of organic matter in humus by living things in soil is favoured and this resource improves in terms of the availability of organic matter.

The chromatogram of the soil from a holm-oak wood points out that this sample is set at an intermediate level regarding the quality of organic matter. This is a significant fact, since the sample comes from a well-preserved natural environment. Even though this study cannot shed light on the reasons that may explain this finding, from an educational perspective it may be interesting to speculate about the role that the geological structure of soil plays in the formation of humus. In that regard, the subterranean drainage that characterises the calcareous bedrock of the sampling site (Aguirre et al., 2010) constrains the surface water availability which might affect the process of humus formation. This is consistent with the fact that the holm-oak wood, from where the sample was collected, shows a strikingly poor shrub and herbaceous layer.

CONCLUSIONS AND EDUCATIONAL IMPLICATIONS

The teaching sequence described in this paper proposes an educational tool to foster the secondary school students' knowledge concerning soil organic matter. The sequence places a particular emphasis on detailing a practical procedure to ensure that students can be actively involved in their learning process. In this regard it should be stressed that teachers' skills for designing practical activities and laboratory experiences are considered one of the most significant factors related to the improvement of science education (Wenglinsky, & Silverstein, 2007).

The teaching sequence allows students to emulate the actual laboratory activity carried out in the field of soil science. More specifically, a method for comparing the availability of organic matter that different soil samples have is detailed but by avoiding very technical, expensive or inaccessible methodologies.

This is a key point of the teaching sequence, since that, finding a feasible and practical procedure to address the topic of the role that organic matter has in the productive capacity of soils is not an easy issue in the confines of a secondary school classroom.

Moreover, comparing samples from soils subject to different uses (urban utilization, intensive farming, well-preserved natural environment, et cetera) allows students to consider how the availability of organic matter in soil is closely tied, not only to the environmental characteristics of the sampling site but, also to how this resource is used by human beings.

In this manner, it is believed that students might achieve the final objective that this teaching sequence pursues; that is to say, being aware of the importance that soil preservation has for ecosystems, biodiversity, and for ensuring sustainable development.

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Educational implementations of experiments in Green mustard (*Brassica juncea l*) production with cow urine for horticulture learning

Aplicación educativa de los experimentos de producción de mostaza verde (*Brassica juncea l*) con orina de vaca en el aprendizaje de horticultura

Dewa Nyoman Oka

Faculty of Matematics and Natural Science Education, IKIP Saraswati, Jalan Pahlawan [2] Tabanan-Bali.Indonesia,
e-mail: dewanyoman_oka@yahoo.co.id

Abstract

This study is to identify (1) whether the use cow urine affects the production of green mustard; (2) whether the model of this experiment can be implemented in horticulture learning process. This is an experimental study that uses the simple experimental design, posttest only control group. 90 sample plants were grouped into two groups. The experimental group was given cow urine which had been stored for 2 weeks while the control group was not given cow urine. The data obtained were in the form of production or wet weight of leaf mustard. The t-test analysis showed that there was significant difference between the production of leaf mustard that was fed with cow urine and the production of green mustard that was not fed with cow urine. The production of the plants that were given cow urine was higher than the production of those that were not given cow urine. This experiment is very relevant to be implemented in horticulture learning since this experiment can increase creativity of the learners, is relatively low cost, takes only 42 days.

Key words*: education, cow urine, production, green mustard, horticulture*

Resumen

Este estudio es para determinar: (1) si la orina de vaca influye en la producción de mostaza verde; (2) si el modelo de este experimento se puede implementar en proceso de aprendizaje de horticultura. Se trata de un estudio experimental que utiliza el diseño experimental simple y el control posterior a la prueba. Noventa (90) muestras de las plantas se dividieron en dos grupos. El grupo experimental fue tratado con orina de vaca que había sido almacenada durante 2 semanas, mientras que en el grupo de control no se aplicó la orina de vaca. Los datos obtenidos se colectaron a través del peso húmedo de hojas de mostaza. El análisis de t-test mostró que no había diferencia significativa entre la producción de hoja de mostaza que se alimenta con orina de vaca y la producción de la mostaza verde que no se alimenta con orina de vaca. La producción de las plantas que recibieron la orina era más alta que la producción de los que no se les dio este componente. Este experimento es muy relevante para ser implementado en el aprendizaje horticultura ya que puede aumentar la creatividad de los alumnos, su costo es relativamente bajo y dura solo 42 dias.

Palabras clave*: educación, horticultura, producción, mostaza verde, horticultura, orina de vaca*

INTRODUCTION

Horticulture or plantation is one of the popular science topics which focuses attention on the science of gardening plants that have artistic or aesthetic, health and economy value. It contains the artistic value because it can meet the spiritual needs of, among others, could cause mental tranquility and gratification to the viewer. Horticulture is said to have health value as its product contains a variety of vitamins and minerals that are needed by the body. As a part of the plants that produce horticulture food, it also has economic value because the result can be traded, both in the domestic market and abroad.

Horticulture is a branch of agronomy. In contrast to agronomy, horticulture focuses on the cultivation of fruit (pomology / fruticulture), flowers (floriculture), vegetables (olericulture), medicines (biofarmaca), and the park (landscape). One characteristic of horticultural products are perishable because they are fresh (Wikipedia, 2014).

A vegetable is a plant that can be consumed both fresh and processed. Vegetables are needed by society because of the importance of the fresh and healthy foods intake in order to maintain a healthy body. Demand for food will continue to increase in line with population growth. Among the vegetable crops that are easily cultivated, is mustard greens. Mustard greens are favored by everyone as an ingredient to make the kind of dishes such as sayur lodeh soups, and lalap (dish of raw vegetables). Mustard greens have a good flavor when fresh and lots of protein, fat, carbohydrates, Ca, P, Fe, vitamin A, and vitamin C. The mustard greens crop is very good for relieving itching in the throat as it also acts as a blood purifier, improves renal function and facilitates digestion.

The green revolution *(green revolution)* has changed the face of the horticultural plants cultivation, not only in Indonesia but throughout the world. The real change is the shift of the horticultural cultivation practice from traditional to modern which is characterized by the excessive usage of artificial fertilizers and pesticides or herbicides. The changing face of horticultural crops cultivation practice was followed by the changing face of agricultural land that is increasingly critical as the negative impact of the use of inorganic fertilizers, pesticides and herbicides (Zulkarnean, 2010).

The use of inorganic fertilizers and synthetic pesticides in high doses not only affects lower levels of soil fertility, but also results in the decline of biodiversity and increased pests, diseases, and weeds. The negative impact will also be seen in the emergence of resistant pests, development of parasitic organisms, the increasing threat to the predator organisms, fish, birds, and even to the health and safety of humans. Toxic effects are not only limited to local use, but can be distributed more widely through the components of the food chain, such as drinking water, vegetables, fruits and other contaminated products (Zulkarnean, 2010).

Studying the chemical composition of the plant will give the clues about the nutritional needs of plants. By using hydroponic cultivation method, it has successfully identified 17 elements that are essential nutrients for all plants and some other elements that are essential for certain plant groups. The elements required by plants in large numbers are called macronutrients. There are nine macronutrients. The six main constituent elements of organic compounds: carbon, oxygen, hydrogen, nitrogen, sulfur and phosphorus. The three other elements of macronutrients are potassium, calcium and magnesium. The required elements by plants in very small quantities are called micronutrients. The micronutrients are iron, chloride, copper, manganese, zinc, molybdenum, boron and nickel. Nitrogen, phosphorus and potassium are the three elements that are often lacking in the fields and garden soil. (Campbell, 2000)

Cow urine contains various compounds in dissolved form that are produced by the kidneys. (Dwijoseputro, 1992). Cow urine also contains Auxin (a growth regulator) as one of the substances contained in green food that is not digested in the cow's body and eventually wasted with cow urine. The auxin content of cow urine is higher than the bulls' (Supriadji, 1985). Supriadji (1985) states that, cow urine can be used as a source of auxin. The urine should be diluted with water to obtain a concentration of 5-10%. Cow urine is used as a stimulant on the rooting of Robusta coffee cuttings. One effort to stimulate root growth bud cuttings can be done by using Growth Regulator Substance (Auxin).

Liquid manure (cow urine) in addition works quickly since it also contains certain hormones that can significantly stimulate the development of plant. In liquid manure, the N and K content is large enough, while the solid manure contains enough P content, so the results of the mixture between the two in the cage is a good fertilizer for the growth and development of plants (Aisha, 2011).

In addition to urea, a high content of elements K, N and Cl also found in the urine of cattle, in the form of ions K^+, NO_3^- and Cl^- (Oliveira, 2009). Nutritional analysis of cow urine tested in the winter and spring showed that the urine of cattle in the winter contain 0.88% N ($NH4^+$ 0.18%, 0.70% Urea), K^+ 1.04%, 0.081% S, Ca1185 ppm, 147 ppm Mg, Na 31 ppm, 390 ppm P. While in the spring containing N 0.70% (NH_4^+ 0.34%, 0.36% Urea), K 0.85%, 0.065% S, Ca 280 ppm, 85 ppm Mg, Na 410 ppm, 280 ppm P. (Legard, 1982)

Among different organic sources cow urine is a source of nitrogen. The analysis of cow urine has shown that it contain nitrogen, sulfur, phosphate, sodium, manganese, iron, silicon, chlorine, salt, vitamins, A,B,C, D and E mineral lactose, enzyme hormone as well as other acids. [5]. Total N in the cow urine ranged from 6.8-21.1 g N litre of which in average 69% was urea, 7.3% allantoin, 5.8% hippuric acid, 3.7% creatinine, 2.5% creatine, 1.3% uric acidand 0.5% xanthin plus hypoxanthin, 1.3% free aminoacid nitrogen and 2.8% as ammonia(Singh, 2014).

Cow urine, which has been considered as waste, can actually be utilized as a good quality liquid fertilizer that can be relied upon to replace chemical fertilizers. It is an organic liquid fertilizer that contains more complete nutrient compared to chemical fertilizers. With a simple processing, cow urine can be converted into a liquid fertilizer that is higher in value. Liquid fertilizer can be done in a simple way. The making technology of liquid fertilizer from urine is easy, cheap, and provides many benefits for farmers and ranchers. Liquid fertilizer is made using urine, feces, molasses, and water (Hadi, 2013).

Cow urine can be used as liquid organic manure if we process it, because it contains all the nutrients needed by plants including Nitrogen of 1%, phosphorus of 0.5%, potassium of 1.5%, carbon of 1.1%, water of 92%, and Phytohormone Auxin that is stimulus substance that can be used as a growth regulator. After the urine liquid fertilizer is processed, the nutrients are increased. Nitrogen increases to 2.7%, phosphorus to 2.4%, potassium to 3.8% and carbon to 3.8%. The color, which is originally yellow, turns into a blackish, and the pungent smell, which was originally is much, reduced. Another strength of this urine liquid fertilizer is that it is able to repel pests, rats, leafhoppers, walang rice pest and borer, so that, the plants avoid the attack of these pests. Cow urine should not be used directly. If it were directly sprayed on the plant, it will harm the plants because it forms ammonia gas. Urine is allowed to stand for 2 weeks without being processed (Margono, 2014).

According to the law of the national education system number 20 of 2003, the national education goals is developing students' potentials to become a man of faith and piety to God Almighty, noble, healthy, knowledgeable, skilled, creative, independent and responsible.

If we look over the educational goals, it is clear that the creativity increase of the learners becomes one of our priorities. Our global creativity index is very low. Based on reports from Martin Prosperity Institute and Richard Florida, our global creativity index is the second lowest number in the World after Cambodia. Two-thirds of one's creativity abilities gains through education, the remaining third comes from genetics. The converse applies to intelligence, i.e.: the one-third is obtained from education, the remaining two-thirds is derived from genetics. This means that the intelligence-based learning will not give such significant results as those based on creativity (Mendikbud, 2013).

Good learning is learning that requires active learners and meaningful *(meaningful-discovery learning)*. In active learning *(discovery learning)*, students are no longer placed in a passive position as recipients of teaching materials provided by the teacher / lecturer, but as a subject of active thinking process, searching, processing, parse, merge, deduce, and solving problems. (Hanafi & Sukana, 2009).

Based on the discussion above, the objectives of this study are to investigate: (1) does the application of cow urine affect the production of mustard greens? (2) Can this experiment model be implemented in the horticulture learning process?

RESEARCH METHOD

This research is experimental, using simple experimental design *post-test only control group design*. The seed-population in this study is the green mustard in the nursery box, which is planted from seeds that originated from a single parent plant which has been prepared as a seed crop. Green mustard plant that will be used as samples, are taken at random from the box and planted in the experiment pot that has been provided. Each pot contains one plant. Samples are grouped into two: the first group as the

control group and the second group as the experiment group. Each group consists of 15 plants because there are three replications (test) then the total number of plants of each group was 45 plants. The number of green mustard samples that are used for both groups, is as much as 2 x 45 plants = 90 plants. The experiment groups are given cow urine that has been stored for 2 weeks and sprinkled in a circle around the plant. The watering distance is three centimeters from stem, while the control groups are not given cow urine.

The data that are obtained in the form of production (wet weight) of mustard plants are tested for normality and homogeneity. Normality test is done by using the *Kolmogorov-Smirnov* statistic and the *Shapiro-Wilk, w*hereas homogeneity test was performed with *Levene test.* Level of significance (α) is set of 0.05. The used criteria of normality and homogeneity test is when the number of significance (sig.) is greater than the significance level (α), then the numbers obtained are not statistically significant, meaning that the sample data came from a normally-distributed population. If the requirements have met the normality and homogeneity criteria, then the parametric analysis is conducted by t-test.

RESULT AND DISCUSSION

The collection of research result is conducted for 42 days of seeding in the nursery box or 28 days after transplanting into pots. Harvesting is done by cutting the plants into three inches above ground level. Average production (wet weight) of green mustard after experiments with three times of testing is presented in Table 1.

Table 1 Average Production of Green Mustard Plant

Group	Testing		
	I	II	III
Experiments	61.25	60.96	79.87
Controls	30.75	29.58	31.04

Based on the above table, it can describe the average production of mustard greens after three times of testing for each group as shown in Figure 1.

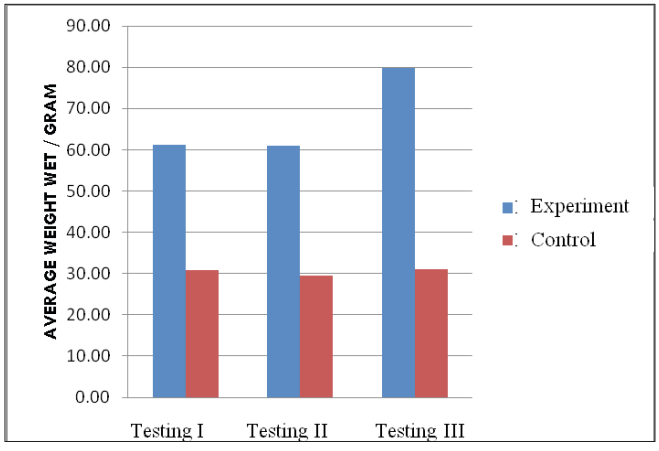

Figure 1 Average Production of Green Mustard Plant after Three Times Testing

Normality and Homogeneity Test

Green mustard production data normality is tested with *the Kolmogorov-Smirnov* and *Shapiro-Wilk Z,* while the homogeneity is tested by *Leven* test. The normality and homogeneity analysis results of data are presented in Table 2.

Table 2 Data Normality Test using the *Kolmogorov-Smirnov Z* test and the *Shapiro-Wilk* test and homogeneity test using *Levene* Test

Group	Value of p		
	Kolmogorov-Smirnov Z	***Shapiro-Wilk***	***Levene***
Experiments	0.200	0.979	0.066
Controls	0.123	0.244	0.066

Based on the normality test results using *the Kolmogorov-Smirnov Z* test and *the Shapiro-Wilk* test on production data of greens mustard in the experimental group and the control group, it shows that the data are normally distributed. Because the p-value of *the Kolmogorov-Smirnov Z* for the experimental group = 0.200 and control group = 0.123 or > 0.05. While the p-value from *Shapiro-Wilk* test for the experimental group = 0.979 and control group = 0.244 or > 0.05. Based on the results of *Levene's* test of homogeneity, it turns out that the data is homogeneous, because the p-value of *Levene's* test for the experimental group = 0.066 and control group = 0.066 or > 0.05.

t-test

To determine whether the application of cow urine gives significant influence or not on the production of mustard greens, mustard greens crop production data are analyzed by t-test. t-test analysis results are presented in Table 3.

Table 3. t-test analysis

Group	Value of t	SD	Value of p
Experiments	16.987	2.173	0.000
Controls	16.987	2.173	0.000

The results of t-test analysis show that t count is 16.987 with significance of 0.000 which is smaller than the set significance level (α) of 0.05. Thus, it means there are significant differences between the productions of green mustard plants which are fertilized with cow urine and the mustard greens which are not given cow urine. The green mustard plants which were fed with cow urine produced significantly more than the green mustard plant not given cow urine.

DISCUSSION

The results of t-test analysis found a significant difference between the production of green mustard plants which fed with cow urine and the mustard greens that are not given cow urine. The plants, which are given cow urine, produce more than the plants that are not given cow urine. This is because cow urine contains mineral elements needed by plants, including nitrogen, phosphorus, potassium, carbon, water, and auxine phytohormone (Margono 2014).

Nitrogen, phosphorus, potassium, carbon elements are the essential elements and the macronutrients that are needed in huge quantities by plants (Campbell, 2000). Nitrogen (N) is indispensable for growth, especially in the vegetative phase that is the branches, leaves, and stems growth. Nitrogen is also helpful in the formation process of green leaves or chlorophyll. Chlorophyll is essential to the process of photosynthesis. In addition, nitrogen is helpful in the formation of proteins and other various organic compounds. Nitrogen deficiency can cause the growth of abnormal or stunted plants. The leaves will turn yellow and dry up. A lot of (severe) nitrogen deficiency can cause the plant tissue to dry and die. The growth of fruit, which get nitrogen-deficient, is not perfect, fast ripening and its protein level is low. Phosphorus (P) is useful to establish roots, fruit ripening accelerator, strengthening plant stems, and increasing the yield of grains and tubers. Phosphorus deficiency causes plants to become stunted, the root growth is not good, and the growth of branches or twigs is hindered. In addition, phosphorus deficiency can cause delayed fruit ripening, more green leaf color, and yellow old leaf before it's time, and the less fruit or seed. Severe phosphorus deficiency causes plants not bear fruit. The function of Potassium (K) is to assist the formation of proteins and carbohydrates. Furthermore, potassium serves to strengthen plant tissue and has an important role in the formation of antibodies that can fight disease and drought. If potassium is deficient, the plants are not resistant to disease, drought, and cold air. Lack of potassium can inhibit plant growth and cause the leaf looks a bit curly and shiny. Eventually the leaves will turn yellow at the tops and edges. Finally, the leaves between the fingers turn yellow, while the fingers remain green. In addition, potassium deficiency causes the leaf to be weak so that it is easy to drop, and the seed shell wrinkled. Carbon (C) is beneficial to form carbohydrates, fats, and proteins that are beneficial to plant growth. In addition, it serves to establish cellulose which is cell membrane and strengthen parts of plants.

Nitrogen, phosphorus and potassium are the three elements of minerals that are commonly less abundant in fields and gardens (Campbell, 2000). Cow urine contains all the three elements. This means that by the application of cow urine, the essential minerals become abundant in the soil of green mustard plant pot as the experimental group. The same thing does not happen in the soil of the control group. Consequently the growth of green

mustard plant in the experimental group became more optimal, so the production is better.

Liquid manure (cow urine) in addition to working quickly, also contains certain hormones that can significantly stimulate plant growth (Aisha, 2011). Urine cow contains auxin as one of the substances contained in green food that is not digested in the body of cow and finally wasted with cow urine (Supriadji, 1985). Auxin is a growth hormone that cannot be separated from the process of *plant growth and development.* Auxin is derived from the Greek *auxein* that means increase. The researchers found no growth would occur in the absence of auxin. In addition, studies show that auxin can increase the osmotic pressure, increase cell permeability to water, reduce pressure on the cell membrane, increase protein synthesis, and increase plasticity and cell membrane development. All of this is supporting the development of the plant. Auxin can accelerate the formation and extension of stem and leaves. Auxin also plays a role in extension and early root growth.

Based on the discussion above, it is clear that the content of cow urine either in the form of mineral elements and phytohormones is indispensable for the growth of the vegetative phase of plant mustard greens, especially the growth of branches, leaves, and stems and the formation of roots, strengthen the tissues and prevents the leaves from curling. Since the production of mustard greens is calculated from the wet weight of the plants which are cut into three centimeters above ground level, which only consists of stems and leaves, then the application of cow urine obviously give a significant effect on the production of green mustard plant.

By the nature of education in the context of national development has the following functions: (1) to unite the nation; (2) equalization of opportunity; (3) development potential. Education is expected to strengthen the unity of the nation within the Unitary Republic of Indonesia (NKRI), giving equal opportunity for every citizen to participate in the construction, and giving the chance for every citizen to develop their own potential optimally.

According to the law of the national education system number 20 of 2003, the national education goals is the development potential of students to become a man of faith and fear of God Almighty, noble, healthy, knowledgeable, skilled, creative, independent, and become democratic and accountable citizens. Such purposes include (1) aspects of attitude which consists of a spiritual attitude (believe and fear in God Almighty) and social attitudes (noble, healthy, independent, democratic and responsible); (2) aspects of knowledge (knowledgeable) and aspects of skills (proficient and creative). The low quality of education is due to the lack of students' creativity, whereas creativity is the base of innovation. There will be no innovation without creativity. Two-thirds of one's creativity ability is acquired through education, the remaining one-third comes from genetics. The converse applies to intelligence capabilities, that is: the one-third of intelligence is obtained through education, and the remaining two-thirds are derived from genetic (Mendikbud, 2013, 2013).

Provision of education expressed as a civilizing process and the empowerment of learners that lasts a lifetime, where in the process there should be educators who provide exemplary and able to build a will, and develop potential and creativity of the learners. The principal aim is to cause a paradigm shift in the educational process, from the teaching paradigm to the paradigm of learning. Teaching more focused on the role of educators on students' learning rather than on transmitting knowledge. Learning paradigms are shifted to provide more roles for learners to expand the potential and their creativity. This is in line with what was stated by the Hanafi and Sukana 2009 which states that good learning is learning that demands learners activity and meaningful (meaningful-discovery learning). In active learning (discovery learning), learners are no longer placed in a passive position as recipients of teaching materials provided by the teacher / lecturer, but as an active subject thought process, search for, cultivate, extract, merge, deduce, and solve problems. In the learning process, the creativity capabilities are acquired through: Observing, Questioning, Associating, Experimenting and Networking. Therefore, the teachers / lecturers need to design a learning process that emphasizes the personal experience through the process of observing, questioning, associating, and experimenting (observation-based learning) to increase the creativity of learners. In addition, the students must be accustomed to working in networking through collaborative learning.

The provision of education in Indonesia, prior to the enactment of Law No. 14 of 2005 on Teachers and Lecturers, explicitly organized by the Institute of Education Workers (LPTK). The form can be a High School Teacher Training Education (STKIP), Institute of Teaching (Teachers' Training) and the Teacher Training Faculty of Education (Guidance and Counseling, whose existence under the university). Such institutions are the source of agency personnel or teacher educators (Azhar, 2009). Teachers are professional educators with the primary task of educating, teaching, guiding, directing, training, assessing, and evaluating students on early childhood education, formal education, elementary education and secondary education. One of the subjects that are taught in LPTK is horticulture which generally appearing in the fifth semester. By implementing research "Cow Urine Increase Crop Production Green Mustard (*Brassica juncea L.)"* on the practical horticultural courses, students will be trained how to design an experiment, make observations, collect data, analyze the data. So that someday when they have become teachers, they can be creative educators who are able to develop the potential and creativity of learners. Thus the criticism leveled at LPTK stating that the system and the learning process less attention to the establishment of an independent personality, creative, innovative and democratic be annihilated.

CONCLUSIONS

There are significant differences between the production of green mustard plants which are given cow urine and the mustard greens which are not given cow urine, where the production of the given one is higher than the production of the other one. By implementing research "Cow Urine Increase Crop Production Green Mustard (*Brassica juncea L.*)" on the subject horticulture so in practice the candidates for teachering will be trained how to design an experiment, by making observations, collecting and analyzing data. So that someday when they have become teachers, they are able to develop the potential and creativity of learners

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