The Effect of Various Nutrient Hydroponic Formulation on Growth and Yield of Three Varieties of Common Bean (*Phaseolus vulgaris L.*) on Hydroponic Drip Irrigation System	Accepted with Revision
53	ULICOSTE080	L Y Irawan, Sumarmi, S Bachri, D Panoto, Nabila, I H Pradana, A C Darmansyah, R Faizal, and W E Prasetyo	State University of Malang	Combination of Machine Learning Model (LR-FR) for Flash Flood Susceptibility Assessment in Dawuan Sub Watershed Kabupaten Mojokerto	Accepted with Revision
54	ULICOSTE081	Sundari, Abdu Mas'ud, Didik Wahyudi, Estri Laras Arumingtyas, Lukman Hakim, Rodiyati Azrianingsih	Indonesian Agency for Agricultural Research and Development	Genetic Diversity of Local Durian from Tidore Islands Based on Morphological And Molecular Data for a Tropical Fruit Conservation Model in North Maluku	Accepted with Revision
55	ULICOSTE082	V Fitrianti and M I A Ghafari	University of Mataram Hasanuddin University	The Study of Reef Fish Community in the Outer Islets of Sekotong Bay, Indonesia	Accepted with Revision
56	ULICOSTE083	Hendri Irwandi	Universitas Indonesia	Lake Toba Water Level Fluctuation, Associated with the 2015/2016 El Niño	Accepted with Revision
57	ULICOSTE086	Kusumaputri Amala, Soesilo B, and H. Kusnoputranto	University of Indonesia	Implementation of Cleaner Production to Improve Wastewater Treatment Performance	Accepted with Revision
58	ULICOSTE087	Khodijah Ummu Fadhilah Murad, Nismah Nukmal, and Endah Setiayaningrum	University of Lampung	The Effect of Storage Time of Candidate Raw Insecticide from Gamal Leaves (Gliricidia maculata) on the Toxicity Stability to Control Mealy Bug	Accepted with Revision
59	ULICOSTE088	Suwarsono, D Triyono, MR Khomarudin and Rokhmatuloh	Universitas Indonesia Remote Sensing Application Center – LAPAN	Detecting the Surface Temperature Anomaly of the Anak Krakatau Volcano using Landsat-8 TIRS during 2018 Eruption	Accepted with Revision
60	ULICOSTE089	M Mardiharini	Indonesian Agency for Agricultural Research and Development	CIPP model for performance evaluation of sustainable agricultural-techno park	Accepted with Revision

No	CODE OF ARTICLE	AUTHORS	AFFILIATION	TITLE	DECISION
				development	
61	ULICOSTE090	I Carolita, M S Rosid, A Ibrahim, D Dirgahayu, H Noviar, T Kartika, S Arifin, and J Supriatna	Indonesian National Aeronautic Space Institute University of Indonesia	Potential of PALSAR SCANSAR data for Oil Palm Plantation Monitoring	Accepted with Revision
62	ULICOSTE094	Djoko Mulyono, Yulia Irawati and M Jawal Anwarudin Syah	Indonesian Center for Horticulture Research and Development IP2TP Subang, IndonesianTropical Fruit Research Institute	Morphological Variability of Six Mangosteen (*Garcinia mangostana L.*) Varieties	Accepted with Revision
64	ULICOSTE097	R Evizal and F E Prasmatiwi	University of Lampung	Farmers' perception to climate change and adaptation to sustain black pepper production in North Lampung, Indonesia	Accepted with Revision

Bandar Lampung, October 19th 2020

Chair of ULICOSTE 2020

ULICOSTE
UNIVERSITAS LAMPUNG

Dr. Ir. Lusmeilia Afriani, D.E.A.

THE 1ST UNIVERSITAS LAMPUNG INTERNATIONAL CONFERENCE ON SCIENCE, TECHNOLOGY AND ENVIRONMENT 2020

Address: Jl. Prof. Dr. Ir. Sumantri Brojonegoro No: 1, Gedong Meneng, Kota Bandar Lampung, Lampung 35141

The 1st Universitas Lampung International Conference on Science, Technology and Environment, ULICOSTE 2020

October 19th, 2020

Dear ULICOSTE 2020 Presenters,

We are pleased to announce that based on the screening process, your manuscript has been accepted by The Committee of The 1st Universitas Lampung International Conference on Science, Technology and Environment, ULICOSTE 2020. Please check on **the list of an accepted paper in the attachment (Appendix I)** to as certain the authors and the title. Furthermore, presenters are asked to pay the publication fee and follow the instructions from the ULICOSTE committee, as follow:

1. The article will be process (review) after payment.
2. Article must follow the guidelines of IOP: *Earth and Enviromental Science*.
3. Authors must revise the article following comments and suggestion from reviewer.
4. Article will submitted to IOP Publisher after the revise of paper has been accomplished.
5. The Committee of ULICOSTE will do strict review to reduce the potential for rejection from IOP: *Earth and Enviromental Science*. For article was submitted, but rejected by IOP Publisher, The Organizer will refund 20% of the total payment.
6. For presenter with accepted full paper are required to make PAYMENT in system (IDR1,500,000/Articles). Please make payment to the following account:
   - **Bank : BNI**
   - **Account Holder : Abdul Mutolib**
   - **Account Number : 1120768456**
   - Contact Person : 081271471188 (Mr. Kevin)/081271471133 (Miss Bunga)
   - No later than October 26th, 2020
7. Please write your paper code (e.g. ULICOSTE001) on your payment receipt (using handwriting) and upload it to the email (**ulicoste01@kpa.unila.ac.id**) or WA number (Mr. Kevin **081271471188**/Miss Bunga **081271471133**).
8. Deadline of revised full paper submission is on November 10th, 2020.
9. Articles that are not listed in **Appendix I,** will be accepted after completing the full paper, translate (form Indonesia to English), and linking to the scope of ULICOSTE. Further information will be sent by email.

Chair of ULICOSTE 2020

ULICOSTE
UNIVERSITAS LAMPUNG

Dr. Ir. Lusmeilia Afriani, D.E.A.

REVISION REQUIRED

(29 NOVEMBER 2020)

CATATAN :
HASIL PERBAIKAN MAKALAH (KOREKSI) DARI REVIEWER TERLAMPIR DARI HALAMAN 27-38

Guidelines for Article Review (BLIND REVIEW)

1st Universitas Lampung International Conference on Science, Technology and Environment (ULICoSTE), Universitas Lampung

Code: 062

Title: Plant-Based Pesticide using Citronella (Cymbopogon nardus L.) Extract to Control Insect Pests on Rice Plants

Similarity Level (Plagiarism Check, must be below 20%):

Check point	**Observation**		**Suggestion**
	YES	NO	
Is the subject matter within the scope of the journal? (Sustainable Development, Remote Sensing and GIS, Climate Change, Environmental Science, Natural Science, Renewable Energy)	YES		Natural Science
Does the paper contain enough original results to warrant publication?	YES		
Is the paper technically sound and free of errors?	YES		
Is the work clearly and concisely presented? Is it well organized?	YES		
Does the title clearly and sufficiently reflect its contents?		NO	However, need improvement. Introdution part and Discussion part need improvemnet
Is the abstract informative? Are the main results and conclusions mentioned?	YES		
Are the illustrations of adequate quality, relevant and understandable?	YES		
Does the bibliography give a clear view of the current state-of-the-art in the domain?	YES		
Is the quality of the language satisfactory?	YES		
Is article already following IOP EES template?		NO	90% YEs

- Please check (√) the options
- You can fill the “Suggestion” column or just comment on the article by using Ms. Word → “Review” → “Comments” and “Tracking” , but please pay the attention to the check points

Reviewer Name: XYZ

Reviewer Signature:

Date: 25 November 2020

Plant-Based Pesticide using Citronella (*Cymbopogon nardus* L.) Extract to Control Insect Pests on Rice Plants

M Telaumbanua[1], E A Savitri[1], T Wahyuningsih[2], Jumari[2], S Suharyatun[1], F K Wisnu[1], A Haryanto[1,*]

[1]Agricultural Engineering Departement, University of Lampung, Bandar Lampung, Indonesia
[2]Food and Horticultural Crops Protection Laboratory, Agriculture Service, Pringsewu Regency, Lampung, Indonesia

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Comment [u1]: Maksimal 6 authors

Abstract. The main enemy in rice production is the attack of stinky bugs, brown planthoppers, grasshoppers, ladybugs, aphids and others. This attack inhibits the growth of rice plants, thereby reducing production or even thwarting the harvest. Chemical pesticide application is able to reduce pests and diseases. However, the long-term use of chemical pesticides can disrupt the ecosystem. This study aims to study the application of plant-based pesticide to the presence of pests and predatory insects for rice plants. The research was begun with the preparation of citronella-based pesticide from citronella extract obtained by mixing citronella with water at a weight ratio of 2:1. The extract was mixed with water at ratio of 1 liter for 50 ml of citronella extract. The application of the prepared pesticide was carried out by spraying 21-DAP (day after planting) rice plants at two plots sizing 400 m^2 each. The types and numbers of pests and predatory insects were observed before every pesticide application. Spraying was repeated weekly for the following 4 weeks. Results showed a decrease of insects in experimental plots A and B after the application of pesticide. After the fourth application, only one type of insect (green grasshopper) was found in plot A and no insect were found in plot B. However, four types of insects were found in the control plot. The application of citronella-based pesticide also related to the decrease of predatory insects population.

Introduction

Rice is the main food crop to produce white rice which is the staple food of Indonesian people. However, Indonesia still routinely imports rice from Thailand, Vietnam and the Philippines to meet national rice needs. This is due to the low productivity of Indonesia's rice plants. One of the threats that haunts rice farmers is the attack of pests, especially insects, or plant diseases. Pest/disease attacks are a common condition in the rice cultivation. Pests and diseases can cause total harvesting failure. Insect pests use rice plants a place to breed or a source of food by sucking nutrients from plant tissues, making holes in plants, damaging leaves and so on. Some insect pests that stick to plants also carry diseases, so that the plants grow unoptimally.

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In general, plant pest control is carried out by using chemical pesticides. However, the application of chemical pesticides in crop cultivation has an adverse impact on the surrounding environment. The prolonged and excessive use of chemicals increases resistance of insect pests such that ~~chemical pesticides has~~chemical pesticides have little effect on pest control. In addition, application of chemical pesticides also disrupts the surrounding ecosystem [1]. For example, chemical pesticides kill not only insect pests, but also predatory insects which are useful in insect pest control. Chemical pesticides also contaminate the soil, affecting their texture and ability to hold water, and inhibit the development of

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~~decomposter~~decomposer microorganisms. This certainly affects the availability of nitrogen and other nutrients in the soil. For that reason, a solution is needed to overcome the problem of insect pests in rice plants which is able to sustainably prevent environmental damage. The use of plant-based pesticides is one of the solutions in controlling plant pests. The content of plant-based pesticides is not desired by insect pests. Research conducted by Koul and Walia (2009) demonstrated that plant-based pesticides inhibited the growth of insect pests and pathogens [2].

One of the popular plants that is easy to cultivate and can be used as a pesticide is citronella (*Cymbopogon nardus* L.). This plant contains citronellol which causes a distinctive odor and is disliked by insect pests. This odor can irritate and reduce the destructive power of insect pests to plant tissue. Sahabuddin and Anshary (2010) state that extract of citronella leaves at a concentration of 8.5% can cause a mortality of 66.67% and inhibits the eating activity of larvae by 82.66% [3]. Other study stated that the use of citronella and cloves extracts cause pest mortality more than 50% with average efficacy of 89.29% and the loss of pepper fruit yield decreased to 4.1% [4]. Nurmansyah (2011) found that citronella extract at a concentration of 0.2% caused 91.62% mortality of *Helopeltis antonii* by six hours after application [5]. Zahro *et al.* (2016) found that citronella leaf extract can suppress larvae appetite, inhibit pupa and imago development, and interfere the imago's reproductive system in cabbage cultivation [6]. Pinheiro *et al.* (2013) said that citronella contains monterpenes (citronellal, limonene and geraniol) which provide plant defense from pests [7]. Field experiment showed that treatment of citronella oil at 2.0 mL/L significantly reduced fruit damage by *H. armigera* similar to the plots treated with spinosad at 60 g ai/ha. Another study found that citronella oil application on chili pepper significantly decreased fruit damage by 72% [8]. This impact will inhibit the development of insect pests. Another study on non-chemical pest control was conducted by Telaumbanua et al. (2020) using automatic insect pest trap [9]. The use of citronella extract can be combined with this trap to support the development of automatic pest trapping system.

This current study aims to determine the effect of pesticide application based on citronella extract on the types and numbers of insect pests and predatory insects in the cultivation of rice (Ciherang varieties). Through this research, it is expected to know the effectiveness of pesticides from citronella extract in controlling pests of rice plants.

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Material and Method

1.1. Place and Materials

The materials used were citronella (Figure 1) and water without a mixture of other ingredients. Citronella is very close to its cousin lemongrass because they belong to the same genus, namely Cymbopogon. But, they both have different scents. Citronella is used to produce essential oils, while lemongrass is used for flavoring food. Visually, citronella has slightly red bark, while the bark of lemongrass is green like the leaves.

Figure 1. Citronella harvesting (left) and lemongrass (right) space.

This research was conducted at the experimental field for Food and Horticulture Crops Protection of Agriculture Service, Pringsewu Regency, Indonesia (Figure 1). The equipments used in this study included a set of tools for extracting citronella plants such as knives, blender, filters, containers, and so on. A knapsack sprayer was used for application of citronella extract to rice plants. A logbook and laptop was used to document the observation data.

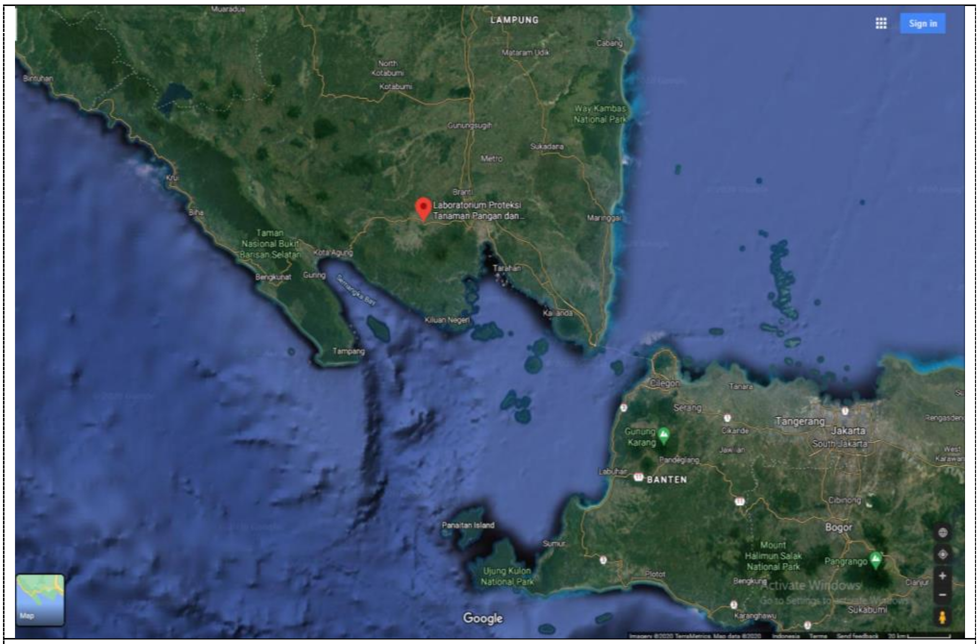

Figure 2. Location of field experiment (red baloon) on the Google map

1.2. Pesticide Preparation

The preparation of citronella-based pesticide was carried out at the Laboratory of Food and Horticulture Crops Protection. In this case, leaves and stems of citronella were used. These materials were wilted first by windrowed outside, and then cut into pieces about 2 cm in length. These chips were then crushed using a kitchen blender with the addition of tap water at a ratio of 1 : 2 (citronella : water). This maceration aims to expand the mass transfer surface of the solvent with raw materials (solids). The milled material is left for 2 hours so that the compounds in the citronella can adhere to the solvent. The next step is extraction to separate the solution from the solid using a filter. The separated solution is then stored in a tightly closed jerry can and then stored in a refrigerator until application time.

1.3. Pesticide Application

Pesticide application was carried out on rice plants that were 21 days old. The research field consisted of three plots, namely experimental plot A, experimental plot B and control plot. The area of each plot is 400 m^2 and each plot is separated by a bund. Citronella extract was diluted using water at a ratio of 50 ml of extract in one liter of water. Pesticide spraying was carried out using a knapsack sprayer on the rice plants. Spraying was carried out on experimental plots A and B at the same rate (10 liters per plot). Spraying was not carried out for control plot. Pesticide application was repeated on experimental fields A and B every week for the next 4 weeks.

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Figure 3. Citronella harvesting (left) and lemongrass (right) space.

1.4. Observation and Data Analysis

The first stage in this research is to collect data on the types and populations of insect pests and predatory insects (natural enemies of pests) in the rice clumps in experimental plots A, B and control. Pests that may be present include brown planthoppers, green leafhoppers, white leafhoppers, green grasshoppers, stink bugs, green ladybugs, armyworms, and stem borer. Predatory insects include spiders, Lycosa, Tettragnatha, Phederus, Micraspis, Ophionea, parasitoids and dragonflies. The data is tabulated in graphical form to determine the pattern of decline each week. Observations were made every week before the spray application was carried out. Four students supervised by a field technician made this observation.

Result and Discussion

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1.5. Insect Pests

Figure 4 shows the type and initial number of insect pests in each experimental plot before application of citronella-based pesticide. The types of insect pests in the three plots were the same and included brown planthoppers (BPH), green grasshoppers (GG), armyworms (AW), and stink bugs (SB). However, the number of each insect is different in each plot with plot B being the least. Overall, the control plot had the highest number of pests, namely 17 tails, followed by plot A 15 tails, and plot B 7 tails. According to its species, BPH was the most pest of 15 tails in total, followed by GG 12, SB 9, and AW 3 tails.

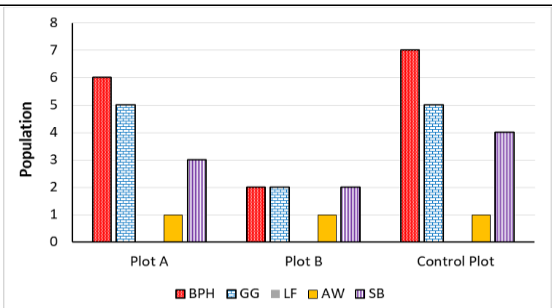

Figure 4. Type and number of insect pest before pesticide application (paddy 21 DAP)

Figure 5 shows the change in pest insect population after first application of citronella-based pesticide. Three types of insect pests still survive, namely the brown planthoppers, green grasshoppers, and stink bugs. Overall the number of insect pests is still 17 tails in the control plot, 13 in the A plot (2 less) and 11 in the B plot (4 more). Based on the type, BPH decreased by 4 (remained 11), GG was still 12 heads with a changed distribution, SB increased by 8 (become 17 heads), and AW disappeared from all experimental plots. However, a new insect pest was present in the control plot, namely leaf flies (LF). The results showed that the spraying of citronella-based pesticide in the first week had not had an effective impact on insect pest control, although the number of insect pests in control plots was still higher than in plots A and B.

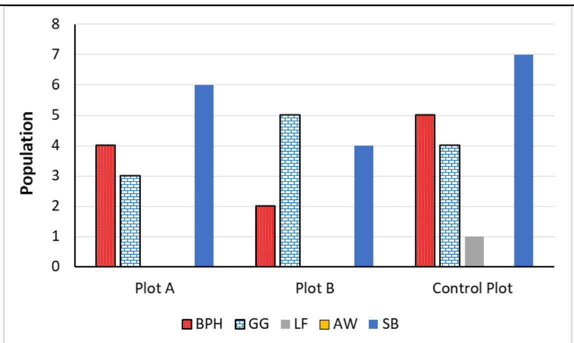

Figure 5. Type and number of insect pests after first application of pesticide (paddy 28 DAP)

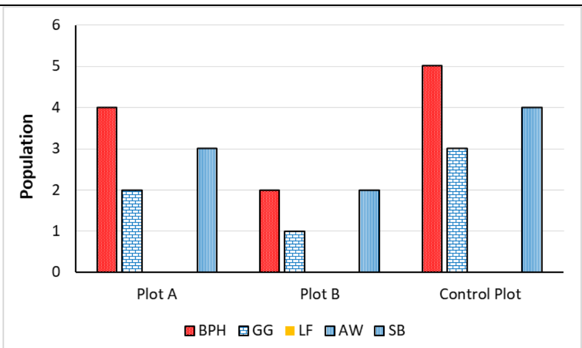

Figure 6. Type and number of insect pests after second application of pesticide (paddy 35 DAP)

In the second spraying when the rice plants were 35 DAP, the pesticide application began to show its effect. Figure 6 shows that there was a decrease in insect pests after the application of citronella-based pesticides. The results of the inspection showed that the types and number of insect pests began to decrease, especially on the application plots. Overall, there are only 3 types of pests left, namely BPH, GG, and SB. From the distribution, the control plot had the most insect pests, with a total of 12 animals, followed by the experimental plot A with 9 animals, and the plot B with only 5 animals. In terms of species, BPH was still the highest with a total of 11 tails, followed by SB 9 tails and GG 6 tails.

Observations after the third application of citronella-based pesticide (paddy age 42 DAP) showed increasingly significant results. In both experimental plots A and B, only one BPH was found (Figure 7), and no insect pests that were found in the previous week, such as green grasshoppers and stink bugs. On the other hand, in the control plot, the three types of insect pests still survive. Although the number was less than that of the previous week, there were still more BPH pests in the control plot as compared to those in the experimental plots.

The last application of pesticide was carried out when the rice plants were 49 DAP. Observations show the presence of green grasshoppers in experimental plot A, while in the experimental plot B there was no insect pest at all (Figure 8). In the BPH control plot, there were still 3 tails of BPH and one SB.

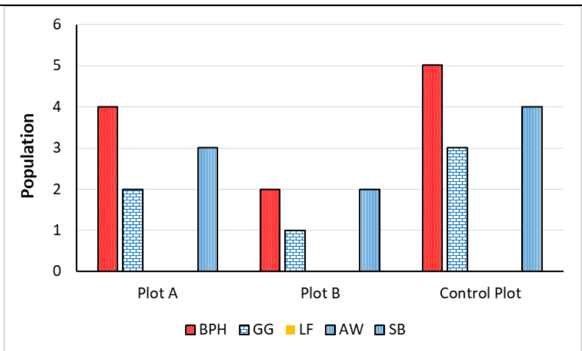

Figure 7. Type and number of insect pests after third application of pesticide (paddy 42 DAP)

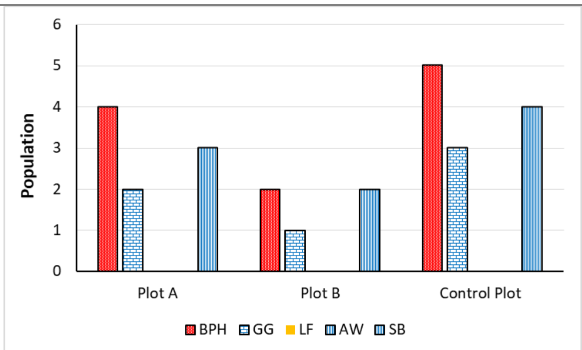

Figure 8. Type and number of insect pests after fourth application of pesticide (paddy 49 DAP)

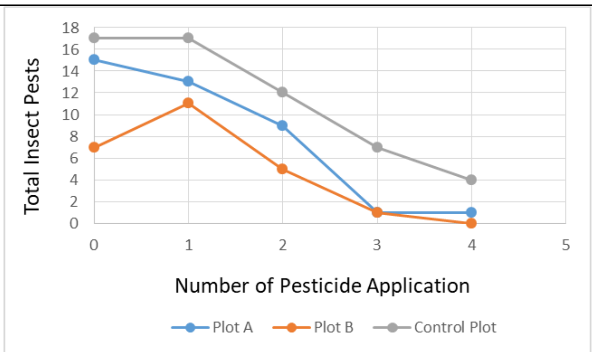

Figure 9. Progress of total number of insect pests during pesticide application

Figure 9 shows the progress of total insect pests population during five times application of citronella-based pesticide on the paddy field. These results concluded that the application of citronella-based pesticide can reduce the existence of insect pests in rice plants. The application of this pesticide can control even the very vicious pest like BPH. During the 4 application of citronella pesticide, the insect pest population decreased from 7 to 0 in plot A, down from 15 to 1 in Plot B. In the insect pest control plot it also decreased from 17 to 4. the impact of the experimental plot due to its adjacent location.

1.6. Predatory Insects

Predatory insects are beneficial as they are natural enemies for the insect pests. They are important to help control insect pests. Figure 10 shows the types and initial numbers of predatory insects found in the three experimental plots. Predatory insects found included *Lycosa* sp. (LC), spiders (SP), *Paederus* sp. (PD), *Ophionea* sp. (OP), dragonflies (DF), and *Tettragnatha* sp. (TT). The distribution and numbers of predatory insects were uneven in the experimental plots. For example, in plots A and B there was *Lycosa* sp. which was not found in the control plot. On the other hand, dragonflies are found in plot A and control plot, but not in plot B. Only three types of predatory insects were found in all the three plots, namely spiders, *Paederus* sp., and *Ophionea* sp. Based on the type, *Paederus* sp. were the most common, namely 23, followed by *Lycosa* sp. 12, *Ophionea* sp. 10, spider 7, dragonflies 2, and *Tettragnatha* sp. 1.

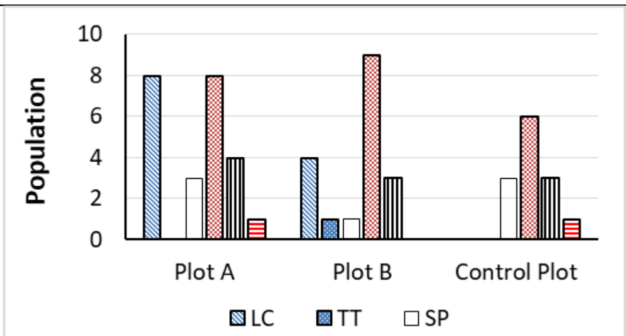

Figure 10. Type and number of predatory insects before pesticide application (paddy 21 DAP)

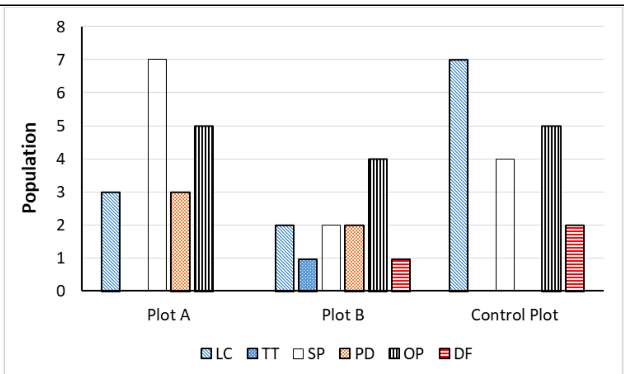

Figure 11. Type and number of predatory insects after first pesticide application (paddy 28 DAP)

Figure 11 shows the type and number of predatory insects after the first application of citronella-based pesticide. The types of predatory insects are still the same as those found before the application of pesticide, namely *Lycosa* sp., spiders, *Paederus* sp., *Ophionea* sp., *Tettragnatha* sp., and dragonflies. Based on the type, *Ophionea* sp. were the most common, namely 14, followed by spiders 13, *Lycosa* sp. 12, *Paederus* sp. 5, dragonflies 3, and *Tettragnatha* sp. 1.

Observations on 35 DAP (after the second spraying) showed that *Ophionea* sp. predatory insects predatory (Figure 12). Population of *Ophionea* sp. in fact, far exceeded the previous week's record (28 DAP). Other remaining predatory insects include spiders in all plots, *Tettragnatha* sp. only in the control plot, and *Paederus* sp. in plot B and control plot. Overall, the insect population in the control plot was higher than that in the experimental plot. This suggests that the application of citronella-based pesticide is also related to the decrease in the number and types of predatory insects in rice plants.

After the third pesticide application, only three types of predatory insects remained in the rice plots, namely spider, *Paederus* sp., and *Ophionea* sp. the population is not much different (Figure 13). These three types of insects also survived after the fourth pesticide application. However, this time the total population in the control plot is significantly more than the total population in experimental plot A or plot B. This supports the notion that the application of citronella-based pesticide is not only able to control insect pests but is also associated with a decrease in the number and types of predatory insects.

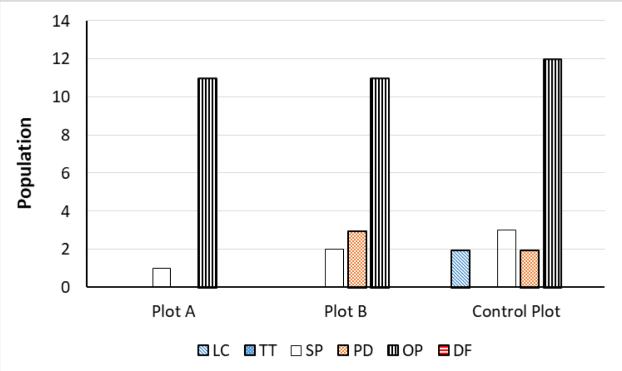

Figure 12. Type and number of predatory insects after second pesticide application (paddy 35 DAP)

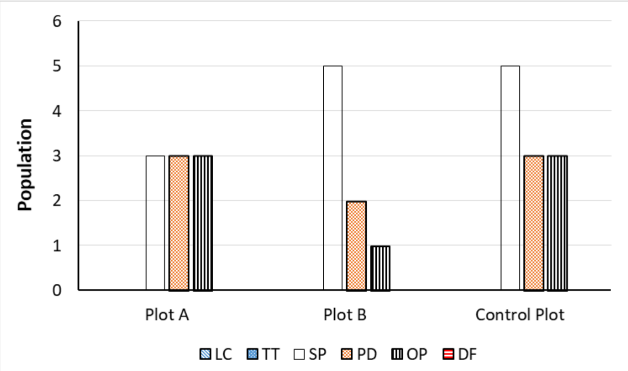

Figure 13. Type and number of predatory insects after third pesticide application (paddy 42 DAP)

From the results of observations during the spraying of citronella pesticide 4 times, it was found that there had been a decrease in the population of predatory insects in all observation plots. This population decline occurred gradually on land that had been exposed to pesticides (Figure 14). This proves that the application of citronella-based pesticide, also reduces the population of predatory insects in rice cultivation land. The nature of lemongrass containing secondary metabolics has been exposed to the tissues and environment of rice plants, thus disturbing insects. However, the citronella-based pesticide relationship may not be a direct one but a side effect of decreased insect pests. As the name suggests, predatory insects will hunt insect pests. If insect pests disappear from the rice plot, the predatory insects will also disappear.

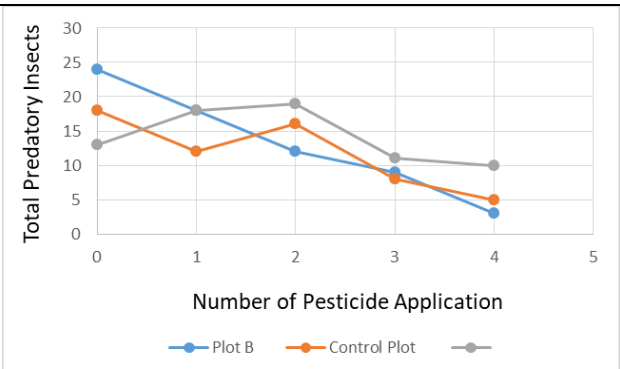

Figure 14. Progress of total number of predatory insect during pesticide application

Conclusion

Pests in rice plants include brown planthoppers, green grasshoppers, stink bugs, leaf flies, and armyworms. While, the predatory insects found consisted of *Lycosa* sp. (LC), spiders (SP), *Paederus* sp. (PD), *Ophionea* sp. (OP), dragonflies (DF), and *Tettragnatha* sp. (TT). The application of citronella-based pesticides can significantly reduce the insect pest population. During the 4 application of citronella pesticides, the population of insect pests decreased from 7 to 0 in plot A, down from 15 to 1 in Plot B. In the insect pest control plot it also decreased from 17 to 4. In general, the application of citronella-based pesticides was also related to declining predatory insect populations. However, the citronella-based pesticide relationship may be due to the side effect of decreased insect pests.

Acknowledgments

MT, EAS, and AH would like to express their gratitude and appreciation to the Food and Horticulture Crops Protection of Agriculture Service, Pringsewu Regency, for giving permission and a place to carry out this research.

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Plant-based pesticide using citronella (*Cymbopogon nardus* L.) extract to control insect pests on rice plants

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Abstract. The main enemy in rice production is the attack of stinky bugs, brown planthoppers, grasshoppers, ladybugs, aphids, and others. This attack inhibits the growth of rice plants, thereby reducing production or even thwarting the harvest. Chemical pesticide application can reduce pests and diseases. However, the long-term use of chemical pesticides can disrupt the ecosystem. This study aims to study the application of plant-based pesticides to the presence of pests and predatory insects for rice plants. The research was begun with the preparation of citronella-based pesticide from citronella extract obtained by mixing citronella with water at a weight ratio of 2:1. The extract was mixed with water at a ratio of 1 liter for 50 ml of citronella extract. The application of the prepared pesticide was carried out by spraying 21-DAP (day after planting) rice plants at two plots sizing 400 m^2 each. The types and numbers of pests and predatory insects were observed before every pesticide application. Spraying was repeated weekly for the following 4 weeks. Results showed a decrease of insects in experimental plots A and B after the application of pesticides. After the fourth application, only one type of insect (green grasshopper) was found in plot A, and no insect was found in plot B. However, four types of insects were found in the control plot. The application of citronella-based pesticides is also related to the decrease of predatory insects' population.

1. Introduction

Rice is the main food crop to produce white rice, which is the Indonesian people's staple food. However, Indonesia still routinely imports rice from Thailand, Vietnam, and the Philippines to meet national rice needs. This is due to the low productivity of Indonesia's rice plants. One of the threats that threaten ice farmers is the pests' attack, especially insects or plant diseases. Pest/disease attacks are a common condition in rice cultivation. Pests and diseases can cause total harvesting failure. Insect pests use rice plants as a place to breed or a source of food by sucking nutrients from plant tissues, making holes in plants, damaging leaves, and so on. Some insect pests that stick to plants also carry diseases, so that the plants grow unoptimally [1-5].

In general, plant pest control is carried out by using chemical pesticides. However, the application of chemical pesticides in crop cultivation has an adverse impact on the surrounding environment. The prolonged and excessive use of chemicals increases resistance of insect pests such that chemical pesticides have little effect on pest control. In addition, application of chemical pesticides also disrupts the surrounding ecosystem [1, 6]. For example, chemical pesticides kill not only insect pests, but also predatory insects which are useful in insect pest control. Chemical pesticides also contaminate the soil, affecting their texture and ability to hold water, and inhibit the development of decomposer microorganisms [6-9]. This certainly affects the availability of nitrogen and other nutrients in the soil.

For that reason, a solution is needed to overcome the problem of insect pests in rice plants which is able to sustainably prevent environmental damage. The use of plant-based pesticides is one of the solutions in controlling plant pests. The content of plant-based pesticides is not desired by insect pests. The results of research in 2008 demonstrated that plant-based pesticides inhibited the growth of insect pests and pathogens [10].

One of the popular plants that is easy to cultivate and can be used as a pesticide is citronella (*Cymbopogon nardus* L.). This plant contains citronellol which causes a distinctive odor and is disliked by insect pests. This odor can irritate and reduce the destructive power of insect pests to plant tissue. he research state that extract of citronella leaves at a concentration of 8.5% can cause a mortality of 66.67% and inhibits the eating activity of larvae by 82.66% [11]. Other study stated that the use of citronella and cloves extracts cause pest mortality more than 50% with average efficacy of 89.29% and the loss of pepper fruit yield decreased to 4.1% [12]. The other study found that citronella extract at a concentration of 0.2% caused 91.62% mortality of *Helopeltis antonii* by six hours after application [13]. A study found that citronella leaf extract can suppress larvae appetite, inhibit pupa and imago development, and interfere the imago's reproductive system in cabbage cultivation [14]. The citronella contains monterpenes (citronellal, limonene and geraniol) which provide plant defense from pests [15]. Field experiment showed that treatment of citronella oil at 2.0 mL/L significantly reduced fruit damage by *H. armigera* similar to the plots treated with spinosad at 0.06 kg ai/ha. Another study found that citronella oil application on chili pepper significantly decreased fruit damage by 72% [16].

The use of pesticides made from lemongrass is also able to reduce the population of insects that interfere with humans such as flies, cockroaches, fleas, and others [17,18]. This impact will inhibit the development of insect pests. Another study on non-chemical pest control was conducted using automatic insect pest trap [19,20]. The use of citronella extract can be combined with this trap to support the development of automatic pest trapping system. In order for the spraying of organic pesticides to be more precise, the spraying system can use a microcontroller as an information processor [21-24]. Automatic pest control system using organic pesticides (citronella pesticides) is one step towards precision agriculture to increase organic agricultural production in Indonesia.

This current study aims to determine the effect of pesticide application based on citronella extract on the types and numbers of insect pests and predatory insects in the cultivation of rice (Ciherang varieties). Application of citronella pesticides to rice plants using manual spraying using a knapsack. Through this research, it is expected to know the effectiveness of pesticides from citronella extract in controlling pests of rice plants.

2. Material and Method.

2.1. Place and materials

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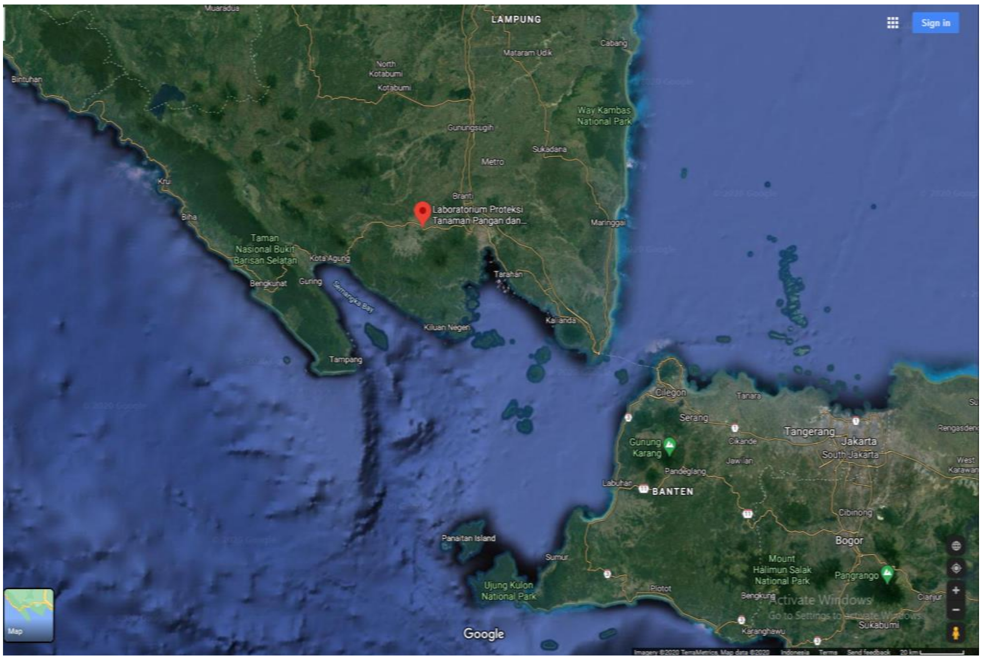

Figure 2. Location of field experiment (red baloon) on the Google map

2.2. Pesticide Preparation
The preparation of citronella-based pesticide was carried out at the Laboratory of Food and Horticulture Crops Protection. In this case, leaves and stems of citronella were used. These materials were wilted first by windrowed outside, and then cut into pieces about 2 cm in length. These chips were then crushed using a kitchen blender with the addition of tap water at a ratio of 1 : 2 (citronella : water). This maceration aims to expand the mass transfer surface of the solvent with raw materials (solids). The milled material is left for 2 hours so that the compounds in the citronella can adhere to the solvent. The next step is extraction to separate the solution from the solid using a filter. The separated solution is then stored in a tightly closed jerry can and then stored in a refrigerator until application time.

2.3. Pesticide Application
Pesticide application was carried out on rice plants that were 21 days old. The research field consisted of three plots, namely experimental plot A, experimental plot B and control plot. The area of each plot is 400 m^2 and each plot is separated by a bund. Citronella extract was diluted using water at a ratio of 50 ml of extract in one liter of water. Pesticide spraying was carried out using a knapsack sprayer on the rice plants. Spraying was carried out on experimental plots A and B at the same rate (10 liters per plot). Spraying was not carried out for control plot. Pesticide application was repeated on experimental fields A and B every week for the next 4 weeks.

Figure 3. Citronella harvesting (left) and lemongrass (right) space.

2.4. Observation and Data Analysis

The first stage in this research is to collect data on the types and populations of insect pests and predatory insects (natural enemies of pests) in the rice clumps in experimental plots A, B and control. Pests that may be present include brown planthoppers, green leafhoppers, white leafhoppers, green grasshoppers, stink bugs, green ladybugs, armyworms, and stem borer. Predatory insects include spiders, Lycosa, Tettragnatha, Phederus, Micraspis, Ophionea, parasitoids and dragonflies. The data is tabulated in graphical form to determine the pattern of decline each week. Observations were made every week before the spray application was carried out. Four students supervised by a field technician made this observation.

3. Result and Discussion

3.1. Insect Pests

Figure 4 shows the type and initial number of insect pests in each experimental plot before application of citronella-based pesticide. The types of insect pests in the three plots were the same and included brown planthoppers (BPH), green grasshoppers (GG), armyworms (AW), and stink bugs (SB). However, the number of each insect is different in each plot with plot B being the least. Overall, the control plot had the highest number of pests, namely 17 tails, followed by plot A 15 tails, and plot B 7 tails. According to its species, BPH was the most pest of 15 tails in total, followed by GG 12, SB 9, and AW 3 tails.

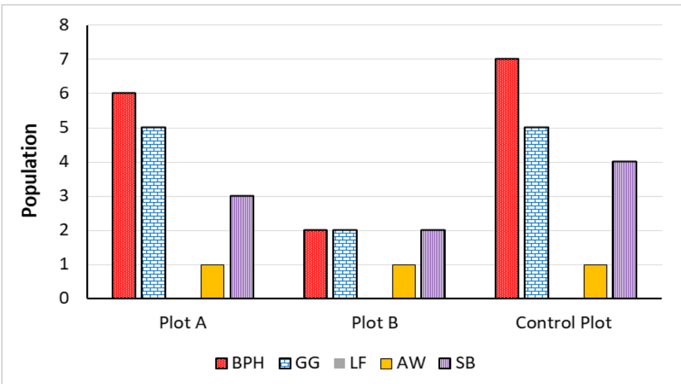

Figure 4. Type and number of insect pest before pesticide application (paddy 21 DAP)

Figure 5 shows the change in pest insect population after first application of citronella-based pesticide. Three types of insect pests still survive, namely the brown planthoppers, green grasshoppers, and stink bugs. Overall the number of insect pests is still 17 tails in the control plot, 13 in the A plot (2 less) and 11 in the B plot (4 more). Based on the type, BPH decreased by 4 (remained 11), GG was still 12 heads with a changed distribution, SB increased by 8 (become 17 heads), and AW disappeared from all experimental plots. However, a new insect pest was present in the control plot, namely leaf flies (LF). The results showed that the spraying of citronella-based pesticide in the first week had not had an effective impact on insect pest control, although the number of insect pests in control plots was still higher than in plots A and B.

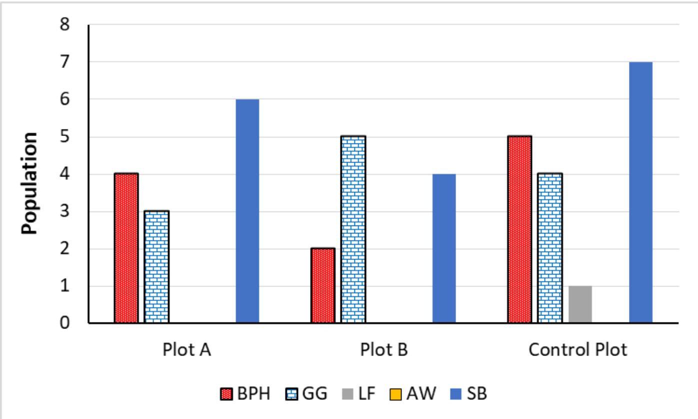

Figure 5. Type and number of insect pests after first application of pesticide (paddy 28 DAP)

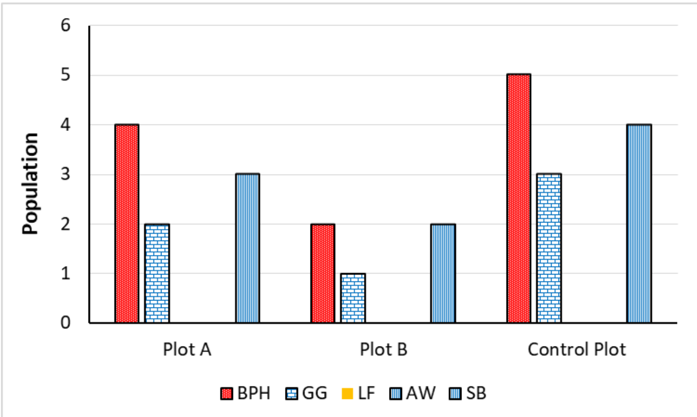

Figure 6. Type and number of insect pests after second application of pesticide (paddy 35 DAP)

In the second spraying when the rice plants were 35 DAP, the pesticide application began to show its effect. Figure 6 shows that there was a decrease in insect pests after the application of citronella-based pesticides. The results of the inspection showed that the types and number of insect pests began to decrease, especially on the application plots. Overall, there are only 3 types of pests left, namely BPH, GG, and SB. From the distribution, the control plot had the most insect pests, with a total of 12 animals, followed by the experimental plot A with 9 animals, and the plot B with only 5 animals. In terms of species, BPH was still the highest with a total of 11 tails, followed by SB 9 tails and GG 6 tails.

Observations after the third application of citronella-based pesticide (paddy age 42 DAP) showed increasingly significant results. In both experimental plots A and B, only one BPH was found (Figure 7), and no insect pests that were found in the previous week, such as green grasshoppers and stink bugs. On the other hand, in the control plot, the three types of insect pests still survive. Although the number was less than that of the previous week, there were still more BPH pests in the control plot as compared to those in the experimental plots.

The last application of pesticide was carried out when the rice plants were 49 DAP. Observations show the presence of green grasshoppers in experimental plot A, while in the experimental plot B there was no insect pest at all (Figure 8). In the BPH control plot, there were still 3 tails of BPH and one SB.

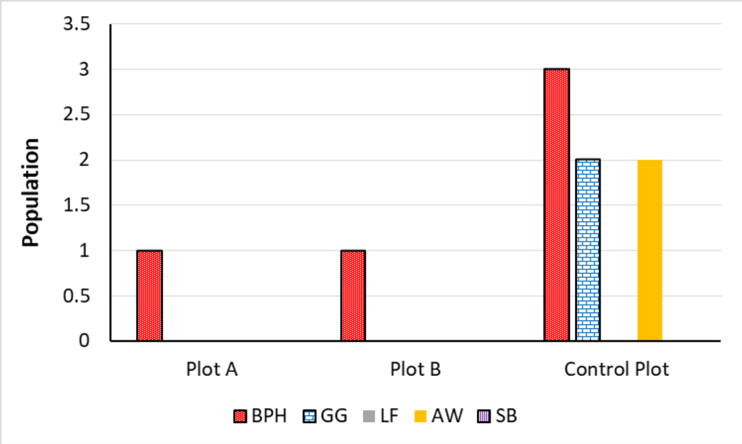

Figure 7. Type and number of insect pests after third application of pesticide (paddy 42 DAP)

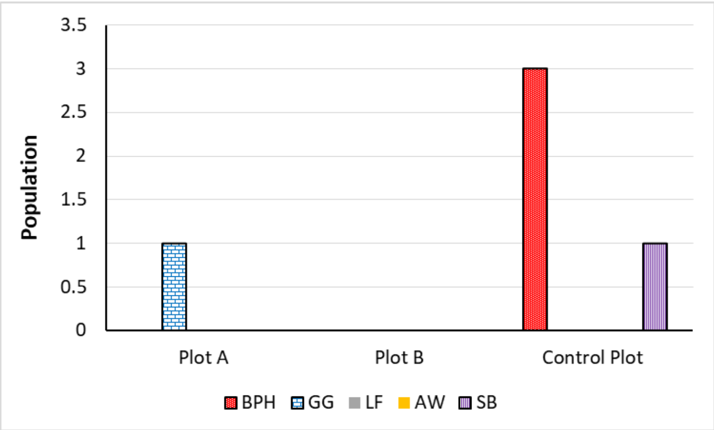

Figure 8. Type and number of insect pests after fourth application of pesticide (paddy 49 DAP)

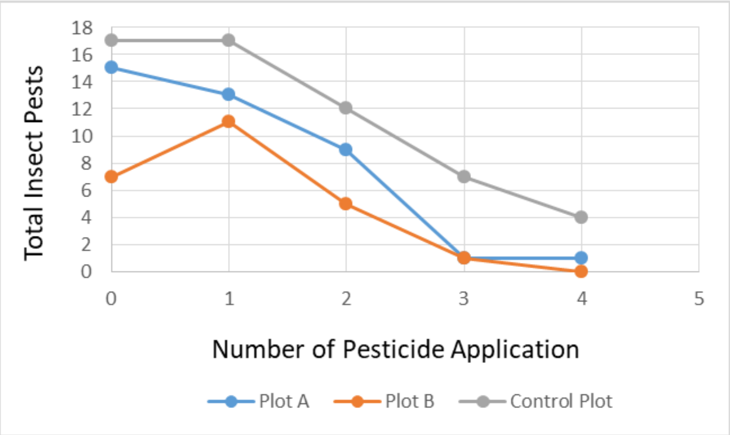

Figure 9. Progress of total number of insect pests during pesticide application

Figure 9 shows the progress of total insect pests population during five times application of citronella-based pesticide on the paddy field. These results concluded that the application of citronella-based pesticide can reduce the existence of insect pests in rice plants. The application of this pesticide can control even the very vicious pest like BPH. During the 4 application of citronella pesticide, the insect pest population decreased from 15 to 1 in plot A, down from 7 to 0 in Plot B. In the insect pest control plot it also decreased from 17 to 4. the impact of the experimental plot due to its adjacent location.

3.2. Predatory Insects

Predatory insects are beneficial as they are natural enemies for the insect pests. They are important to help control insect pests. Figure 10 shows the types and initial numbers of predatory insects found in the three experimental plots. Predatory insects found included *Lycosa* sp. (LC), spiders (SP), *Paederus* sp. (PD), *Ophionea* sp. (OP), dragonflies (DF), and *Tettragnatha* sp. (TT). The distribution and numbers of predatory insects were uneven in the experimental plots. For example, in plots A and B there was *Lycosa* sp. which was not found in the control plot. On the other hand, dragonflies are found in plot A and control plot, but not in plot B. Only three types of predatory insects were found in all the three plots, namely spiders, *Paederus* sp., and *Ophionea* sp. Based on the type, *Paederus* sp. were the most common, namely 23, followed by *Lycosa* sp. 12, *Ophionea* sp. 10, spider 7, dragonflies 2, and *Tettragnatha* sp. 1.

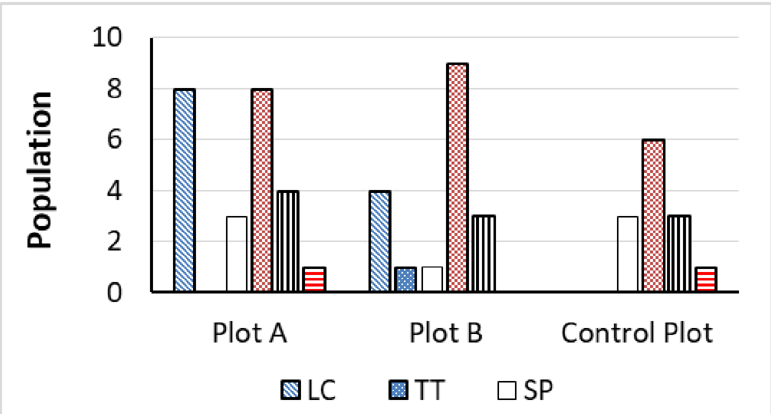

Figure 10. Type and number of predatory insects before pesticide application (paddy 21 DAP)

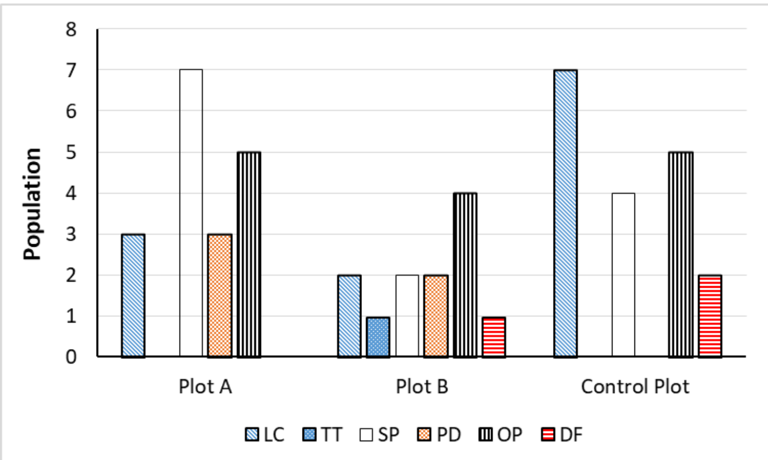

Figure 11. Type and number of predatory insects after first pesticide application (paddy 28 DAP)

Figure 11 shows the type and number of predatory insects after the first application of citronella-based pesticide. The types of predatory insects are still the same as those found before the application of pesticide, namely *Lycosa* sp., spiders, *Paederus* sp., *Ophionea* sp., *Tettragnatha* sp., and dragonflies. Based on the type, *Ophionea* sp. were the most common, namely 14, followed by spiders 13, *Lycosa* sp. 12, *Paederus* sp. 5, dragonflies 3, and *Tettragnatha* sp. 1.

Observations on 35 DAP (after the second spraying) showed that *Ophionea* sp. predatory insects predatory (Figure 12). Population of *Ophionea* sp. in fact, far exceeded the previous week's record (28 DAP). Other remaining predatory insects include spiders in all plots, *Tettragnatha* sp. only in the control plot, and *Paederus* sp. in plot B and control plot. Overall, the insect population in the control plot was higher than that in the experimental plot. This suggests that the application of citronella-based pesticide is also related to the decrease in the number and types of predatory insects in rice plants.

After the third pesticide application, only three types of predatory insects remained in the rice plots, namely spider, *Paederus* sp., and *Ophionea* sp. the population is not much different (Figure 13). These three types of insects also survived after the fourth pesticide application. However, this time the total population in the control plot is significantly more than the total population in experimental plot A or plot B. This supports the notion that the application of citronella-based pesticide is not only able to control insect pests but is also associated with a decrease in the number and types of predatory insects.

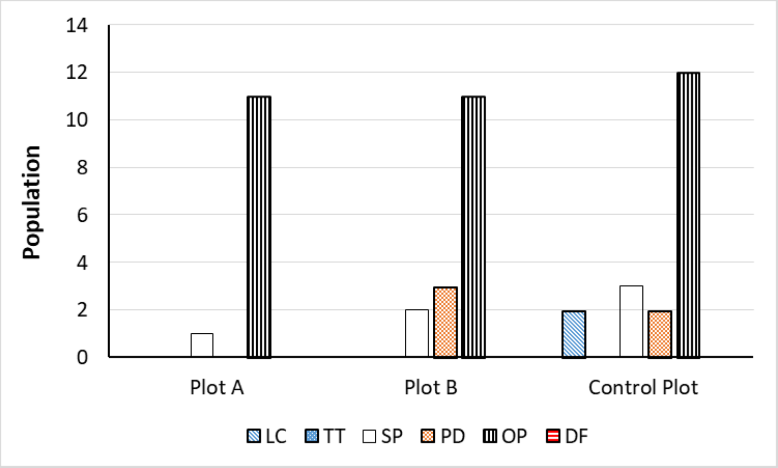

Figure 12. Type and number of predatory insects after second pesticide application (paddy 35 DAP)

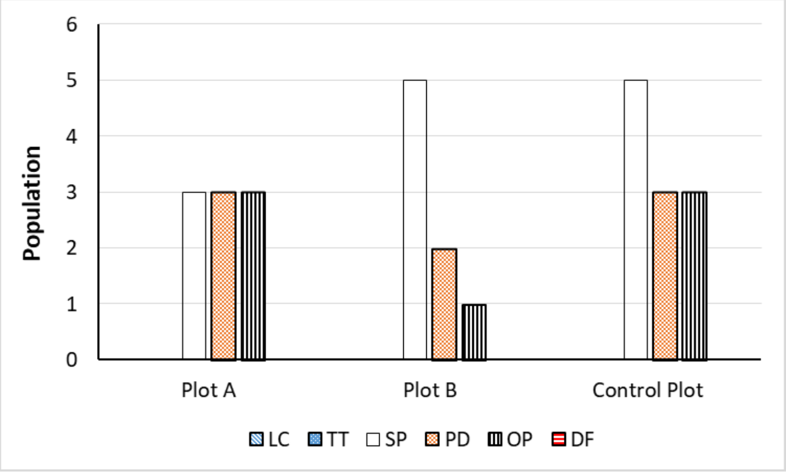

Figure 13. Type and number of predatory insects after third pesticide application (paddy 42 DAP)

Observations on 49 DAP have shown that there are still predatory insects in experimental plot A and experimental plot B. The number of predatory insects in plot A is 3 and plot B is 5. In the control plot, the number of predatory insects is 10 (Figure 14). The reduction in predatory insects in plot A and plot B is due to lack of food, namely insect pests, due to the influence of citronella pesticides.

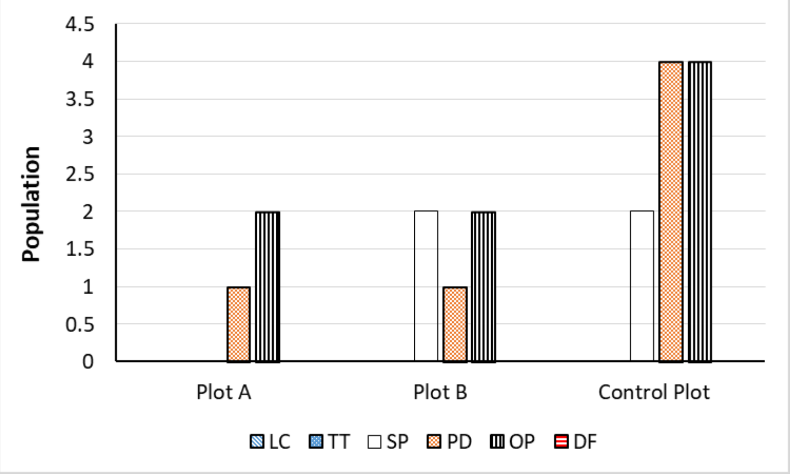

Figure 14. Type and number of predatory insects after third pesticide application (paddy 49 DAP)

From the results of observations during the spraying of citronella pesticide 4 times, it was found that there had been a decrease in the population of predatory insects in all observation plots. This population decline occurred gradually on land that had been exposed to pesticides (Figure 15). This proves that the application of citronella-based pesticide, also reduces the population of predatory insects in rice cultivation land. The nature of lemongrass containing secondary metabolics has been exposed to the tissues and environment of rice plants, thus disturbing insects. However, the citronella-based pesticide relationship may not be a direct one but a side effect of decreased insect pests. As the name suggests, predatory insects will hunt insect pests. If insect pests disappear from the rice plot, the predatory insects will also disappear.

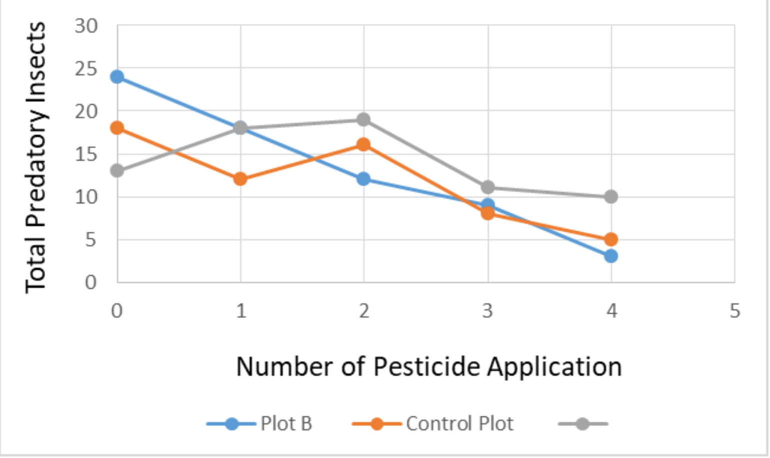

Figure 15. Progress of total number of predatory insect during pesticide application

Synthetic insecticides result in environmental pollution, pest resistance and residues problems; hence, focus is now given on plant based products for pest control. This study aims to assess the efficacy of two plant extracts, Citronella and Cinnamon against the two stored grain pests, Tribolium castaneum, Sitophilus oryzae, and the fruit fly Drosophila melanogaster under laboratory conditions. The extracts of two medicinal plants, Citronella and Cinnamon were applied separately at various concentrations (1, 2 and 3 mL/petri dish) on filter papers in petri dish containing the test insects. Mortality was recorded after one, two and three hours exposure. The three hours exposure at 3mL/dish caused 90-99% mortality. Mortality was largely dependent on exposure time and concentrations of both the extracts. A decrease in concentration resulted in low fatality and vice versa. Mortality in control and solvent batches was less than 10% in all the experiments. Our results confirm that the extracts of Citronella and Cinnamon are highly effective against Sitophilus oryzae, Tribolium castaneum and Drosophila melanogaster. These findings further suggest the need for molecular studies of these medicinal plants.

The positive impact of the decline in the insect pest population is the reduction in rice plants' damage due to pest attacks. This also happened to predatory insects (natural enemies) in experimental fields A and B. The population of predatory insects in fields A and B has decreased compared to control fields. However, this population decline was not very significant compared to control areas (Figure 15). Perhaps this is due to the unavailability of natural food for predatory insects, namely insect pests. This may be the cause of predatory insects to move to another place.

Chemical pesticides can control (kill) insect pests quickly. It is different from organic pesticides, which are repellent (repellent for insects) due to their odor. Its anti-oxidant properties cause the insects to dislike the plants or cause the plant tissue to taste bitter, thereby reducing the interest of insect pests to eat them and lay their eggs. Citronella contains essential oils that are toxic to nerves, reduce reproductive capacity, disrupt the nervous system, and disrupt the hormonal system. lemongrass (Citronella pesticides) contains saponins, flavonoids, polyphenols, alkaloids, and essential oils. The essential oil content of citronella is citral, citronellal, methylheptenone, dipentene, eugenol, metal ether, cadinene, geraniol, mirsena, nerol, farsenol, cadinol and limonene [25]. Citronella is a contact poison. Citronella causes dehydration in insects, resulting in a continuous loss of fluids. This condition causes the death of insect pests [16]. Also, geraniol and citronellal compounds can be used as organic fungicides. Eugenol compounds in Citronella play a role in inhibiting the growth and development of pathogenic fungi. The citronella content can control (decrease) the population of *Tribolium* sp, *Sitophilus* sp, *Callosobruchus* sp, *Meloidogyne* sp, and *Pseudomonas* sp.

The advantages of using organic pesticides from lemongrass (Citronella) are organic materials, so they do not cause toxic effects. Predatory insects (natural enemies) do not die when exposed to organic pesticides so that pest control can sustainably take place. The costs required are more affordable and friendly (leaving no residue) to air, soil, water, and production plant tissue (consumption plants).

4. Conclusion

Pests in rice plants include brown planthoppers, green grasshoppers, stink bugs, leaf flies, and armyworms. While, the predatory insects found consisted of *Lycosa* sp. (LC), spiders (SP), *Paederus* sp. (PD), *Ophionea* sp. (OP), dragonflies (DF), and *Tettragnatha* sp. (TT). The application of citronella-based pesticides can significantly reduce the insect pest population. During the 4 application of citronella pesticides, the population of insect pests decreased from 15 to 1 in plot A, down from 7 to 0 in Plot B. In the insect pest control plot it also decreased from 17 to 4. In general, the application of citronella-based pesticides was also related to declining predatory insect populations. However, the citronella-based pesticide relationship may be due to the side effect of decreased insect pests.

Acknowledgments

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Plant-based pesticide using citronella (*Cymbopogon nardus* L.) extract to control insect pests on rice plants

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Abstract. The main enemy in rice production is the attack of stinky bugs, brown planthoppers, grasshoppers, ladybugs, aphids, and others. This attack inhibits the growth of rice plants, thereby reducing production or even thwarting the harvest. Chemical pesticide application can reduce pests and diseases. However, the long-term use of chemical pesticides can disrupt the ecosystem. This study aims to study the application of plant-based pesticides to the presence of pests and predatory insects for rice plants. The research was begun with the preparation of citronella-based pesticide from citronella extract obtained by mixing citronella with water at a weight ratio of 2:1. The extract was mixed with water at a ratio of 1 liter for 50 ml of citronella extract. The application of the prepared pesticide was carried out by spraying 21-DAP (day after planting) rice plants at two plots sizing 400 m^2 each. The types and numbers of pests and predatory insects were observed before every pesticide application. Spraying was repeated weekly for the following 4 weeks. Results showed a decrease of insects in experimental plots A and B after the application of pesticides. After the fourth application, only one type of insect (green grasshopper) was found in plot A, and no insect was found in plot B. However, four types of insects were found in the control plot. The application of citronella-based pesticides is also related to the decrease of predatory insects' population.

1. Introduction

Rice is the main food crop to produce white rice, which is the Indonesian people's staple food. However, Indonesia still routinely imports rice from Thailand, Vietnam, and the Philippines to meet national rice needs. This is due to the low productivity of Indonesia's rice plants. One of the threats that threaten ice farmers is the pests' attack, especially insects or plant diseases. Pest/disease attacks are a common condition in rice cultivation. Pests and diseases can cause total harvesting failure. Insect pests use rice plants as a place to breed or a source of food by sucking nutrients from plant tissues, making holes in plants, damaging leaves, and so on. Some insect pests that stick to plants also carry diseases, so that the plants grow unoptimally [1-5].

In general, plant pest control is carried out by using chemical pesticides. However, the application of chemical pesticides in crop cultivation has an adverse impact on the surrounding environment. The prolonged and excessive use of chemicals increases resistance of insect pests such that chemical pesticides have little effect on pest control. In addition, application of chemical pesticides also disrupts the surrounding ecosystem [1, 6]. For example, chemical pesticides kill not only insect pests, but also predatory insects which are useful in insect pest control. Chemical pesticides also contaminate the soil, affecting their texture and ability to hold water, and inhibit the development of decomposer microorganisms [6-9]. This certainly affects the availability of nitrogen and other nutrients in the soil. For that reason, a solution is needed to overcome the problem of insect pests in rice plants which is able to sustainably prevent environmental damage. The use of plant-based pesticides is one of the solutions in controlling plant pests. The content of plant-based pesticides is not desired by insect pests. The results of research in 2008 demonstrated that plant-based pesticides inhibited the growth of insect pests and pathogens [10].

One of the popular plants that is easy to cultivate and can be used as a pesticide is citronella (*Cymbopogon nardus* L.). This plant contains citronellol which causes a distinctive odor and is disliked by insect pests. This odor can irritate and reduce the destructive power of insect pests to plant tissue. he research state that extract of citronella leaves at a concentration of 8.5% can cause a mortality of 66.67% and inhibits the eating activity of larvae by 82.66% [11]. Other study stated that the use of citronella and cloves extracts cause pest mortality more than 50% with average efficacy of 89.29% and the loss of pepper fruit yield decreased to 4.1% [12]. The other study found that citronella extract at a concentration of 0.2% caused 91.62% mortality of *Helopeltis antonii* by six hours after application [13]. A study found that citronella leaf extract can suppress larvae appetite, inhibit pupa and imago development, and interfere the imago's reproductive system in cabbage cultivation [14]. The citronella contains monterpenes (citronellal, limonene and geraniol) which provide plant defense from pests [15]. Field experiment showed that treatment of citronella oil at 2.0 mL/L significantly reduced fruit damage by *H. armigera* similar to the plots treated with spinosad at 0.06 kg ai/ha. Another study found that citronella oil application on chili pepper significantly decreased fruit damage by 72% [16].

The use of pesticides made from lemongrass is also able to reduce the population of insects that interfere with humans such as flies, cockroaches, fleas, and others [17,18]. This impact will inhibit the development of insect pests. Another study on non-chemical pest control was conducted using automatic insect pest trap [19,20]. The use of citronella extract can be combined with this trap to support the development of automatic pest trapping system. In order for the spraying of organic pesticides to be more precise, the spraying system can use a microcontroller as an information processor [21-24]. Automatic pest control system using organic pesticides (citronella pesticides) is one step towards precision agriculture to increase organic agricultural production in Indonesia.

This current study aims to determine the effect of pesticide application based on citronella extract on the types and numbers of insect pests and predatory insects in the cultivation of rice (Ciherang varieties). Application of citronella pesticides to rice plants using manual spraying using a knapsack. Through this research, it is expected to know the effectiveness of pesticides from citronella extract in controlling pests of rice plants.

2. Material and Method.

2.1. Place and materials

Figure 1. Citronella harvesting (left) and lemongrass (right) space.

The materials used were citronella (Figure 1) and water without a mixture of other ingredients. Citronella is very close to its cousin lemongrass because they belong to the same genus, namely Cymbopogon. But, they both have different scents. Citronella is used to produce essential oils, while lemongrass is used for flavoring food. Visually, citronella has slightly red bark, while the bark of lemongrass is green like the leaves.

This research was conducted at the experimental field for Food and Horticulture Crops Protection of Agriculture Service, Pringsewu Regency, Indonesia (Figure 1). The equipments used in this study included a set of tools for extracting citronella plants such as knives, blender, filters, containers, and so on. A knapsack sprayer was used for application of citronella extract to rice plants. A logbook and laptop was used to document the observation data.

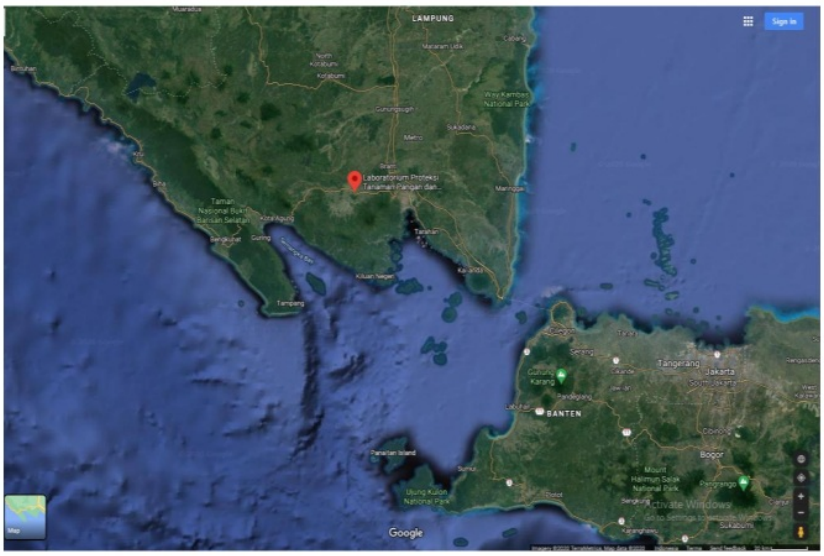

Figure 2. Location of field experiment (red baloon) on the Google map

2.2. Pesticide Preparation

The preparation of citronella-based pesticide was carried out at the Laboratory of Food and Horticulture Crops Protection. In this case, leaves and stems of citronella were used. These materials were wilted first by windrowed outside, and then cut into pieces about 2 cm in length. These chips were then crushed using a kitchen blender with the addition of tap water at a ratio of 1 : 2 (citronella : water). This maceration aims to expand the mass transfer surface of the solvent with raw materials (solids). The milled material is left for 2 hours so that the compounds in the citronella can adhere to the solvent. The next step is extraction to separate the solution from the solid using a filter. The separated solution is then stored in a tightly closed jerry can and then stored in a refrigerator until application time.

2.3. Pesticide Application

Pesticide application was carried out on rice plants that were 21 days old. The research field consisted of three plots, namely experimental plot A, experimental plot B and control plot. The area of each plot is 400 m^2 and each plot is separated by a bund. Citronella extract was diluted using water at a ratio of 50 ml of extract in one liter of water. Pesticide spraying was carried out using a knapsack sprayer on the rice plants. Spraying was carried out on experimental plots A and B at the same rate (10 liters per plot). Spraying was not carried out for control plot. Pesticide application was repeated on experimental fields A and B every week for the next 4 weeks.

Figure 3. Citronella harvesting (left) and lemongrass (right) space.

2.4. *Observation and Data Analysis*

The first stage in this research is to collect data on the types and populations of insect pests and predatory insects (natural enemies of pests) in the rice clumps in experimental plots A, B and control. Pests that may be present include brown planthoppers, green leafhoppers, white leafhoppers, green grasshoppers, stink bugs, green ladybugs, armyworms, and stem borer. Predatory insects include spiders, Lycosa, Tettragnatha, Phederus, Micraspis, Ophionea, parasitoids and dragonflies. The data is tabulated in graphical form to determine the pattern of decline each week. Observations were made every week before the spray application was carried out. Four students supervised by a field technician made this observation.

3. Result and Discussion

3.1. *Insect Pests*

Figure 4 shows the type and initial number of insect pests in each experimental plot before application of citronella-based pesticide. The types of insect pests in the three plots were the same and included brown planthoppers (BPH), green grasshoppers (GG), armyworms (AW), and stink bugs (SB). However, the number of each insect is different in each plot with plot B being the least. Overall, the control plot had the highest number of pests, namely 17 tails, followed by plot A 15 tails, and plot B 7 tails. According to its species, BPH was the most pest of 15 tails in total, followed by GG 12, SB 9, and AW 3 tails.

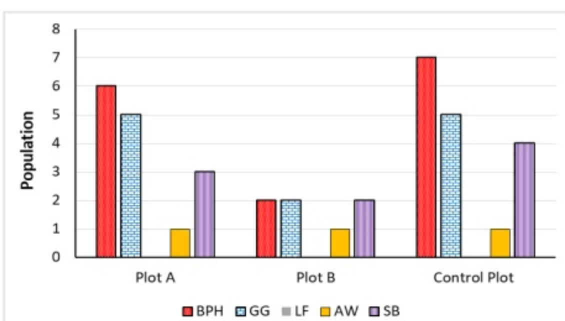

Figure 4. Type and number of insect pest before pesticide application (paddy 21 DAP)

Figure 5 shows the change in pest insect population after first application of citronella-based pesticide. Three types of insect pests still survive, namely the brown planthoppers, green grasshoppers, and stink bugs. Overall the number of insect pests is still 17 tails in the control plot, 13 in the A plot (2 less) and 11 in the B plot (4 more). Based on the type, BPH decreased by 4 (remained 11), GG was still 12 heads with a changed distribution, SB increased by 8 (become 17 heads), and AW disappeared from all experimental plots. However, a new insect pest was present in the control plot, namely leaf flies (LF). The results showed that the spraying of citronella-based pesticide in the first week had not had an effective impact on insect pest control, although the number of insect pests in control plots was still higher than in plots A and B.

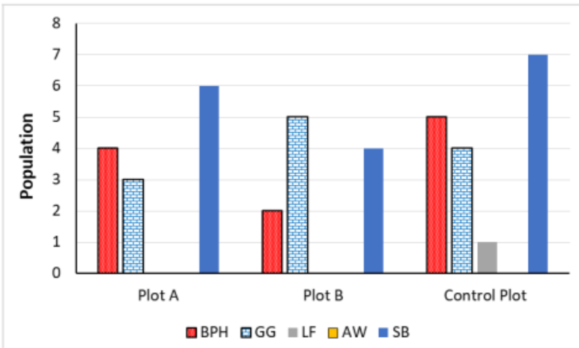

Figure 5. Type and number of insect pests after first application of pesticide (paddy 28 DAP)

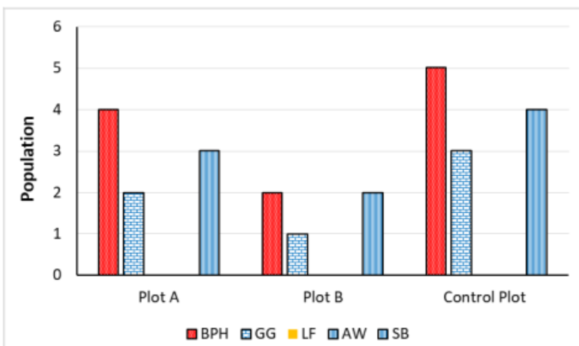

Figure 6. Type and number of insect pests after second application of pesticide (paddy 35 DAP)

In the second spraying when the rice plants were 35 DAP, the pesticide application began to show its effect. Figure 6 shows that there was a decrease in insect pests after the application of citronella-based pesticides. The results of the inspection showed that the types and number of insect pests began to decrease, especially on the application plots. Overall, there are only 3 types of pests left, namely BPH, GG, and SB. From the distribution, the control plot had the most insect pests, with a total of 12 animals, followed by the experimental plot A with 9 animals, and the plot B with only 5 animals. In terms of species, BPH was still the highest with a total of 11 tails, followed by SB 9 tails and GG 6 tails.

Observations after the third application of citronella-based pesticide (paddy age 42 DAP) showed increasingly significant results. In both experimental plots A and B, only one BPH was found (Figure 7), and no insect pests that were found in the previous week, such as green grasshoppers and stink bugs. On the other hand, in the control plot, the three types of insect pests still survive. Although the number was less than that of the previous week, there were still more BPH pests in the control plot as compared to those in the experimental plots.

The last application of pesticide was carried out when the rice plants were 49 DAP. Observations show the presence of green grasshoppers in experimental plot A, while in the experimental plot B there was no insect pest at all (Figure 8). In the BPH control plot, there were still 3 tails of BPH and one SB.

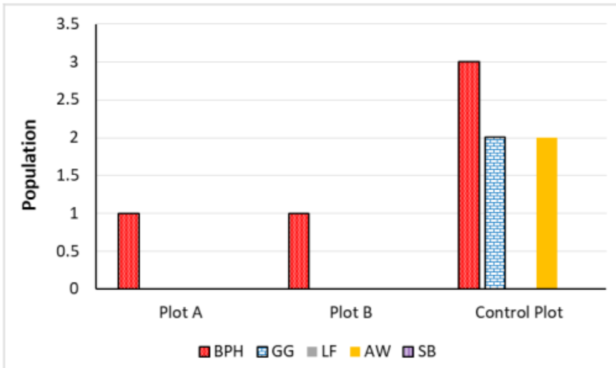

Figure 7. Type and number of insect pests after third application of pesticide (paddy 42 DAP)

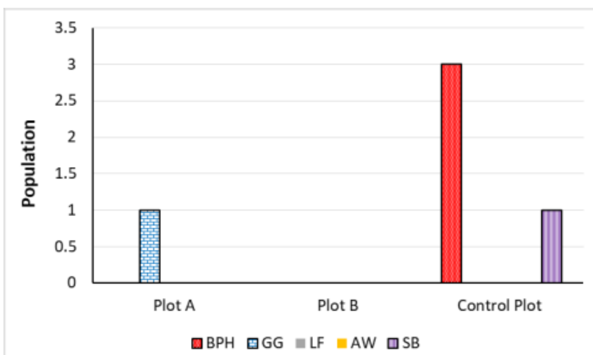

Figure 8. Type and number of insect pests after fourth application of pesticide (paddy 49 DAP)

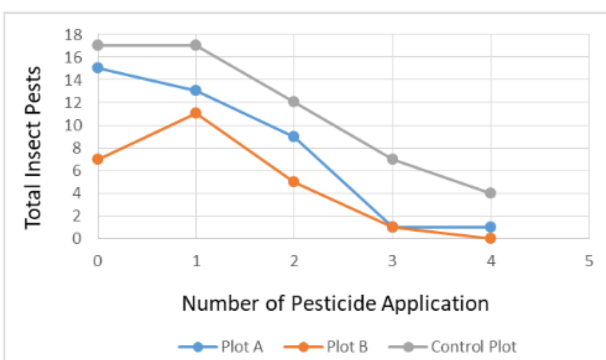

Figure 9. Progress of total number of insect pests during pesticide application

Figure 9 shows the progress of total insect pests population during five times application of citronella-based pesticide on the paddy field. These results concluded that the application of citronella-based pesticide can reduce the existence of insect pests in rice plants. The application of this pesticide can control even the very vicious pest like BPH. During the 4 application of citronella pesticide, the insect pest population decreased from 15 to 1 in plot A, down from 7 to 0 in Plot B. In the insect pest control plot it also decreased from 17 to 4. the impact of the experimental plot due to its adjacent location.

3.2. Predatory Insects
Predatory insects are beneficial as they are natural enemies for the insect pests. They are important to help control insect pests. Figure 10 shows the types and initial numbers of predatory insects found in the three experimental plots. Predatory insects found included *Lycosa* sp. (LC), spiders (SP), *Paederus* sp. (PD), *Ophionea* sp. (OP), dragonflies (DF), and *Tettragnatha* sp. (TT). The distribution and numbers of predatory insects were uneven in the experimental plots. For example, in plots A and B there was *Lycosa* sp. which was not found in the control plot. On the other hand, dragonflies are found in plot A and control plot, but not in plot B. Only three types of predatory insects were found in all the three plots, namely spiders, *Paederus* sp., and *Ophionea* sp. Based on the type, *Paederus* sp. were the most common, namely 23, followed by *Lycosa* sp. 12, *Ophionea* sp. 10, spider 7, dragonflies 2, and *Tettragnatha* sp. 1.

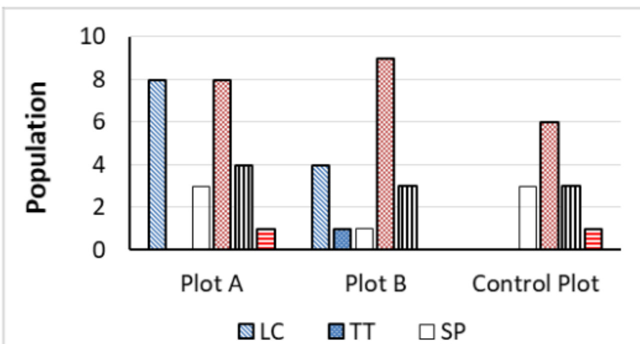

Figure 10. Type and number of predatory insects before pesticide application (paddy 21 DAP)

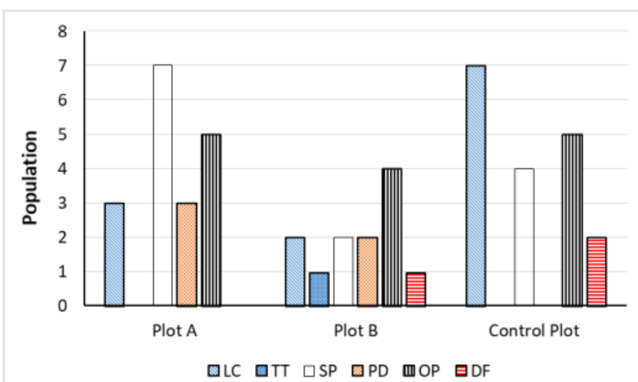

Figure 11. Type and number of predatory insects after first pesticide application (paddy 28 DAP)

Figure 11 shows the type and number of predatory insects after the first application of citronella-based pesticide. The types of predatory insects are still the same as those found before the application of pesticide, namely *Lycosa* sp., spiders, *Paederus* sp., *Ophionea* sp., *Tettragnatha* sp., and dragonflies. Based on the type, *Ophionea* sp. were the most common, namely 14, followed by spiders 13, *Lycosa* sp. 12, *Paederus* sp. 5, dragonflies 3, and *Tettragnatha* sp. 1.

Observations on 35 DAP (after the second spraying) showed that *Ophionea* sp. predatory insects predatory (Figure 12). Population of *Ophionea* sp. in fact, far exceeded the previous week's record (28 DAP). Other remaining predatory insects include spiders in all plots, *Tettragnatha* sp. only in the control plot, and *Paederus* sp. in plot B and control plot. Overall, the insect population in the control plot was higher than that in the experimental plot. This suggests that the application of citronella-based pesticide is also related to the decrease in the number and types of predatory insects in rice plants.

After the third pesticide application, only three types of predatory insects remained in the rice plots, namely spider, *Paederus* sp., and *Ophionea* sp. the population is not much different (Figure 13). These three types of insects also survived after the fourth pesticide application. However, this time the total population in the control plot is significantly more than the total population in experimental plot A or plot B. This supports the notion that the application of citronella-based pesticide is not only able to control insect pests but is also associated with a decrease in the number and types of predatory insects.

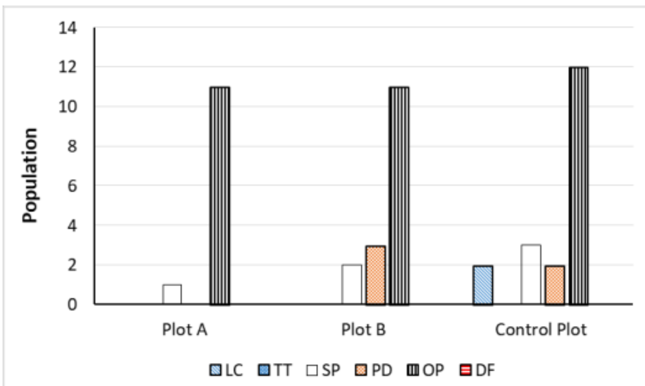

Figure 12. Type and number of predatory insects after second pesticide application (paddy 35 DAP)

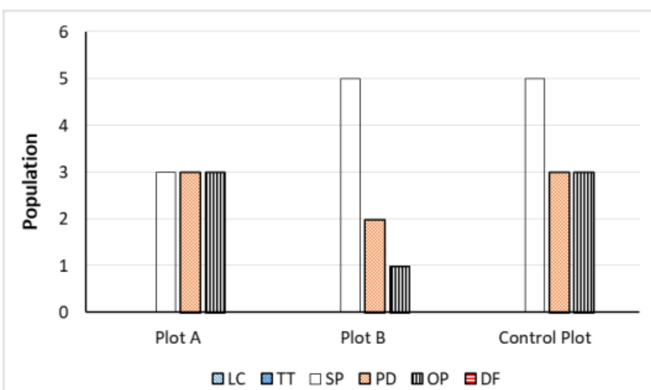

Figure 13. Type and number of predatory insects after third pesticide application (paddy 42 DAP)

Observations on 49 DAP have shown that there are still predatory insects in experimental plot A and experimental plot B. The number of predatory insects in plot A is 3 and plot B is 5. In the control plot, the number of predatory insects is 10 (Figure 14). The reduction in predatory insects in plot A and plot B is due to lack of food, namely insect pests, due to the influence of citronella pesticides.

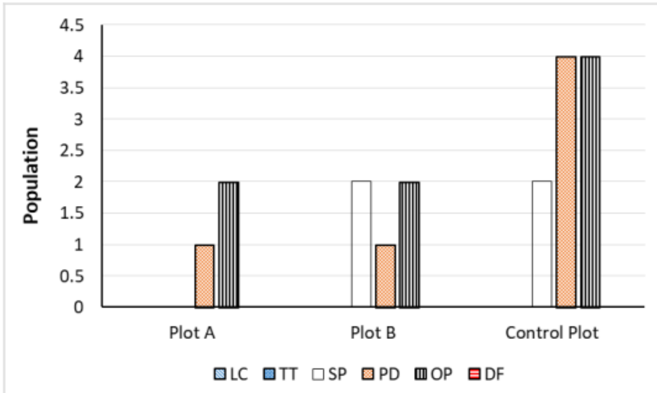

Figure 14. Type and number of predatory insects after third pesticide application (paddy 49 DAP)

From the results of observations during the spraying of citronella pesticide 4 times, it was found that there had been a decrease in the population of predatory insects in all observation plots. This population decline occurred gradually on land that had been exposed to pesticides (Figure 15). This proves that the application of citronella-based pesticide, also reduces the population of predatory insects in rice cultivation land. The nature of lemongrass containing secondary metabolics has been exposed to the tissues and environment of rice plants, thus disturbing insects. However, the citronella-based pesticide relationship may not be a direct one but a side effect of decreased insect pests. As the name suggests, predatory insects will hunt insect pests. If insect pests disappear from the rice plot, the predatory insects will also disappear.

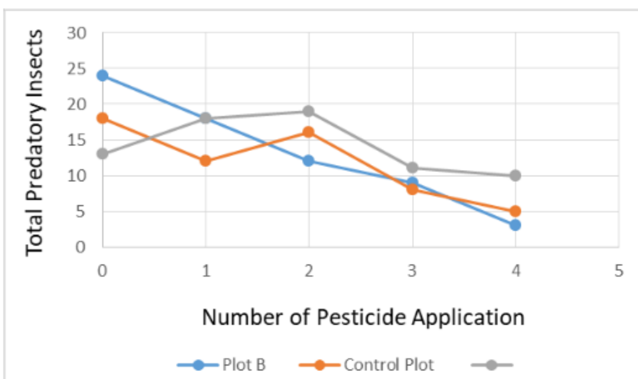

Figure 15. Progress of total number of predatory insect during pesticide application

Synthetic insecticides result in environmental pollution, pest resistance and residues problems; hence, focus is now given on plant based products for pest control. This study aims to assess the efficacy of two plant extracts, Citronella and Cinnamon against the two stored grain pests, Tribolium castaneum, Sitophilus oryzae, and the fruit fly Drosophila melanogaster under laboratory conditions. The extracts of two medicinal plants, Citronella and Cinnamon were applied separately at various concentrations (1, 2 and 3 mL/petri dish) on filter papers in petri dish containing the test insects. Mortality was recorded after one, two and three hours exposure. The three hours exposure at 3mL/dish caused 90-99% mortality. Mortality was largely dependent on exposure time and concentrations of both the extracts. A decrease in concentration resulted in low fatality and vice versa. Mortality in control and solvent batches was less than 10% in all the experiments. Our results confirm that the extracts of Citronella and Cinnamon are highly effective against Sitophilus oryzae, Tribolium castaneum and Drosophila melanogaster. These findings further suggest the need for molecular studies of these medicinal plants.

The positive impact of the decline in the insect pest population is the reduction in rice plants' damage due to pest attacks. This also happened to predatory insects (natural enemies) in experimental fields A and B. The population of predatory insects in fields A and B has decreased compared to control fields. However, this population decline was not very significant compared to control areas (Figure 15). Perhaps this is due to the unavailability of natural food for predatory insects, namely insect pests. This may be the cause of predatory insects to move to another place.

Chemical pesticides can control (kill) insect pests quickly. It is different from organic pesticides, which are repellent (repellent for insects) due to their odor. Its anti-oxidant properties cause the insects to dislike the plants or cause the plant tissue to taste bitter, thereby reducing the interest of insect pests to eat them and lay their eggs. Citronella contains essential oils that are toxic to nerves, reduce reproductive capacity, disrupt the nervous system, and disrupt the hormonal system. lemongrass (Citronella pesticides) contains saponins, flavonoids, polyphenols, alkaloids, and essential oils. The essential oil content of citronella is citral, citronellal, methylheptenone, dipentene, eugenol, metal ether, cadinene, geraniol, mirsena, nerol, farsenol, cadinol and limonene [25]. Citronella is a contact poison. Citronella causes dehydration in insects, resulting in a continuous loss of fluids. This condition causes the death of insect pests [16]. Also, geraniol and citronellal compounds can be used as organic fungicides. Eugenol compounds in Citronella play a role in inhibiting the growth and development of pathogenic fungi. The citronella content can control (decrease) the population of *Tribolium* sp, *Sitophilus* sp, *Callosobruchus* sp, *Meloidogyne* sp, and *Pseudomonas* sp.

The advantages of using organic pesticides from lemongrass (Citronella) are organic materials, so they do not cause toxic effects. Predatory insects (natural enemies) do not die when exposed to organic pesticides so that pest control can sustainably take place. The costs required are more affordable and friendly (leaving no residue) to air, soil, water, and production plant tissue (consumption plants).

4. Conclusion

Pests in rice plants include brown planthoppers, green grasshoppers, stink bugs, leaf flies, and armyworms. While, the predatory insects found consisted of *Lycosa* sp. (LC), spiders (SP), *Paederus* sp. (PD), *Ophionea* sp. (OP), dragonflies (DF), and *Tettragnatha* sp. (TT). The application of citronella-based pesticides can significantly reduce the insect pest population. During the 4 application of citronella pesticides, the population of insect pests decreased from 15 to 1 in plot A, down from 7 to 0 in Plot B. In the insect pest control plot it also decreased from 17 to 4. In general, the application of citronella-based pesticides was also related to declining predatory insect populations. However, the citronella-based pesticide relationship may be due to the side effect of decreased insect pests.

Acknowledgments

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