S -01

INFLUENCE OF FREQUENCY NATURAL GRASSHOPPERS SOUND TO LEAF CHLOROPHYLL CONTENT TEAK (*TECTONA GRANDIS*) AND PEANUT (*ARACHIS HYPOGAEA*) AS NATURAL SCIENCE LEARNING RESOURCES

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Abstract

The results of research used for natural science learning resources are still seldom. This study focuses on use of research results especially on influence of natural frequency of grasshoppers on leaf chlorophyll content as Natural Science Learning Resources. This study based on the data from research "Increasing of Food Tenacity of Infertile Land Farmers through Hard Plant Fortification and Horticulture by Using Natural Frequency of Grasshoppers as Stimulator for Growth and Increasing of Crop Products". This study was conducted descriptively by basing on materials existing in KTSP and Curriculum 2013 for junior high school level for lesson of natural sciences

If viewed from process and products of study, selection of use of study results as learning resources, and application of study results to materials, this study can be used for alternative to natural science learning resources in junior high school for some learning sub-materials such as functional structure of plants and sound. The results of study can be increased as materials.

Keywords: *frequency, grasshoppers, leaf chlorophyll, natural science resource*.

Introduction

Learning is viewed as cooperation between various elements or components. Suhardi (2007: 1) suggested than the components of learning consist of *raw input*, *instrumental input*, *environment* and *output* that are used to achieve specified objectives of learning. Teachers, students, instruments and *raw input* are elements that are highly needed to create a conductive science learning situation. Good science learning situation is when it able to create interaction between teachers-students, students-students, students-objects or between teachers-students and objects- teachers.

Resource of learning is one of *instrumental input* components in learning system. Natural science learning resources are everything existing surrounding us, that can be used for natural sciences learning. Natural science learning resources can be fields, ponds, wet fields, book of resources, etc. One problem of natural sciences learning is poorly to optimize nature as learning resources. What exist in the nature are seldom used for objects of natural sciences learning. Main constraints of learning performance adopting local problems are low competence of teachers in selecting and organizing problems existing in the nature to be raised as learning problems. It affects teachers.

Most of teachers are still reluctant to adopt natural phenomena as problems in learning and own tendency to learn natural sciences by relying on text books. Use of text books in learning are only a dimension of natural sciences learning, i.e. dimension of natural sciences text book products are collections of *body of knowledge* from natural sciences. Text book is important, but science learning has other more important sides, i.e. dimension of process. Orientation to natural sciences learning is still cognitive-oriented, where students are provided with many concepts without understanding how and where the concepts are from. Such learning is a false learning because it emphasizes on only scientific products. Whereas, natural sciences

learning must not ignore essential of natural sciences dimensions, i.e. process, product and attitude.

Environment is habitat for various living things; one of them is plant and insect. In the nature, there are interactions between plants and insects. Unique phenomena are how plants respond to sound of insects, especially grasshoppers. It is attractive to be used for learning problems. Because time to see the symptoms needs long, so it is necessary to have secondary data of study results revealing the phenomena. Materials of natural sciences that can be learnt are associated with items such as functional structure of plant and sound.

I hope that this work can used for illustrating use of results of study on "Increasing of Food Tenacity of Infertile Land Farmers through Hard Plant Fortification and Horticulture by Using Natural Frequency of Grasshoppers as Stimulator for Growth and Increasing of Crop Products" as Natural Science Learning Resources and giving scientific vision associated with application of *Audio Organic Growth System* technology in specific frequency of grasshoppers sound to cultivate teak (Leaf Chlorophyll Content Teak (*Tectona grandis*)) and Peanut (*Arachis hypogaea*) horticulture by using Natural Frequency of Grasshoppers in dry land and influence of Natural Frequency of Grasshoppers on Leaf Chlorophyll Content of Teak (*Tectona grandis*) and Peanut (*Arachis hypogaea*).

Discussion

Before studying use of study results as learning resources, it is necessary to understand that results of study are parts of study data with title: "Increasing of Food Tenacity of Infertile Land Farmers through Hard Plant Fortification and Horticulture by Using Natural Frequency of Grasshoppers as Stimulator for Growth and Increasing of Crop Products" (Juli Astono, Agus Purwanto, Asri Widowati, 2013). Location of planting in the study was in Pucung Planjan Village, sub-district of Saptosari, district of Gunung Kidul, Yogyakarta, with altitude from 0 m to 300 m on sea level and temperature from 23.2^{o}C to 32.4^{o}C.

This study used natural frequency of grasshoppers as simulator for growth and increasing of crop products, in this case, ah followed by integration system between Teak (*Tectona grandis*) in intercropping form. This intercropping technique was selected because the technique is one planting model in dry land. Land plots available to Gunung Kidul area are so wide, but condition of land tending to be dry and lime makes the land not conductive to grow crops. Moreover, the intercropping technique is found able to minimize harvest failure and increase efficiency of water use (Amin zuchri, 2007: 156).

This study of "Increasing of Food Tenacity of Infertile Land Farmers through Hard Plant Fortification and Horticulture by Using Natural Frequency of Grasshoppers as Stimulator for Growth and Increasing of Crop Products" used *Audio Bio Harmonic System*. *Audio Bio Harmonic System* is way of leaf fertilization by atomization of fertilizer solution containing trace mineral combined together with sound wave in high frequency (Purwadaria, 19980. Work concept of this technology is to spray nutrition such as leaf fertilizer using generator installation aid to generate sound wave.

Not all sound frequencies can be used to drive stomata as to open. Only specific frequency can affect leaf stomata opening. Therefore, in application to *Audio Bio Harmonic System*, natural sound that will be recorded need to be analyzed first. In addition, it is also necessary to do sound synthesis to gain sound with frequency and clear sound color of noise. In this study, recorded sound was sound of grasshoppers. Acoustic frequency is driven to Teak (*Tectona grandis*) and Peanut (*Arachis hypogaea*) seeds, i.e. 3000 Hz, 4599 Hz and original frequency. Acoustic frequency is driven every day at 07.00 AM and 16.30 PM in time interval of 1 hour with similar time variation and intensity.

One of parameters measured in control and treatment group plants chlorophyll content. Based on results of study, chlorophyll content of each leaf with different treatments showed

different results. Results of study associated with leaf chlorophyll content with treatments such as sound of grasshoppers are shown in the following table:

Table 1. Measurement of Leaf Chlorophyll Content in Each Treatment of Peanut

Treatment	Leaf	Chlorophyll a (mg/L)	Chlorophyll b (mg/L)	Chlorophyll (mg/L)	Mean chlorophyll content (mg/L)
	Kcg1	2,58869	1,577	4,1484	4,008
	Kcg2	2,01427	1,1254	3,1268	
	Kcg3	2,98835	1,4006	4,3714	
	Kcg4	2,13662	1,1708	3,2939	
	Kcg 5	2,30669	1,0538	3,3471	
4500 Hz	Kcg 6	3,98321	1,8002	5,7604	
	Kcg 1	1,54188	0,8664	2,3984	3,4877
	Kcg2	2,80081	1,3234	4,1077	
	Kcg 3	2,2807	1,2268	3,4932	
	Kcg 4	2,83955	1,2566	4,0799	
3000 Hz	Kcg 5	2,33409	1,0386	3,3593	
	Kcg 1	1,57232	6.6944	8,2233	5,121417
	Kcg 2	3,41161	1,6642	5,0554	
	Kcg 3	2,34258	1,3284	3,6559	
	Kcg 4	2,04026	0,9524	2,9807	
	Kcg 5	2,72569	1,501	4,2094	
Original	Kcg 6	0,56566	6,0748	6,6038	
	Kcg 1	1,65053	0,9194	2,5594	
	Kcg2	1,46961	0,7026	2,1635	
Without	Kcg 3	0,94714	0,562	1,5029	
treatment	Kcg 4	1,89146	0,8084	2,6892	2,415

(source: Juli Astono, Agus Purwanto, Asri Widowati, 2013)

Table 1 shows that chlorophyll content of different plants with each sound frequency treatment. Mean highest chlorophyll content of Peanut (*Arachis hypogaea*) is 5.121417 mg/L, given original frequency treatment and the lowest chlorophyll content of control group (without treatment) is 2.415 mg/L.

Table 2. Chlorophyll Content of Teak (*Tectona grandis*) Leaf in Each Treatment

Treatment	Chlorophyll a (mg/L)	Chlorophyll b (mg/L)	Chlorophyll (mg/L)
4500 Hz	3,1861625	6,3973	9,837225
3000 Hz	4,085266	9,1439	13,71648
Original	4,1071475	7,5243	15,07883
Without treatment	2,99367	3,867	6,82895

(Source: Juli Astono, Agus Purwanto, Asri Widowati, 2013)

Table 2 shows results of Teak (*Tectona grandis*) leaf chlorophyll measurement; in fact, the highest chlorophyll content a of plant treated by original frequency sound stimulator was 4.107 mg/L, highest chlorophyll content b of treatment of 3000 Hz frequency sound was 9.1439 mg/L and highest chlorophyll content of treatment with original frequency sound was 15.07993 mg/L. Lowest chlorophyll content of Teak (*Tectona grandis*) without treatment was 6.82895 mg/L.

Based on data of chlorophyll measurement in Table 1 and Table 2, there is information indicating that chlorophyll contents of plants were different from each treatment of sound frequency. Mean chlorophyll content of Peanut (*Arachis hypogaea*) and Teak (*Tectona grandis*) with treatment of original frequency had highest chlorophyll content than Peanut (*Arachis hypogaea*) and Teak (*Tectona grandis*) with other treatments, and the lowest chlorophyll content was shown by control group (without treatment). In this case, chlorophyll content was one factor which might affect speed of photosynthesis because chlorophyll functions as light catcher when processing photosynthesis. According to Salisbury (1995: 24), basic principle of light absorption by chlorophyll indicates that each molecule could only absorb one photon and this photon caused excitation of one only electron, then excitation energy was used in photosynthesis.

Results of study as learning resources must be selected. Selection of process and products of study as learning resources must refer to Curriculum of Educational Unit Level (KTSP) and Curriculum 2013 of junior high school and requirements as learning resources as to develop cognitive, affective and psychomotor domains. Moreover, we should consider time, cost, instruments, and competence of teachers and students.

This study based on the data from research "Increasing of Food Tenacity of Infertile Land Farmers through Hard Plant Fortification and Horticulture by Using Natural Frequency of Grasshoppers as Stimulator for Growth and Increasing of Crop Products" . Considerations focuses on use of research results especially on influence of natural frequency of grasshoppers on leaf chlorophyll content as Natural Science Learning Resources are as follows:

1. Clarity of potentials

   Clarity of potentials is determined by some objects and problems that can be revealed. Objects used in this study were Peanut (*Arachis hypogaea*) as crop and Teak (*Tectona grandis*). The objects contained problems that could be revealed in an activity of learning. Question raised was "How sound frequency affected chlorophyll content of plant?"
2. Consistence with learning objectives

   Based on results of analysis of curriculum 2006 or KTSP for lesson of natural sciences, there are some Standard Competence (SK) and Basic Competence (KD) that can be taught using learning resources such as results of study mentioned above. Competence of integrated natural sciences can be mapped as shown in Table 3.

Table 3. Map of Integrated Natural Science Competences Based On KTSP

Aspect	Physic	Biology	Chemistry
Standard competence	6. Understand concept and application of vibration, wave, and optic in daily technology products	2. Understand systems in plant life	
Basic Competence	6.2. Describe sound concepts in daily life	2.1 Identify structure and function of plant tissues	
Objectives	To describe concept of	To identify	

	sound as a wave To identify the effect of sound (as *audio bio harmonic system*) to plant based on data	chloroplast in leaf anatomy To compare chlorophyll content in leaf based on data	
Material	Sound Sub material: use of sound in daily life as *audio bio harmonic system*	Tissues of leaf structure Sub material: chloroplast, chlorophyll contents	

Based on results of analysis of curriculum 2013 for lesson of natural sciences, there are some Core Competence (KI) and Basic Competence (KD) that can be taught using learning resources such as results of study mentioned above:
Table 4.

Class/Core Competence	Basic competence	
Kelas VIII		
1.Appreciate and comprehend followed religion teachings	1.1 Awe orderliness and complexity of what are created by the God on aspects of physic and chemistry, life in ecosystem and role of human in environment and creation in followed religion teaching implementation	
2. Appreciate and comprehend honest, discipline, responsible and care behaviors (tolerance, mutual aid), good manners, self-reliance, in interacting effectively to social and natural environments in friendship range and existence	2.1 Show scientific behavior (having curiosity, objective, honest, careful; accurate, persevering, thorough, responsible, open, critical, creative, innovative, and caring for environment) in daily activities	
3. Understand and apply knowledge (factual, conceptual and procedural) based on curiosity on technology, art, and culture sciences associated with	3.2. Explain correlation of plant structure tissues and function and various uses in technology inspired by the structure	Material: structure of plant functions, sub-material; chloroplast, chlorophyll content Material: sound

visible phenomena and events	3.10. Understand concepts of vibration, wave, sound, and hearing and application to sonar system in animals and in daily life.	Sub material: use of sound in life as *audio bio harmonic system*
4. Process, present and rationalize in concrete domains (using, decreasing, modifying and making0 and abstract domains (writing, reading, calculating, drawing and composing) according to what are learnt in school	4.2 Observe plant tissue structure and generate simple technology ideas inspired by the structure (such as, design of building)	

4. Clarity of targets
   Targets that should be aimed are:
   a. Targets of observation: structure of Peanut (*Arachis hypogaea*) and Teak (*Tectona grandis*) functions, especially leaf; leaf chlorophyll content of Peanut (*Arachis hypogaea*) and Teak (*Tectona grandis*), sound of grasshoppers.
   b. Targets of allocation (subjects) are students of .

5. Clarity of revealed information
   Information forms that want to be revealed are: (a) structure of leaf anatomy, especially leaf chloroplast containing chlorophyll pigments, (b) *audio bio harmonic system*; (c) sound can affect leaf chlorophyll content of Peanut (*Arachis hypogaea*) and Teak (*Tectona grandis*).
6. Clarity of exploration guidance
   Exploration guidance that is achieved is exploration of morphologic and anatomic structures of Peanut (*Arachis hypogaea*) and Teak (*Tectona grandis*) parts, leaf chlorophyll content between treatment group (group with treatment of manipulated grasshoppers sound) and control group.
7. Clarity of expected achievement
   a. Cognitive achievements obtained are: knowledge on leaf chlorophyll content and use of sound as *audio bio harmonic system*
   b. Expected affective achievements are: students can develop careful attitude in observing, sensitive to environment, cooperating in discussion, accuracy to read data, developing kind attitude, receiving and appreciating opinions of others, responsible, critical of insulting problems of society, especially concerning problems of inset destruction in the nature.
   c. Expected psychomotor achievements such as: observing, interpreting data, making conclusions

   In order to adopt process and products of study as learning resources, things that must be considered after study results meet requirements of learning resources are selection and modification of study results. Steps of selection and modification of study are:
   (1) Consider allocation to learning time, if experiments takes longer than one month, it is impossible to do experiment in school. Alternatives of study result use forms

enable solutions to problems supported by secondary empiric data as study products that may be used for secondary information.

(2) Select time and modify or simplify implementation of activities that can be explained as follow: (a) time selection by determining types of activities allocated to intra-curricular and curricular activities; (b) modification of implementation can be conducted by (i) goal and formulation of problems determined by teachers; (ii0 data of study results given by teachers; (iii) study of literatures conducted by students; (iv) interpretation of analysis results made by students; (v0 presentation of discussion results conducted by students in groups; (vi) conclusions made by students using direction of teachers.

Conclusions and Recommendations

Viewed from process and products of study, selection of study results as learning resources and application of study results as learning resources, then this study can be alternative to natural sciences learning resources in for questions on "How sound frequency affects chlorophyll content of plants ? containing some sub-materials such as: structure of plant functions, especially chlorophyll and sound.

For natural sciences teachers, the results of study can be used as an alternative to extra learning resources for students, if necessary. These can be used for selection and modification according to learning needs. The results of study can be followed-up to organize as materials such as modules and other materials.

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