Traditional rice field rat (Rattus-rattus brevicaudatus) control with “lateng ngiu” (Laportea stimulans) leaf and its implementation in irrigated rice field ecosystem

by Dewa Nyoman Oka, Herry M Sumampouw, Mokosuli Yermia Semuel

International Journal of Biology Research
ISSN: 2455-6548
Impact Factor: RJIF 5.22
www.biologyjournal.in
Volume 3; Issue 1; January 2018; Page No. 281-286

Traditional rice field rat (*Rattus-rattus brevicaudatus*) control with "*lateng ngiu*" (*Laportea stimulans*) leaf and its implementation in irrigated rice field ecosystem

[1] **Dewa Nyoman Oka,** [2] **Herry M Sumampouw,** [3] **Mokosuli Yermia Semuel**
[1] Biology Education Department, Institute of Teaching Training and Education Saraswati Tabanan, Bali, Indonesia
[2] Biology Department, State University of Menado, North Sulawesi, Indonesia
[3] Biology Department, State University of Manado, North Sulawesi, Indonesia

Abstract
This research aims at knowing whether (1) *lateng ngiu* leaf (*Laportea stimulans)* can be used as traditional rice pest control on irrigated rice field; (2) the implementation of this practicum model in the learning process with irrigated rice field ecosystem materials can improve learning outcomes. This research applied complete randomized design. Each rice field rat (*Rattus-rattus brevicaudatus)* used as a sample was given a portion of cooked rice mixed with 8 doses of *lateng ngiu* leaf (2.5, 5, 7.5, 10, 12.5, 15, 17.5 and 20 grams). The frequency of replicate is four times making the total number of samples as many as 32 rats. All subjects carried out a practicum after discussing the theories. Based on the data analysis, it could be concluded that (1) *lateng ngiu* leaf could be used as traditional rice pest control on irrigated rice field, where 10-gram dose of *lateng ngiu* leaf was the most effective and efficient one; (2) the implementation of this practicum model in the learning process with irrigated rice field ecosystem materials could improve learning outcomes.

Keywords: *lateng ngiu* leaf, rice field rat, ecosystem learning

1. Introduction

Rice field rats are rodent, which is the largest group in the mammals. This group has 2,000 species or 40% of 5,000 species in mammal. In Indonesia there are 164 species of rats and more than 25 species of rats among them are causing damage to various types of plant. There are only 13 species of rats that are pests in agricultural areas one of which is rice field rat (*Rattus-rattus brevicaudatus*).

Rice field rats can cause damage to rice crops starting from the time of the rice seedlings until the rice is ready to be harvested. They even attack the rice in the storage warehouse. The damage caused by rice field rats in Asian countries reaches 10 - 15% every year. In Indonesia the area of rat attack each year reaches more than 100,000 ha on average. The losses due to rice field rats can be much greater because the damage on the nursery and vegetative stages is not included in the reported losses (Sudarmaji, 2004).

Rice field rats can also damage various agricultural commodities such as crops, holticulture, and plantation crops. They attack not only irrigated rice field but also the plants on dry land and swamp. Therefore, this kind of rat is known as cross agroecosystem pest. Sudarmaji (2004) found that the damage caused by rats attack was different in each stage/stadium of paddy. The most severe damage was found in stadium *bunting* ("pregnant" of paddy).

Rice field rat population increases if there is enough food and it decreases if the food is not sufficient. Rats are poliesterous animals that can bear offspring anytime in a year disregarding seasonal factors. They can give birth to 3 until 12 rats, and when the food is sufficient they can give birth to 16 to 18 rats. When the food is abundant, they eat as much as they possibly could to pile up fat in their body. They do this to survive in lacking-food time by making use of their fat reserves. Rats are cunning vertebrate, destructive, and able to bear offsprings quickly. These three factors make them difficult to control. A colony that consists of 100 rats can cause damage by eating up more than one ton of food in a year (Priyambodo, 2003) [4].

Rice field rats often migrate one until two kilometers away from their previous location. They migrate to settlements, warehouses, and areas surrounding the rice fields where food is sufficient. Rats rely on the food they could find to survive, and they will move to new environment when there is no more food or when the food is becoming scarce. Their mobility is very high and within the radius of 700 meters. When food is found in a habitat, then a 10-meter-radius area is a targeted point or a territory of rats. By the time the food is scarce rats have already found a new desired habitat within their mobility area so that they will never lack of food (Priyambodo, 2003) [4].

Rice field rat control in irrigated rice fields in Bali is mostly done chemically by using rodentisida, which is classified as acute toxin and anticoagulant. Acute toxin can kill the rats instantly at the location where they eat prey so that this can give a kind of shock teraphy to these pests. While anticoagulant rodenticides can cause mice to die five days after consuming the prey with a right dose so as not to cause trap-shyness. However, the type of anticoagulant rodenticide has a negative secondary effect on rat predators, which are generally coming from mammals, birds and reptiles. The predators from mammal are among other things ferrets, cats and dogs, the predators from bird are owls and birds of *kowak* and the predators form reptile are rat snake, cobra, and python.

The death of these rat predators cause a disturbance of the balance of irrigated rice field ecosystem. If the ecosystem is disturbed, human will suffer from unfavorable consequences. Therefore, it is necessary to find a way to control the rice field rats, which is relatively as effectiveness as using rodentisida, accessible, relatively cheap, practical, and does not significantly bring harm ecosystem especially irrigated rice field ecosystem.

Lateng ngiu is a perennial (annual) plant that breeds with rhizoma to form clumps. Its stem is about 1-2 metres. The leaves, stems and flowers of nettle are covered by fine hair. That fine hair is an epidermal derivative that is often called a trichomata. Trichomata forms diverse structures such as hair, scales, hair glands, bulges, etc. The fine hair on Lateng Ngiu leaves is called *rambut gatal* (itchy hair). This itchy hair has a single cell with a sac-shaped base and a pointed tip (Sudjiono, 2009) [6]. The trunk can be either branched or not and grow upright. The leaf sheet is elliptical with dimension of 6-20 x 2-13 cm. The edges of the leaves are serrated and pointed. Besides vegetative way (using rhizoma), *lateng ngiu* can also bred in a generative way, that is by seed production.

Inside the trichomata there are chemicals that can cause rashes, itching, and stinging. *Lateng ngiu* leaf is also known to be able to produce toxic effects to the central and peripheral nervous system, cardiovascular system, and respiratory system (dyspnea or cyanosis) (Peterson, 2006) [3]. The clinical signs and prognosis may include salivation, vomiting, arrhythmias, trembling, ataxia, weakness, depression, dyspnea, cyanosis, and collapse. According to Peterson and Talcott (2006) [3] the toxin components of the nettle plant are acetylcholine and histamine concentrated in the itchy hair of the plant.

Based on the researcher's 15–year experience of teaching capita selecta biology in biology education study program of Institute of Teacher Training and Education Sarawati Tabanan, lack of practicum included ecosystem materials, particularly of utilizing local natural resource like *lateng ngiu* (many found in Bali), has caused most of the students to get graduation score averagely 5.95. With the implementation of this practicum, it is expected that the students can get higher score.

In accordance with the explanation posed above, the aims of this research are then to know whether (1) *lateng ngiu* leaf (*Laportea stimulans*) could be used as traditional rice pest control on irrigated rice field, where 10-gram dose of lateng ngiu leaf was the most effective and efficient one; (2) the implementation of this practicum model in the learning process with irrigated rice field ecosystem materials could improve learning outcomes.

2. Method

The research design used was complete randomized design. The samples were taken from the population of rats on irrigated rice fields in Subak Batu Angsut, Mambal village, Abiansemal sub-regency, Badung regency, Bali province. Before being selected as samples of the rats were quarantined for three weeks. On the twenty-second day of the qurantine the authors selected 32 rats from 57 qurantined rats to be used as the samples. The rats that were used as the samples were 13.85 grams to 15.29 grams and 14 to 15 centimeters long. Each rice field rat was given a treatment of white rice mixed with different dose of *lateng ngiu* leaf. The doses given were 2.5 grams, 5 grams, 7.5 grams, 10 grams, 12.5 grams, 15 grams, 17.5 grams and the 20 grams. The eight doses were repeated four times. The treatment was performed to see the effect of the doses given on how fast the rats died. The results of the research were analyzed with descriptive analysis and statistical analysis methods. Descriptive analysis was conducted to illustrate the results of the research in tables and graphs. Statistical analysis was done depending on the results of normality test data. If the death time data of rats obtained is normally distributed, then the analysis is done by one-way anava statistic test. If the data is not normally distributed, then the statistical test used is Kruskal Wallis test. The specified significance level is 0.05. While the number of subjects (students) who contract ecosystem courses there are 11. All subjects carry out the practicum after discussing the theory.

3. Results and Discussion

Based on the collected data, the finding can be presented as follows:

Table 1: The Death Time of Rats Based on "*Lateng Ngiu*" Doses

Doses/Gram	The Repeat	Death Time /Hour
2,5	1	348
	2	312
	3	321
	4	360
5	1	351
	2	327
	3	309
	4	309
7,5	1	225
	2	216
	3	216
	4	234
10	1	126
	2	138
	3	129
	4	150
12,5	1	108
	2	111
	3	126
	4	135
15	1	117
	2	108
	3	129
	4	129
17,5	1	132
	2	117
	3	111
	4	126
20	1	129
	2	108
	3	114
	4	135

Based on table 1, the average death time of rats with the doses of lateng ngiu leaf can be clearly shown.

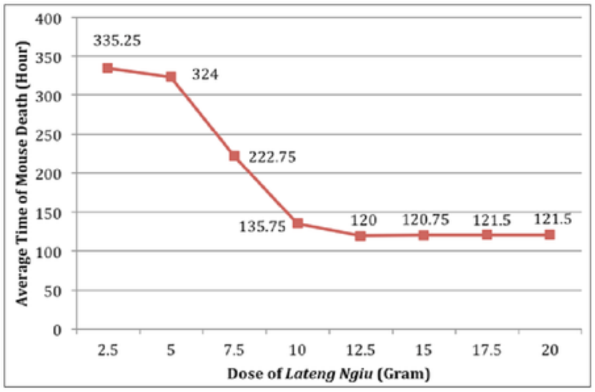

Fig 1: The death time of rats per hour per gram of "*Lateng Ngiu*" leaf doses

Based on table 1 and figure 1, the difference between the prescribed doses of *lateng ngiu* and the death time of rats is visible. An increase in the number of doses from 2.5 to 10 grams appears to have a very sharp effect on the acceleration of rat death time from 335.35 hours to 135.75 hours. However, an increase in doses from 10 grams to 20 grams, has been seen not so real in reducing the rats death time. Because there is a difference in the rats' death time based on different doses prescription, hence, statistical tests are conducted to answer whether the differences differ significantly.
The statistical test begins with the normality test of data distribution of research results. The normality test results based on the output of spss presented in Table 2.

Tabel 2: The Results of Normality Test

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	DF	Sig.	Statistic	DF	Sig.
Death TIme	,303	32	,000	,772	32	,000

a. Lilliefors Significance Correction

Based on table 2, obtained for both tests sig. or nipai p = 0,000. The value is smaller than the specified significance level of 0.05. So it can be concluded the data is not normally distributed. Therefore, the statistical test used is Kruskan Wallis test. After conducting test, the spss output was obtained as shown in Table 3.

Table 3: Summary of Kruskal Wallis Test

Test Statistics [a,b]	
	The Detah Time of Rats
Chi-Square	24,597
Df	7
Asymp. Sig.	,001

a. Kruskal Wallis Test
b. Grouping Variable: Doses of *lateng ngiu* leaf

Based on table 3, obtained the calculation of H (Chi-Square) of 24.597 with sig./ p = 0.001. This value is much smaller than the specified significance level of 0.05. Thus it can be concluded that there is a significant difference between the dose given to the rats death time. Due to the significant differences, it is necessary to look for more details between the doses which differ significantly in the rate of killing rice field rats. Therefore, further testing is done with the help of Mann Whitney Test for each of the 2 types of doses administered. Based on spss calculation results then it can be summarized in Table 4.

Table 4: Asymp. Sig. (2-tailed) from mann whitney test in each dose treatment

Trearment/Doses										
			1	2	3	4	5	6	7	8
			2,5	5	7,5	10	12,5	15	17,5	20
Treatment/ Doses	1	2.5		0,384	0,020	0,021	0,021	0,020	0,021	0,021
	2	5			0,019	0,020	0,020	0,019	0,020	0,020
	3	7,5				0,020	0,020	0,019	0,020	0,020
	4	10					0,110	0,139	0,110	0,191
	5	12,5						0,884	0,770	0,770
	6	15							0,884	0,882
	7	17,5								1,000
	8	20								
Note		= differ significantly								
		= not differ significantly								

Based on statistical results of further test summarized in table 4, it is seen that there are 17 pairs of doses differ significantly in increasing the speed of rice field rats' death time. This means that an increase in the number of doses of *lateng ngiu* leaf from 2.5 to 10 gives a significantly different effect of rats' death rate. If the dose mass is added from 10 to 20 grams, then it is seen that it does not give the rate effect difference of rats death. In other words, the death time of rats with doses above 10 grams is relatively constant.
For the data of student learning result, the conducted test has been tested (validation, reliability, difficulty level and power of difference) obtained average value of 7.05 (there is an average increase 1,1)

4. Discussion

Based on the analysis with Kruskal Wallis test and Mann Whitney's further test showed that the increase of the dose of *lateng ngiu* leaf from 2.5 grams to 10 grams in 10 grams of rice gave effect to the death time of rats that differed significantly. If the dose of *lateng ngiu* leaf was increased from 10 grams to 20 grams, then it was seen that it did not give significant difference of rats' death acceleration effect. In other words, the rats' death time with the dose above 10 grams was relatively constant.
According to Peterson and Talcott (2006) [3] the toxin component of the nettle plant is acetyl choline and histamine concentrated on the itchy hair of the plant. Histamine can cause smooth muscle contraction that is in the bronchus and intestines, but it causes strong relaxation in smooth muscle of small blood vessels, resulting in increased permeability and pruritus. In addition, histamine is a strong stimulant of gastric acid secretion and other exocrine glands such as the respiratory mucosa gland. As a result of vasodilation in small blood vessels, then rashes and heat flushed in the face, peripheral resistance decreased so that blood pressure decreased (hypotension). Capillary permeability increases so

that proteins and plasma fluid go out into the extracellular space and cause edema (Gunawijaya, 2017) [2]

Acetylcholine (ACh) is one of the neurotransmitters. Neurotransmitters are the substances of nerve cells used to communicate with other nerve cells. Substances known as neurotransmitters in the various synapses found in the mammalian brain are composed of a very heterogeneous mixture. Starting from two small molecules of amino acid glycine to a large peptide composed of 30 to 40 amino acid covalent bonds, and these neurotransmitters are classified according to their chemical structure (Sukohar, 2014). Once released, the neurotransmitter will only be effective when interacting with its receptor on the target cell. The specificity of this neuronal interaction is determined by the type of transmitter being released and the type of receptor. Receptors are devices that can detect information that goes into cells. The receptor has been known to have a bonding site with a rigid structure. Receptors usually bind to only one type of transmitter, although natural substances and other syntheses can bind to high affinity. However, each type of transmitter can activate more than one receptor type.

Acetylcholine is one of the neurotransmitters that play a role in the functioning of the autonomic nervous system. The autonomic nervous system is an involuntary system that serves to control the needs and activities of the body everyday without the influence of our consciousness. This system primarily plays a role in the visceral motor nerve cells that innervate the smooth muscles of internal organs, heart muscle and exocrine glands. Preganglionic fibers ending in the medulla adrenalis, autonomic ganglia (sympathetic and parasympathetic), and post-ganglionic fibers of the parasympathetic division use ACh as a neurotransmitter. This ACh-mediated transmission is called the cholinergic nerve and Ach is called the cholinergic neuron. ACh is synthesized in the cytoplasm of Acetyl-CoA and Choline through catalysis by the choline acetyltransferase (ChAT) enzyme. The release of the transmitter depends on the extracellular Ca2 + level.

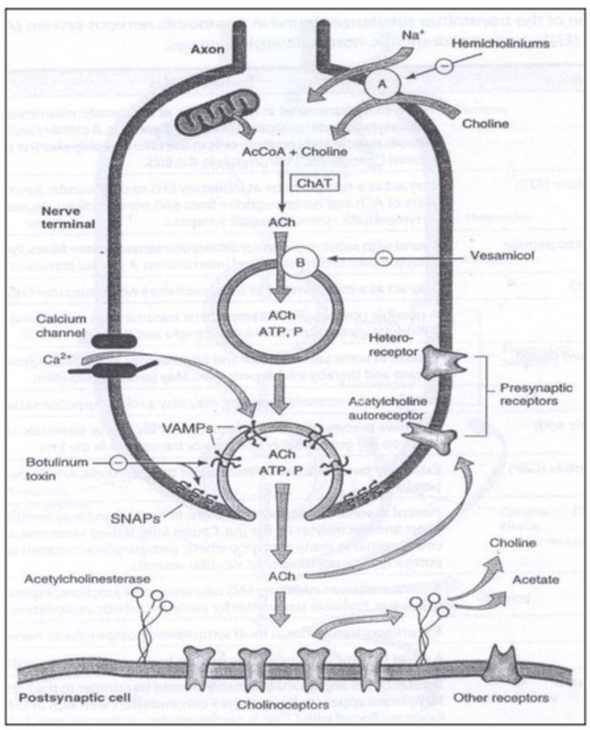

Fig 2: Sinthesis and the release of acetylcholine from neuron cholinergic (Sukohar, 2014).

Upon exiting the presynaptic terminal, the ACh molecule will bind to the receptor and activate the ACh receptor (cholinoceptor). The active receptors will have an effect on several organs such as (1) causing relaxation of the heart muscle, vasodilation (dilation) of blood vessels and the decrease of blood pressure; (2) bronchial muscle contraction resulting in narrowing of the bronchus channel and stimulates the working of the gland so that secretion increases (much slime on bronchus).

The above description is clear that both histamine and acetylcholine can cause the decrease of blood pressure (hypotension). Blood pressure is produced when the heart pumps blood throughout the blood vessels in the body. When blood flows through the arteries, the blood will put pressure on the walls of the arteries. That pressure is considered as a measure of the blood flow strength or called blood pressure. If the blood pressure is too low then the amount of blood that flows will be limited. The limited amount of blood that crosses means the less amount of food that can be transported by blood to reach vital organs. The low amount of food substances that reach the vital organs will inhibit the growth and development of cells forming these vital organs. Low blood pressure can also cause very rapid and irregular breathing. This is due to the condition in which the heart beats faster, so the body responds by making breathing faster. Histamine and acetylcholine also cause contraction of the bronchial muscles and stimulate the work of the secretion gland resulting in a narrowing of the bronchial tubes and the presence of mucus along the bronchus channel. The narrowing and the presence of lot of slime in the bronchus channel will disrupt the respiratory process and reduce the amount of oxygen that can enter the lungs. This means the amount of oxygen that goes into the blood circulation system is also reduced. Low levels of oxygen will cause disruption of various cell metabolisms in these vital organs. The inhibited growth and development as well as disruption of this cell metabolism will damage the up-making cells of vital organs and eventually will damage the organs and in a certain period of time causes death of rice field rats.

The doses of *lateng ngiu* leaf from 2.5 gram to 10 gram gives a significantly different effect of rats death rate. Where the higher the dose of *lateng ngiu* leaves is, the faster rice field rats die. Dose is the amount of a chemical that gains access to the body. A 16th-century physician and chemist, Philipus Aureolus Theophrastus Bombastus von Hohenheim-Paracelsus, mentions that all substances are poison; nothing is not poison. The exact dose is the only thing that distinguishes toxins from drugs. The addition of doses of *lateng ngiu* leaf in rice field rats food means more doses of histamine and acetylcholine that enter into the body of those rats. The increased doses of histamine and acetylcholine that enter the body of rice field rats will have an impact on the lower blood pressure, the narrower blood vessels and more mucus in the bronchial channel. It means less blood amount flows and less oxygen that can be supplied to the vital organs of the rats. More limited amount of food and oxygen that can be supplied to the organs of the rice field rats, the faster destruction of up-making cells of vital organs will accelerate and ultimately will accelerate the destruction of organs and speed up the time of rats' death.

The addition of *lateng ngiu* leaf doses amount from 10 grams to 20 grams, it, then, was not seen giving a significant difference of rats' death rate effect. In other words, the speed of rats' death uses doses above 10 grams is relatively constant. This happens because in 10 grams of *lateng ngiu* dose and 10 grams of rice has happened things as follows (1) the rat's blood pressure is already at its lowest point, so it cannot be lowered anymore; (2) stimulation on mucosa gland of bronchus channel has reached the maximum threshold so that the secretion of the mucosal gland does not increase; (3) the narrowing of bronchus channel has been maximal.

The increasing number of the students' learning outcomes in the subjects of *capita* selecta biology with ecosystem material practice has increased 1.1 averagely. This is because when students carry out practicum activities are required to prepare their own practice guide, able to collect data, arrange hypotheses, carry out the practice in accordance with the guidelines, discuss and conclude it. Students in practicum are faced with problem solutions. Being able to practice their high-level thinking skills. This skill is highly required for the sake of their learning success. The practicum characteristics which is carried out in a project pattern, with various concentrations. With this patterned practicum activities students can find their own concepts in building contructivism. Corebima in Sumamampouw (2011) stated that practicum implementation is a complementary activity and if conducted with the principle of contructivism, the level of accuracy and detailed observation highly determines the success in uncovering the observed phenomenon and arrange it into a concept. Ecosystem practice characteristics are also eligible to meet aspects of process skills.

The conducted practicum is a learning approach oriented on process, in the form of skills owned by scientists. Furthermore it is said that the process of science is mental and physical skills to dig information, process it in various ways and use it to explain natural phenomena and solve problems. For example, scientists can observe, measure, clarify, infer, predict, hypothesize, investigate, interpret data, and communicate it. Competence in using these skills provides a learning experience for students to be able to apply knowledge not only to ecosystem material but also to other areas especially in daily life.

This practicum learning requires students' independence in following the ecosystem material. By implementing practicum, it can minimize the gap between theory and reality in nature. Practicum in the ecosystem ensures the meaningful learning sustainability. The learning has a big chance and is meaningful both cognitive, affective and psychomotor. Practicum learning is actually related to organizing, because it must have an organization at any time, balance and a number of knowledge that has been understood related to the discussed matter. This knowledge organization is hereinafter called the cognitive structure and is believed that this structure, determining students to confront the new concept, so the meaning of something new can be found that there is an existing relationship about the previous understanding.

5. Conclusion

The *lateng ngiu* leaf (*Laportea stimulans*) can be used as a traditional control of rats in irrigated rice fields, where a dose of 10 grams *of lateng ngiu* leaf is the most effective and efficient dose. In the implementation of practical learning of ecosystem material, it can improve student learning outcomes.

6. References

1. Fragoso LR, Esparza JR, Burchiel SW, Ruiz DH, Torres E. Risk and benefits of commonly used herbal medicines in Mexico. Toxicology and Applied Pharmacology. 2008; (227):128-135.
2. Gunawijaya FA. *Manfaat Penggunaan Antihistamin Generasi Ketiga*. Jakarta: Fakultas Kedokteran Universitas Trisakti. 2017.
3. Peterson ME, Talcott PA. Small Animal Toxicology. Ed 2. Elsevier Saunders. Amerika Serikat. 2006.
4. Priyambod S. Pengendalian Hama Tikus. Jakarta: Penebar Swadaya. 2003.
5. Sudarmaji dkk. Karakteristik Perkembangbiakan Tikus Sawah Irigasi dan Implementasinya untuk pengendalian. Penelitian Pertanian Tanaman Pangan. 2007; 26(2):93-99
6. Sudjiono P, Joko T, dan Hadisusanto S. Biologi Kelas XI SMA. Jakarta: Depertemen Pendidikan Nasional. 2009.
7. Sukohar A. Buku Ajar Farmakologi – Asetilkolin dan

Nore Efinefrin. Lampung: Fakultas Kedokteran Universitas. Lampung. 2014.
8. Sumampouw HM. Pembelajaran Biologi Dengan Strategi RQA Berbasis Metakognitif, Berpikir Tingkat Tinggi dan Keterampilan Proses. Yogyakarta: Tita Suryap. 2012.

Traditional rice field rat (Rattus-rattus brevicaudatus) control with "lateng ngiu" (Laportea stimulans) leaf and its implementation in irrigated rice field ecosystem

ORIGINALITY REPORT

12%	10%	1%	3%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	www.biologyjournal.in Internet Source	8%
2	Submitted to City and Islington College, London Student Paper	1%
3	digilib.unimed.ac.id Internet Source	1%
4	cmscollege.ac.in Internet Source	<1%
5	Submitted to Dokuz Eylul Universitesi Student Paper	<1%
6	Submitted to Kenmore State High School Student Paper	<1%
7	Submitted to University of Huddersfield Student Paper	<1%
8	asee.org Internet Source	<1%

9	repository.up.ac.za Internet Source	<1%
10	Submitted to University of Newcastle Student Paper	<1%
11	Submitted to Universitas Sebelas Maret Student Paper	<1%
12	link.springer.com Internet Source	<1%
13	I N S Arida, P P K Wiguna, I W Narka, N K O Febrianti. "Development Planning of Tourist Village Using Participatory Mapping (Case study: Mambal Village, Badung Regency, Indonesia)", IOP Conference Series: Earth and Environmental Science, 2017 Publication	<1%
14	Insar Damopolii, Jan Hendriek Nunaki, Elya Nusantari, Novri Youla Kandowangko. "Integrating local resources into inquiry-based teaching materials to training students' science process skills", AIP Publishing, 2019 Publication	<1%
15	Submitted to University of Wollongong Student Paper	<1%

Exclude quotes	Off	Exclude matches	Off
Exclude bibliography	On		

Traditional rice field rat (Rattus-rattus brevicaudatus) control with “lateng ngiu” (Laportea stimulans) leaf and its implementation in irrigated rice field ecosystem

GRADEMARK REPORT

FINAL GRADE

/0

GENERAL COMMENTS

Instructor

PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6