ONLINE ISSN: 2548-5148

PRINTED ISSN: 2548-5121

AGROTECH JOURNAL

Volume 1, No. 1, December 2016

Published by USN Scientific Journal Group, Indonesia
http://www.usnsj.com/

Editorial Board

Hardcopy Provider
USN Scientific Journal
Jl. Pemuda, No. 339 Kolaka – 93517
Southeast Sulawesi
Indonesia
Website: www.usnsj.com
Email: info@usnsj.com

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Agrotech Journal (ATJ) is indexed at Google Scholar

http://www.usnsj.com/index.php/ATJ/

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Volume 1, No. 1, December 2016

Agrotech Journal
ATJ
Url: http://usnsj.com/index.php/ATJ
Email: editor.atj@usnsj.com

Land Productivity Improvement through Giving Fertilizer N, P, K and Planting Time of Peanut (*Arachis hypogaea* L.) in the Intercropping System with Maize (*Zea mays* L.)

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ARTICLE INFO

ISSN: 2548-5121
Vol. 1, No. 1, December 2016
URL: http://usnsj.com/index.php/ATJ/article/view/ATJ001

Abstract

The purpose of this research is to investigate the productivity of land by N,P,K fertilizer and time of planting peanuts in intercropping systems with maize. This research was conducted applying experimental garden at Agriculture Faculty of Halu Oleo University, Kendari. The research was conducted in the dry season, from August to November 2015. The research was arranged meant by split plot design with two replications. The main plot is NPK fertilizer dose (S) consisted of three levels namely 56-36-25 kg ha^{-1} (S1), 90-54-25 kg ha^{-1} (S2) , 124-72-50 kg ha^{-1} (S3). The subplots was planting time of peanuts with maize intercropping (W) consisted of three levels, namely planting time of peanuts 10 days before planting (DBP) maize (W1), planting peanuts with maize simultaneously (W0), and planting peanuts 10 days after planting (DAP) maize (W2). There are nine treatment combinations of two factors mentioned. Each combination treatment was repeated three times, coupled with each of the three experimental plots for monoculture cropping systems of peanuts and maize. The total number of units was 45 units experimental. Data experiments were analyzed by using analysis of variance followed by Duncan's Multiple Range Test. The results showed that the treatment time 10 DBP planting peanuts with maize to increase productivity, reduce competition index and efficient of the use fertilizer. Provision of fertilizer NPK 124-72-50 kg ha^{-1} dose can increase growth and yield of maize and peanuts.

Keywords: NPK, planting time, peanuts, maize, intercropping

A. Introduction

Southeast Sulawesi (SULTRA) is one of the areas that have the potential of dryland quite extensive which has been used for the development of food crops, especially maize and peanuts. Dry land is defined as land in a natural state, the upper and lower body ground throughout the year did not experience water saturated or not flooded most of the year were below field capacity (Satari *et al*., 1991 cited by Sabaruddin, 2003). The physical condition of dry land are generally in the form of rain fed land Agro-ecology distinctively highly heterogeneous due to the availability of water and fertility, the level of technology adoption is still low and the availability of capital is very limited and susceptible to erosion.

Maize production in Southeast Sulawesi province in 2013 amounted to 67,578 tons of dry seed which had decreased by 10,869 tons (13.86%) compared with production in 2012. The decline in maize production due to reduced harvested area of approximately 3,751 hectares (12.15%), and productivity decreased by 0.49 quintal / hectare (1.95%) (BPS, 2014). While the production of peanut Southeast Sulawesi province in 2013 amounted to 4,941 tons of dry seeds which had decreased by 258 tons 4,96%) compared with 2012. The decline in the production of peanut production in 2013 due to reduced harvested area of 949 hectares (12,66%), while productivity increased by around 0,61 quintal / hectare (8,81%) (BPS, 2014).

The decline in maize production in Southeast Sulawesi caused by the conversion of agricultural land into non-agricultural proposition and soil fertility problems (Subandi, 2007). The type of soil in Southeast Sulawesi is dominated by land ultisol. The limiting factor is the ultisol soil acidity and low soil fertility (Karimuna, 2000), so that the organic fertilizers and inorganic fertilizers as an effort to improve the content of organic matter to improve soil structure. The addition of fertilizer N, P and K are very important on the ground ultisol, because of fertilizer N, P, and K is very beneficial to the growth and crop production. One attempt to do so while ensuring production of corn is by using a pattern of intercropping corn and peanuts. Intercropping is an attempt to plant several kinds of plants on land and the same time or almost simultaneously, which is arranged so that the rows of plants. Intercropping can also increase the productivity of land (Warsana, 2009). Land productivity is the ability of the land to produce crops production in the unit area and can be planted with various species of plants with maximal production.

Intercropping system has inherent limitations of competition between plants in decision nutrients in the soil that would be mutually inhibit plant growth (Sabaruddin *et al.,* 2003). The negative impact from the effect of competition can be reduced by providing nutrients needed by plants and crops main stream (Balitkabi, 2009). Provision of these nutrients can be done with the application of fertilizer N, P, K so that the nutrients can be met and absorbed by plants well.

B. Methodology

This research was conducted at the Experimental Farm, Unit of Dryland Agriculture Faculty Haluoleo University Kendari. The research location is at an altitude of 25 meters above sea level and the position 04000'46 "LS and 122031'06" BT. Research planned to run for four months in the dry season, which was from August to November 2015.

Field trial organized by randomized block design (RAK) with two factors. Both these factors are designed in a split plot design (Split Plot Design). The first factor is the inorganic fertilizer (S) is placed as the main plot (main plot) which consists of three levels, namely NPK dose combination (a) a dose of NPK 56:36:25 kg ha^{-1} (equivalent Urea: SP-36: KCl 125-100-50 kg ha^{-1}) (S1), (b) a dose of NPK 90:54:25 kg ha^{-1} (equivalent Urea: SP-36: KCl 200-150-50 kg ha^{-1} (S2), (b) a dose of NPK 124: 72: 50 kg ha^{-1} (equivalent Urea: SP-36: KCl 275-200-100 kg ha^{-1} (S3). the second factor is the time of planting peanuts in crops such as corn (W) as subplots (sub plot), consists of three levels of planting time namely (a) planting peanuts 10 days before planting (HSB) corn (W1), (b) simultaneously planting corn planting peanuts (W0), and (c) the planting of peanuts 10 days after planting (DAP), corn (W2). There are nine treatment combinations of the two factors mentioned above. Each combination treatment was repeated three times, coupled with each of the three experimental plots for the system monoculture corn and peanuts. The total number of experimental units was 45 units of trial

C. Result and Discussion

1. Leaf Size Index

ILD at the age of 56 HST obtained at the highest dose treatment of NPK 90-54-25 kg ha-1 and the treatment time of planting peanuts 10 days prior to planting corn namely 0.20, a high leaf area index usually increases photosynthesis and the absorption of nutrients and the results of

plant dry matter. The greater the P element available to plants, the greater the P element that can be absorbed by plants, the photosynthesis will increase and the rate of plant growth also increases and promotes the growth of roots and systems rooting good, spurring the formation of flowers and ripening fruit / seeds, the harvesting, increase the percentage of the formation of flowers into fruits / seeds (Karama, Subandi, and Makarim, 1991; Salisbury & Ross, 1995).

Table 1. Effect of dosage of NPK fertilizer and planting peanuts in crops such as corn on the leaf size index of corn plants aged 56 HST

NPK dose	Peanut Planting time			DMRT 0.05
	coincide	10 HSB	10 HST	
56: 36: 25	1.04^{b}_{q}	$1.42^{b}_{p\,q}$	$1.81^{a\,b}_{p}$	2 = 0.51
90: 54: 25	1.71^{a}_{q}	2.35^{a}_{p}	1.36^{b}_{q}	3 = 0.53
124: 72: 50	$1.64^{a\,b}_{q}$	$2.13^{a}_{p\,q}$	2.26^{a}_{p}	
DMRT 0.05	2 = 0.506	3 = 0.531		

Description: The numbers followed by letters are not the same in the same row (p, q) and column (a,b) significantly different at DMRT 0.05

2. The product of Plants

Table 2. Effect of NPK fertilizer dose and timing of planting peanuts in intercropping with maize against corn crop yield (ton ha-1)

NPK dose	Peanut Planting time			DMRT 0.05
	coincide	10 HSB	10 HST	
56: 36: 25	3.90^{b}_{q}	4.64^{b}_{p}	5.24^{a}_{p}	2 = 0.60
90: 54: 25	3.98^{b}_{q}	5.00^{b}_{p}	3.24^{b}_{r}	3 = 0.63
124: 72: 50	4.65^{a}_{q}	6.43^{a}_{p}	5.24^{a}_{q}	
DMRT 0.05	2 = 0.62	3 = 0.65		

Description: The numbers followed by letters are not the same in the same row (p, q, r) and column (a,b) significantly different at DMRT 0.05

Table 3. Effect of NPK fertilizer dose and timing of planting peanuts in crops such as corn to peanut crop yield (ton ha-1)

NPK dose	Peanut Planting time			DMRT 0.05
	coincide	10 HSB	10 HST	
56: 36: 25	1.52^{a}_{q}	1.43^{b}_{q}	1.55^{a}_{p}	2 = 0.25
90: 54: 25	1.38^{a}_{q}	1.73^{a}_{p}	1.31^{a}_{q}	3 = 0.27
124: 72: 50	1.53^{a}_{q}	1.86^{a}_{p}	1.48^{a}_{q}	
DMRT 0.05	2 = 0.285	3 = 0.299		

Description: The numbers followed by letters are not the same in the same row (p, q) and column (a,b) significantly different at DMRT 0.05

The results also show that the effect of the interaction between the dose of NPK fertilizer and planting tangible and very real effect on plant height peanuts at age 42 HST and 56 HST highest dosage of NPK fertilizer 124-72-50 kg ha-1 and the treatment time peanut planting 10 days after planting corn but not significantly different from the dosage of NPK fertilizer 56-36-25 kg ha-1 and the treatment time of planting peanuts 10 days prior to planting corn. One of the plants intercropped first planted the plants are able to take advantage of growth factors in advance without any competition. Treatment of peanut planting maize 10 days before the peanuts are first exploit growth factor peanut plants first master of space to grow before corn become a competitor in the fulfillment of nutrient needs. Bean plant roots have grown and able to absorb most of the nutrients from the soil and peanut leaf canopy has developed to adsorb sunlight without competing with corn plants that grow later and discount posture higher than peanut.

Table 4. Effect of NPK fertilizer dose and timing of planting peanuts in crops such as corn on the values of equality land

NPK dose	Peanut Planting time			DMRT 0.05
	coincide	10 HSB	10 HST	
56: 36: 25	1.73^{a}_{p}	1.70^{b}_{p}	1.80^{a}_{p}	2 = 0.16
90: 54: 25	1.38^{b}_{q}	1.84^{b}_{p}	1.31^{c}_{q}	3 = 0.17
124: 72: 50	1.59^{a}_{q}	2.18^{a}_{p}	1.58^{b}_{q}	
DMRT 0.05	2 = 0.20	3 = 0.21		

Description: The numbers followed by letters are not the same in the same row (p, q) and column (a,b) significantly different at DMRT 0.05

Increasing doses of NPK fertilizer 124-72-50 kg ha-1 at the time of planting peanuts 10 days before planting maize is to increase crop production to the value of the land equal 2.18. This value represents the efficiency of the land, that is, if the value> 1 means profitable. Intercropping systems can increase the productivity of agricultural land if the type of plant species are combined in these systems form a mutually beneficial interaction.

Selection of corn and peanuts as the main component in the system of intercropping have a significant role, as well as corn and peanuts is a plant that is widely known and widely used as a necessity that needs to be developed and improved production. Intercropping systems can increase the productivity of agricultural land if the types of plants are combined in these systems form a mutually beneficial interaction.

Another thing to note in the pattern of intercropping is planting time, because the time of planting associated with vegetative growth, vegetative growth that is faster and dominate the space it will be better able to compete in the fight over water, nutrients and light compared with growth of vegetative slow, finally will affect production. Willey *et al*. (1982) stated that in preparing the cropping system needs to pay attention to the sensitivity of plants to competition during the life cycle. In the period of plant growth are certain periods that are very sensitive to the environment and the stress in the period, influence growth and yield. In order that competition between plant species as small as possible; it should be regulated so demand the highest growth resources for each type of plant does not occur at the same time.

Competition index is an indicator of competition among plants in the cropping system. Competition index can occur intra-specific and inter-specific. Intra-specific competition is usually greater than the inter user specific same plant growth due to compete for nutrients, water and light in the same needs. Variance showed that the interaction between NPK fertilizer and planting very significant effect on the index of competition. The highest competition index obtained in the commission of a dose of NPK 90-54-25 kg ha-1 and the treatment time of planting peanuts 10 days after planting the corn that is the index value and the carrying out of competitions 0.927 dosage of NPK 90-54-25 kg Judge 1 and treatment at the same time of planting peanuts corn is 0.924, while the lowest index gained competition is 0.876 in treatment which is a combination dosage of NPK fertilizer 124-72-50 kg ha-1 and the planting of peanuts 10 days prior to planting corn.

D. Conclusion

1. NPK fertilizer combination treatment and the treatment time of planting peanuts 10 days prior to planting corn, can promote the growth and yield of corn and peanut crops, increase productivity and reduce the index of competition and make efficient use of fertilizers.
2. The interaction between the dose of NPK 124-72-50 kg ha^{-1} and the time of planting peanuts 10 days prior to planting corn can increase crop yields of corn (6.43 t ha^{-1}) and groundnut (1.86 t ha^{-1}), resulting in land equity value is 2.18.

E. References

[BPS] Badan Pusat Statistik. (2014). Produksi Padi dan Palawija. *https://www.kolakakab.bps.go.id/* Accessed *on* August 2016.

Dande. (2014). *Pengaruh Pupuk NPK dan Waktu Tanam Kacang Tanah dalam Sistem Tumpangsari dengan Jagung Terhadap Sifat Fisik Tanah dan Produksi Tanaman Tumpangsari*. Skripsi Universitas Halu Oleo. Kendari. Unpublished Thesis.

Karimuna, L. (2000). *Florostic composition and biomass of fallow vegetation in agricultural field of Southest Sulawesi*. Georgt-Agust-University Goetinggen. Cuvillier geottingen. p : 207.

Sabaruddin L. (2003). *Model Optimasi Pemanfaatan Lahan Kering Berdasarkan Sumber Daya Iklim (Kasus DAS Tiworo, Sulawesi Tenggara)* [Disertasi]. Bogor. Program pascasarjana, Institut Pertanian Bogor.

Sabaruddin, L., Y. Koesmaryono., H. Pawitan & H.M.H.B., Djoefrie. (2003). Tanggap Fisiologi Tanaman Jagung dan Kacang Tanah dalam Sistem Tumpangsari di Lahan Beriklim Kering. J. *Agromet Vol 17. No. (1-2). p : 21-29.*

Salisbury, F.B. & C.W. Ross. (1992). *Fisiologi Tanaman* . Bandung: ITP Press.

Subandi. (2007). Teknologi Produksi dan Strategi Pengembangan*. Iptek Tanaman Pangan, 2(1), 12-25.*

Warsana. (2009). Introduksi Teknologi Tumpangsari Jagung dan Kacang Tanah. *Tabloid Sinar Tani.*

Willey, R.W., M.R. Rao., M. S. Reddy & M. Natarajan. (1982). *Cropping system with sorghum*. Sorghum in the eighties. *Proc. Of the Inter Symp. on Sorghum Patancheru, A.P. India. p : 477-489.*

Agrotech Journal
ATJ
Url: http://usnsj.com/index.php/ATJ
Email: editor.atj@usnsj.com

Effectiveness of Bio-Invigoration Technique against Viability and Vigor of Some Cocoa Seed Source

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ARTICLE INFO

ISSN: 2548-5121
Vol. 1, No. 1, December 2016
URL: http://usnsj.com/index.php/ATJ/article/view/ATJ002

Abstract

The research was aimed to evaluate the effectiveness of bio-invigoration treatment and seed sources on seed viability and vigor. The experiment was conducted in Agronomy Laboratory Unit of Agriculture Faculty of Haluoleo University, from January to May 2013. Laboratory research was arranged in split plot completely design. The main factor was variety which consisted of 3 varieties i.e. Hybrid (V1), Sulawesi 1 (V2) and Sulawesi 2 (V3). The sub plot was seed bio-osmoconditioning with rhizobacteria treatments which consisted of 6 treatments, namely: without seed bio-osmoconditioning (B0), seed bio-osmoconditioning with *Bacillus* sp. CKD061 (B1), seed bio-osmoconditioning with *P. fluorescens* PG01 (B2), seed bio-osmoconditioning with *S. liquefaciens* SG01 (B3), seed bio-osmoconditioning with *Trichoderma* sp. (B4), and seed *osmoconditioning* with KNO_3 (B5). Every treatment was replicated 3 times. Therefore, overall there were 54 experimental units. Data obtained were analized using analysis of variance and followed with Duncan's Multiple Range Test. The result of experiment in the Laboratory showed that *Bacillus* sp. CKD061 and *Trichoderma* sp. were efective in improving viability and vigor of all seed sources of cocoa seed used. In all seed sources used (Hybrid, Sulawesi 1, and Sulawesi 2), these treatment were effective in increasing germination power, homogenous growth, index vigor, and growth compared with untreated treatment. For the best result, still needed further research to evaluated stability effect of seed bio-osmoconditioning on cocoa seedling in the field.

Keywords: bio-invigoration, bio-osmoconditioning, rhizobacteria, cocoa seedling .

A. Introduction

Cocoa (Theobroma cacao L.) is one of the national commodity and plays an important role for the Indonesian economy, especially in terms of farmers' income, especially as a provider of jobs and a source of foreign exchange. Cocoa production is currently 435,000 tons to the production of smallholder plantations around 87%. The highest production of 67% was obtained from the area of cocoa production center centered in South Sulawesi, Southeast Sulawesi and Central Sulawesi. Early expansion of cocoa was performed about 25 years ago. This means that the cocoa plantations in Indonesia have been quite old that result in poor productively. Results showed that cocoa plants have aged 25 years of productivity lived half of its production potential (Suhendy, 2007). The low productivity of cocoa in general due not to use the clones/varieties and plants mostly aged older/broken as well as the low level of maintenance done by the planters.

Some factors contributing to low productivity and cocoa quality Indonesia today is the plant material is varied and unclear source, age of the plants that are old, cultivation technical implementation is very low which contributes to the high levels of pests and plant diseases. Efforts are being made to increase the productivity of cocoa is the rejuvenation and rehabilitation of the plants with the use of superior planting materials among hybrid varieties, clones Sulawesi 1, and clones Sulawesi 2. Hybrid varieties are varieties of the cross between Na 32 and UIT 1. Hybrid varieties have high yield, good quality (large seeds), and resistant to pests and diseases. Clones Sulawesi 1 and Sulawesi 2 are cocoa Lindak with purple beans, which is also resistant to pests and diseases, as well as high productivity.

One effort to improve cocoa seed vigor is through bio-engineering invigorasi seed. Bio-invigoration seed Technique can be done by matriconditioning seed or seed osmoconditioning (Ilyas, 2005). Matriconditioning is conditioning by using the media moist solids that have high water holding power. Osmoconditioning seed is conditioning by using osmotic solution such as KNO3, KH2PO4, NaCl and matinol that is not toxic to the seeds. One treatment osmoconditioning effective and relatively inexpensive is by using osmotic solution in the form of a salt KNO3. KNO3 solution of one of its functions is to accelerate the acceptance of oxygen by the seed.

This study aimed to evaluate the effectiveness of treatment of bio-invigoration and seed source in increasing its viability and vigor as well as information and reference technologies for further research as well as the technology used to be one of the methods that are effective, efficient and environmentally friendly to increase the viability and vigor cocoa seed.

B. Methodology

The study design used was completely randomized design (CRD) in a split plot pattern. The main plot is the seed source consists of three levels, namely: Hybrid (S0), Sulawesi 1 (S1), and Sulawesi 2 (S2). The subplots were perlakuaan bio-invigoration (bio-osmoconditioning) seeds, which consists of six treatments, namely: control (B0), bio-osmoconditioning Bacillus sp. CKD061 (B1), bio-osmoconditioning P. fluorescens PG01 (B2), bio-osmoconditioning S. liquefaciens SG01 (B3), bio-osmoconditioning Trichoderma sp. (B4), and osmoconditioning KNO3 (B5). Each treatment was repeated 3 times, so overall there are 54 experimental units.

The medium used for the multiplication of bacteria that TSA and TSA King's B media made of a mixture to be 20 g and 30 g TSB. Whereas for the manufacture of King's B media consists of a mixture to be 20 g, protease peptone 20 g, glycerol 15 ml, 2.5 g K2HPO4, and MgSO4.7H2O 6 g. The mixture of materials for the manufacture of TSA media and King's B were dissolved in 1000 ml of distilled water and boiled for ± 20 minutes. A mixture of materials that have been incorporated into the boiling flask and sterilized using an autoclave (T 121o C, p 1 atm, t 20 minutes). After that, the mixture is poured into a petri dish 0.5 cm thick aseptically in a laminar air flow cabinet then cooled and ready for use. Before it is used, rizobakteri grown in advance in solid TSA medium (for Bacillus sp. CKD061 and S. liquefaciens SG01), King's B (for P. fluorescens PG01), and PDA (for Trichoderma sp.) and incubated for 48 hours. Bacterial colonies growing suspended in sterile distilled water to a population density of 109 cfu / mL (one loop OSE in 10 ml of sterile distilled water). Seeds soaked in KNO3 and also suspension of Bacillus sp. CKD061, suspension isolates of P. fluorescens PG01, isolates of S. liquefaciens SG01 suspension, and the suspension of Trichoderma sp. for 8 hours. Seeds were planted in a box of 20 grain germination of seeds for each treatment. Maintenance is carried out during the execution of the research that is watering two times a day (morning and afternoon) and adapted to the growing medium moist. Observations were made on the viability and vigor. Observations on viability of seeds were germination (DB). Observation of the vigor which grows simultaneity (KST), vigor index (IV), and relative growth rate (KCT-R).

C. Result

1. Germination

Treatment of bio-osmoconditioning seed better able to increase germination hybrid cocoa seeds, Sulawesi 1, and Sulawesi 2 compared to control (Figure 1) .Compared with control, seed treatment using bio-osmoconditioning better able to increase seed germination hybrid cocoa, Sulawesi 1, and Sulawesi 2. among the six kinds of treatment of bio-osmoconditioning used, bio-osmoconditioning Bacillus sp. CKD061 and bio-osmoconditioning Trichoderma sp. give germination percentage higher than the bio-osmoconditioning P. fluorescens PG01, bio-osmoconditioning S. liquefaciens SG01, and osmoconditioning KNO3 on hybrid seed sources, Sulawesi 1, and Sulawesi 2. The hybrid cocoa seeds germination, Sulawesi 1, and Sulawesi 2 lowest was at the control and significantly different from other treatments (Figure 1). Meanwhile, three sources of seeds used, cocoa seed germination Hybrid performing better than the cacao seed Sulawesi Sulawesi 1 and 2 (Table 1).

Table 1. Effect of bio-osmoconditioning seed treatment and seed source on germination of seeds of cacao hybrids, Sulawesi 1, and Sulawesi 2

Bio-osmoconditioning Seed	Source Seed			Mean *Bio-Osmo*
	Hybrid	Sulawesi 1	Sulawesi 2	
	Germination (%)			
Control	68.33 c P	41.67 c Q	41.67 d Q	50.56
Bio-Osmo CKD061	96.67 a P	95.00 a P	95.00 a P	95.56
Osmo Bio-PG01	95.00 a P	88.33 ab Q	86.67 bc Q	90.00
Osmo Bio-SG01	93.33 a P	86.67 b P	86.67 bc P	88.89
Bio-Osmo Tricho	96.67 a P	95.00 a P	93,33 ab P	95.00
Osmo KNO3	81.67 b P	85.00 b P	80.00 c P	82.22
Mean varieties	88.61	81.95	80.56	

Description: The numbers followed by the same lowercase letters in the same column, and figures followed the same capital letters on the same line showed no significant effect on the level of DMRT 0.05.

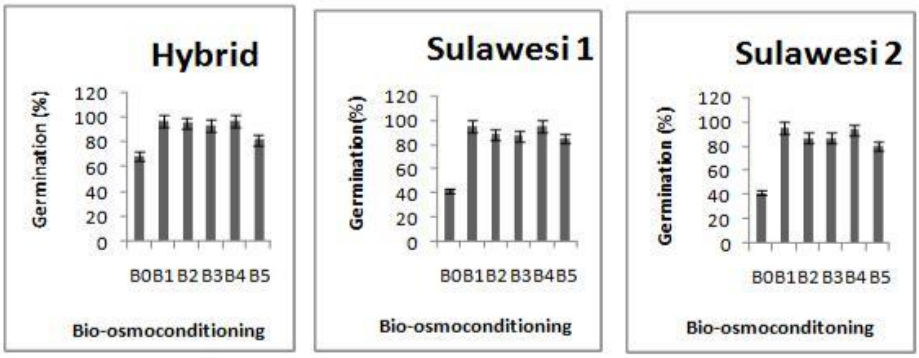

Figure 1. The hybrid cocoa seeds germination, Sulawesi 1 and 2 are chances, Sulawesi treatment of bio-osmoconditioning. B0 (control), B1 (bio-osmoconditioning Bacillus sp. CKD061), B2 (bio-osmoconditioning P. fluorescens PG01), B3 (bio-osmoconditioning S. liquefaciens SG01), B4 (bio-osmoconditioning Trichoderma sp.), B5 (osmoconditioning KNO3).

2. Growing simultaneity

Treatment of bio-osmoconditioning seeds are also better able to increase simultaneity grow cacao seeds Hybrids, Sulawesi 1, and Sulawesi 2 compared with controls. Among the six bio-osmoconditioning treatment is used, the hybrid cocoa seeds bio-osmoconditioning Bacillus sp. CKD061 and bio-osmoconditioning Trichoderma sp. provide simultaneity percentage grows higher as compared with the treatment of bio-osmoconditioning P. fluorescens PG01, bio-osmoconditioning S. liquefaciens SG01, and osmoconditioning KNO3. On Sulawesi cocoa seeds 1, only the treatment of bio-osmoconditioning Bacillus sp. CKD061memberikan simultaneity percentage grows higher than the bio-osmoconditioning P. fluorescens PG01, bio-osmoconditioning S. liquefaciens SG01, bio-osmoconditioning Trichoderma sp., and osmoconditioning KNO_3. While at the Sulawesi cocoa seeds 2, which gives the percentage grows higher simultaneity is bio-osmoconditioning Bacillus sp. CKD061, bio-osmoconditioning P.

fluorescens PG01, and bio-osmoconditioning Trichoderma sp. Simultaneity growing hybrid cocoa seeds, Sulawesi 1, and Sulawesi 2, lowest was at the control and significantly different from other treatments (Figure 2). Meanwhile, three sources of seeds used, hybrid cocoa seeds demonstrate the performance simultaneity grows better than the cacao seed Sulawesi Sulawesi 1 and 2 (Table 2).

Table 2. Effect of treatment of bio-osmoconditioning seed and seed source of the simultaneity grow cacao seeds Hybrids, Sulawesi 1, and Sulawesi 2

Bio-osmoconditioning Seed	Source Seed			Mean *Bio-Osmo*
	Hybrid	Sulawesi 1	Sulawesi 2	
	Growing simultaneity (%)			
Control	58.33 c P	36.67 d Q	36.67 b Q	50.56
Bio-Osmo CKD061	90.00 a P	86.67 a P	63.33 a Q	95.56
Osmo Bio-PG01	73.33 b P	68.33 bc P	60.00 a P	90.00
Osmo Bio-SG01	78.33 ab P	68.33 bc P	45.00 bc Q	88.89
Bio-Osmo Tricho	90.00 a P	75.00 b PQ	61.67 a Q	95.00
Osmo KNO3	75,00 ab P	63.33 c PQ	56.67 ab Q	82.22
Mean varieties	77,50	66.39	53.89	

Description: The numbers followed by the same lowercase letters in the same column, and figures followed the same capital letters on the same line showed no significant effect on the level of 0.05 DMRT.

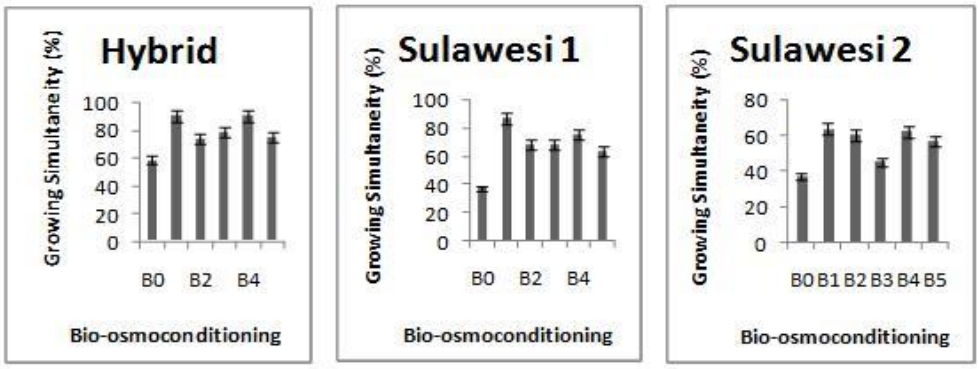

Figure 2. Simultaneity growing hybrid cocoa seeds, Sulawesi 1, and Sulawesi 2 were treated bio-osmoconditioning. B0 (control), B1 (bio-osmoconditioning Bacillus sp. CKD061), B2 (bio-osmoconditioning P. fluorescens PG01), B3 (bio-osmoconditioning S. liquefaciens SG01), B4 (bio-osmoconditioning Trichoderma sp.), B5 (osmoconditioning KNO3).

3. Index of Vigor

Among the six bio-osmoconditioning treatment that are used, the hybrid cocoa seeds bio-osmoconditioning Bacillus sp. CKD061 and bio-osmoconditioning Trichoderma sp. give vigor index percentage is higher than the bio-osmoconditioning P. fluorescens PG01, bio-osmoconditioning S. liquefaciens SG01, and osmoconditioning KNO3. At first Sulawesi cocoa seeds, bio-osmoconditioning Bacillus sp. CKD061 give vigor index percentage is higher than the bio-osmoconditioning P. fluorescens PG01, bio-osmoconditioning S. liquefaciens SG01, bio-osmoconditioning Trichoderma sp., and osmoconditioning KNO_3. While at the Sulawesi cocoa seeds 2, which gives a high percentage vigor index is bio-osmoconditioning Trichoderma sp., and osmoconditioning KNO3. The lowest Hybrid cocoa seed vigor index was at the control and significantly different from other treatments. In Sulawesi 1 seed, the lowest vigor index was at the control and significantly different from the treatment of bio-osmoconditioning Bacillus sp. CKD061 but no significant treatment with bio-osmoconditioning P. fluorescens PG01, bio-osmoconditioning S. liquefaciens SG01, bio-osmoconditioning Trichoderma sp., and osmoconditioning KNO3. While at the Sulawesi 2cocoa seeds, the lowest vigor index was at the control and significantly different from the treatment of bio-osmoconditioning Bacillus sp. CKD061 bio-osmoconditioning P. fluorescens PG01, bio-osmoconditioning Trichoderma sp., and osmoconditioning KNO_3 but no significant effect on the treatment of bio-osmoconditioning S. liquefaciens SG01 (Figure 3).

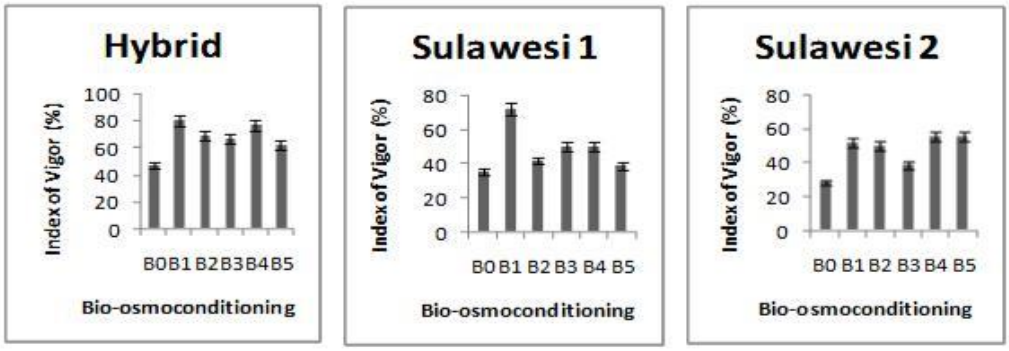

Figure 3. Hybrid cocoa seed vigor index, Sulawesi 1, and Sulawesi 2 were treated bio-osmoconditioning. B0 (control), B1 (bio-osmoconditioning Bacillus sp. CKD061), B2 (bio-osmoconditioning P. fluorescens PG01), B3 (bio-osmoconditioning S. liquefaciens SG01), B4 (bio-osmoconditioning Trichoderma sp.), B5 (osmoconditioning KNO3).

Table 3. Effect of bio-osmoconditioning seed treatment and seed source of the cacao seed vigor index Hybrids, Sulawesi 1, and Sulawesi 2

Bio-osmoconditioning	Source Seed			Mean
Seed	Hybrid	Sulawesi 1	Sulawesi 2	*Bio-Osmo*
	Vigor Index (%)			
Control	46.67 c P	35.00 b PQ	28.33 c Q	36.67
Bio-Osmo CKD061	80.00 a P	71.67 a P	51.67 a Q	67.78
Osmo Bio-PG01	68.33 ab P	41.67 b Q	50.00 ab Q	53.33
Osmo Bio-SG01	66,67 ab P	50.00 b Q	38.33 bc Q	51.67
Bio-Osmo Tricho	76.67 ab P	50.00 b Q	55.00 a PQ	60.56
Osmo KNO3	61.67 b P	38.33 b Q	55.00 a P	51.67
Mean varieties	66.67	47.78	46.39	

Description: The numbers followed by the same lowercase letters in the same column, and figures followed the same capital letters on the same line showed no significant effect on the level of 0.05 DMRT.

Meanwhile, three sources of seeds used, cocoa seed vigor index Hybrids performed better than the cacao seed Sulawesi 1 and Sulawesi 2 (Table 3).

4. Relative Growing Speed

Table 4. Effect of bio-osmoconditioning seed treatment and seed source to grow relative speed hybrid cocoa seeds, Sulawesi 1, and Sulawesi 2

Bio-osmoconditioning	source Seed			Mean
Seed	Hybrid	Sulawesi 1	Sulawesi 2	*Bio-Osmo*
	Speed Relative Growth (% / etmal)			
Control	74.28 c P	44.67 d Q	43.79 d Q	54.24
Bio-Osmo CKD061	112.61 a P	105.46 a PQ	99.35 a Q	105.81
Osmo Bio-PG01	102.61 a P	Bc 90.67 Q	92,66a b Q	95.31
Osmo Bio-SG01	103.72 a P	91.47 bc PQ	87,84b c Q	94.34
Bio-Osmo Tricho	111.45 a P	Ab 99.90 Q	95.17 a Q	102.17
Osmo KNO3	89.94 b P	87.23 c P	85.66 c P	87.61
Mean varieties	99.10	86.57	84.08	

Description: The numbers followed by the same lowercase letters in the same column, and figures followed the same capital letters on the same line showed no significant effect on the level of 0.05 DMRT.

Seed treatment using bio-osmoconditioning able to increase the speed of growth relative hybrid cocoa seeds, Sulawesi 1, and Sulawesi 2 compared to control (Figure 4). Treatment of bio-osmoconditioning Bacillus sp. CKD061 and bio-osmoconditioning Trichoderma sp. provide the best relative growth rate compared to the control and treatment of bio-osmoconditioning P. fluorescens PG01, bio-osmoconditioning S. liquefaciens SG01, osmoconditioning KNO_3 in hybrid cocoa seeds. On Sulawesi cocoa seeds 1, only the treatment of bio-osmoconditioning Bacillus sp. CKD061 which gives the highest relative growth rate compared with other treatments. While in the Sulawesi 2 cocoa seed, which gives the highest relative percentage growth rate is the

treatment of bio-osmoconditioning Bacillus sp. CKD061 and bio-osmoconditioning Trichoderma sp. Relative growth rate was lowest for the control seeds and significantly different from other treatments (Figure 4). Meanwhile, three sources of seeds used, cocoa seed Hybrids show performance relative growth rate is better than the cacao seed Sulawesi 1 and Sulawesi 2 (Table 4).

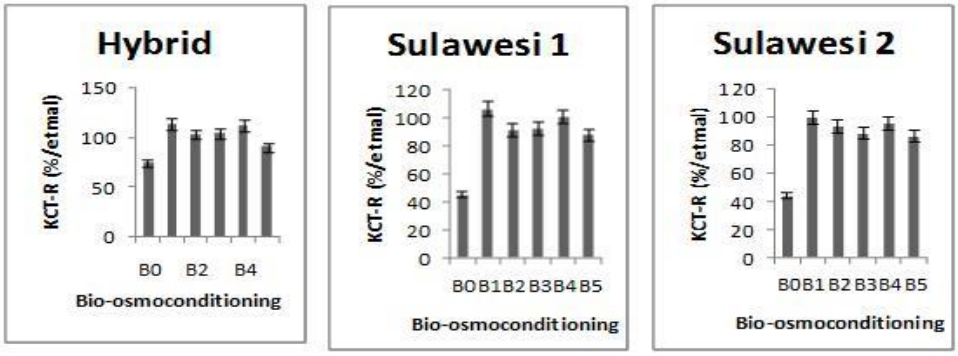

Figure 5. Relative Growth rate of hybrid cocoa seeds, Sulawesi 1, and Sulawesi 2 were treated bio-osmoconditioning. B0 (control), B1 (bio-osmoconditioning Bacillus sp. CKD061), B2 (bio-osmoconditioning P. fluorescens PG01), B3 (bio-osmoconditioning S. liquefaciens SG01), B4 (bio-osmoconditioning Trichoderma sp.), B5 (osmoconditioning KNO3).

D. Discussion

The results showed that the treatment of bio-invigoration (bio-osmoconditioning) seeds significantly able to improve the viability and vigor of cocoa compared with controls. The results of this study are consistent with results of previous studies showing that the use of bio-invigoration (bio-osmoconditioning) as a seed treatment able to improve the viability and vigor of plants. Bio-osmoconditioning seed treatment proven effective in improving the viability and vigor of plants (Ilyas *et al.,* 2002; Sutariati, 2006; Wahid *et al*., 2008; Moradi and Younesi, 2009).

Bio-osmoconditioning seed treatment was done to address the low productivity due to the use of seeds bervigor low. Seed vigor was reflected by two informations about viability, respectively the growing strength and storability of seed. Treatment of bio-osmoconditioning seed showed the very real differences between seed treated with seed bio-osmoconditioning the untreated bio-osmoconditioning. The observation of several variables viability and vigor showed that rizobakteri Bacillus sp. CKD061 and Trichoderma sp. respond more to the cocoa seeds, while P. fluorescens PG01, S. liquefaciens SG01, and KNO3 not provide a response to the cacao seeds used. Rizo-bacterial colonization by the host plant, begins when the seeds germinate. At the same time, rizobakteri also need adequate nutrition for growth and development. Generally rizobakteri nutrients derived from organic acids released its host, and type of organic acids is certainly different between plants with one another. Therefore, the lack of contributions made by the host rizo-bacterial likely caused by a lack of acquisition of nutrients from its host.

The results showed that the treatment of bio-osmoconditioning Bacillus sp. CKD061 and bio-osmoconditioning Trichoderma sp. able to increase the percentage of seed germination compared to the control and treatment of bio-osmoconditioning P. fluorescens PG01, bio-osmoconditioning S. liquefaciens SG01, osmoconditioning KNO 3 (on a hybrid cocoa seeds, Sulawesi 1, and Sulawesi 2).

The observation of the highest percentage of simultaneity grow hybrid cacao seeds and Sulawesi 2 is shown by the treatment of bio-osmoconditioning Bacillus sp. CKD061 and bio-osmoconditioning Trichoderma sp. meanwhile, on Sulawesi cocoa seeds 1, the highest percentage growth synchrony obtained in the treatment of bio-osmoconditioning Bacillus sp. CKD061.

Hybrid seed vigor index highest cocoa obtained in the treatment of bio-osmoconditioning Bacillus sp. CKD061 and bio-osmoconditioning Trichoderma sp. Meanwhile, on Sulawesi cocoa seeds 1, only the treatment of bio-osmoconditioning Bacillus sp. CKD061 are better able to increase the percentage of cocoa seed vigor index. On Sulawesi cocoa seeds 2, which gives the highest percentage vigor index is the treatment of bio-osmoconditioning Trichoderma sp. and osmoconditioning KNO3. In observation of relative growth speed hybrid cocoa seeds, Sulawesi 1, and Sulawesi 2, the highest relative growth rate obtained in the treatment of bio-osmoconditioning Bacillus sp. CKD061 and bio-osmoconditioning Trichoderma sp. From the

experimental results show that the hybrid seed source provides better performance than the seed source Sulawesi 1 and Sulawesi 2.

Treatment of bio-osmoconditioning Bacillus sp. CKD061 in continuity give a better response compared to other treatments and control on plant growth. This is presumably because Bacillus sp. CKD061 can produce growth hormone IAA, gibberellins, and cytokinins, in addition to its ability to dissolve phosphate and nitrogen fixation (Timmusk *et al*., 2005). According to Sutariati & Wahab (2010), Bacillus sp. CKD061 capable of producing IAA with a concentration of 346.97 ppm. IAA is the active form of the hormone auxin found in plants and plays in improving cell development, spur growth, and increase the activity of enzymes.

In addition to acting spur plant growth, Bacillus sp. also able to increase the availability of nutrients with its ability to fix N & P. Use of Rizo- bacteria dissolving solvent phosphate that can substitute some or the entire crop needs to be an element of P can give positive results on plant growth. Nutrient phosphate is indispensable in the metabolism of plants, among others to stimulate plant growth, root development, fruit growth, improve quality and strengthen resistance to pests and diseases. Dissolution of phosphate is caused by bacteria that produce enzymes that can break phosphate phosphatase bound by organic compounds, for example phospholipids and glycolipids that provides nutrients into a form that is available so that the availability of adequate plant P (Joner *et al*., 2000). While the ability to embed P of compound P are bound by gibsid due rizobakteri ability to produce organic acids.

The ability of Trichoderma sp. spur the growth of the plant has been reported by Hajieghrari (2010) on corn seeds by Trichoderma. Isolates of Trichoderma sp. is able to increase the length of roots and shoots of corn seeds and to improve the conductivity of stomata. This is because some isolates of Trichoderma sp. is able to produce factors that can encourage the growth of plants or produce phytohormones such as Indole Acetic Acid (IAA) and similar hormones (Vinale *et al*., 2008). In addition, Trichoderma sp. is able to accelerate the process of decomposition of organic matter and then provide nutrients for plants (Chet, 2001).

E. Conclusion

1. All three source of seeds were used in this study (Hybrids, Sulawesi 1, and Sulawesi 2) responsive to the treatment of bio-invigoration (bio-osmoconditioning) seeds were given, indicated by an increase in the viability and vigor of cocoa.
2. Treatment of bio-osmoconditioning Bacillus sp. CKD061 and bio-osmoconditioning Trichoderma sp. gives a better effect on the viability and vigor of cocoa.

F. References

Chet, I. (2001). Effect of Trichoderma harzianum on Microelement Concentrations and Increased Growth of Cucumber Plants. Plant Soil, 235(2), 235-242.

Hajieghrari, B. (2010). Effects of Some Iranian Trichoderma Isolates on Maize Seed Germination and Seedling Vigor. *African J Biotech,* 9 (28), 4342-4347.

Ilyas, S. (2005). Perubahan Fisiologis dan Biokimia dalam Proses Seed Conditioning. *Keluarga Benih* Vol. VI, 2: 70-79.

Ilyas, S., Sutariati, G.A.K., Suwarno & F.C., Sudarsono. (2002). Matriconditioning Improved Quality and Protein Level of Medium Vigor Hot Pepper Seed. *Seed Technol*. 24:65-75.

Joner, E.J., I.M., Aarle & M., Vosatka. (2000). Phosphatase Activity of Extraradical Arbuscular Mychoriza hyphae: A review. *Plant Soil* 226:190-210.

Moradi, A., Younesi, O., 2009. Effects Of Osmo- and Hydro-Priming On Seed Parameters Of Grain Sorghum (*Sorghum Bicolor* L.). *Australian Journal Of Basic And Applied Sciences*, 3(3): 1696-1700.

Suhendy. (2007). Rehabilitasi Tanaman Kakao: Tinjauan Potensi, Permaslahan, Rehabilitasi Tanaman Kakao di Desa Primatani Tonggolobibi. Prosiding Seminar Nasional 2007. Pengembangan Inovasi Pertanian Lahan Marginal. Departemen Pertanian.

Sutariati, G.A.K & A., Wahab. (2010). Isolasi dan Uji Kemampuan Rizobakteri Indigenus sebagai Agensia Pengendali Hayati Penyakit pada Tanaman Cabai. J. 20(1): 86-95.

Timmusk, S., N. Grantcharova & E.G.H., Wagner. (2005). Paenibacillus polymyxa Invades Plant Roots and Forms Biofilms. Appl. Environ. *Microbiol*. 71:7292-7300.

Vinale, F., K. Sivasithamparam, E.L. Ghisalberti. R. Marra, M.J., Barbetti, H. Li., S.L., Woo & M. Lorito. (2008). A Novel Role for Trichoderma Secondary Metabolites in the Interactions with Plants. *Physiol Mol Plant Pathol* 72, 80-86.

Wahid, A., Noreen A, Shahzad, M.A., Basra., Gelani., S. & Farooq, M. (2008). Priming-Induced Metabolic Changes in Sunflower (Helianthus annuus) Achenes Improve Germination and Seedling Growth. *Botanical Studies* 49: 343-350.

Agrotech Journal
ATJ
Url: http://usnsj.com/index.php/ATJ
Email: editor.atj@usnsj.com

Analysis of Legowo Row Planting System and System of Rice Intensification (Sri) of Paddy Field (*Oryza Sativa* L.) Toward Growth and Production

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ARTICLE INFO

ISSN: 2548-5121
Vol. 1, No. 1, December 2016
URL: http://usnsj.com/index.php/ATJ/article/view/ATJ003

Abstract

Rice is the main commodity crops in the province of Gorontalo, in addition to maize and pulses. One alternative technology to increase productivity is through application of Legowo cropping system that is engineered way of planting the tiles so that there is a spacious room extends to one direction between two rows of rice plants, while the other way seemed more tightly. In rice cultivation with system of transplanting, planting distance is one factor of production that is very important because it determines the productivity achieved. This research is expected to be a reference for farmers, especially in the province of Gorontalo to carry rice cultivation so as to increase the production of rice plants. The design of the study is a Randomized Complete Block Design by comparing between systems that are often used by farmers, namely row planting system tiles (S0), the system of row planting Legowo (2: 1) (S1), system of row planting Legowo (4: 1) (S2), planting system SRI (S3). The parameters of observations made were plant height, number of tillers, production (kg/plot), and observations of soil samplesman. The results showed treatment plant system of tiles provide number of tiller and height of plants that are best compared with other treatments. The best results for a number of productive tillers, the average production of grain/plot, grain weight of 1000 grain was in the treatment plant system Legowo row 2: 1.

Keywords: Legowo, SRI, cropping systems, paddy field

A. Introduction

Rice is the main commodity crops in the province of Gorontalo, as well maize and pulses. Efforts to increase production have been carried out, both in extensification and intensification. Efforts to increase production have been carried out, both in intensification and intensification. However, in recent years, increasing of rice production in the province of Gorontalo does not reach the expected target, while demand for rice continues to increase every year. Projected demand for rice in the year 2010, about 41.50 million tons and is expected to rise to 78 million tons in 2025, so that by 2010 there will be a deficit of about 12.78 million tons of rice (13.50% per year) if no improvement productivity and expansion of harvest area. The average productivity of paddy rice by the Provincial Agriculture Office of Gorontalo in 2014 was 49.18 ku per hectare that the production is not too much different from the years 2012 and 2013 which is 48.01 and 52.01 ku per hectare (BPS, 2015).

Production of rice in the province of Gorontalo was still below the average of the national rice production that is 51.28 ku per hectare. This is because the area of agricultural land decreases in the presence of wetland conversion to non-paddy fields. One alternative technology to increase productivity is through application of cropping system Legowo that is engineered way of planting the tiles so that there is a spacious room extends to one direction between two rows of rice plants, while the other way seemed more tightly. In rice cultivation with system of transplanting, planting distance is one factor of production that is very important because it determines the productivity achieved.

Legowo row planting system (tajarwo), a planting system that takes into account the array. Legowo row pattern is alternating between two or more rows of rice planting and one blank row. The goal of the system Legowo row planting is that the plant population per hectare can be maintained and even improved (Nazlah, 2011), according to Sakti & Ihwan (2012) system Legowo row planting makes all plants into plants aside to absorb sunlight and good air circulation, gain nutrients are evenly and simplify maintenance of plant.

Conventional cropping systems that generally performed by farmers in Gorontalo is a tile row planting system that is 20 x 20 cm or 25 x 25 cm. With rows of tiles this system, the plant population is estimated 160-180 thousand plants per hectare. Through the planting system Legowo 2: 1 & 4: 1, from some of the research results can improve plant population, approximately 15-25% of the population of rows of tiles. Therefore, by simply introducing the system of planting in paddy rice farming that is done by farmers in Gorontalo, is expected to increase rice production in the province of Gorontalo. In this regard, it is necessary to do research on the effects of different cropping systems on the performance and growth of rice production.

B. Methodology

The research was conducted in the form of experiments were arranged in a Randomized Block Design consisting of four (4) treatment planting method. The treatment is S_0 (tiles row planting system (control)), S_1 (Legowo row planting system (2: 1)), S_2 (Legowo row planting system (4: 1)) and S3 (S.R.I cropping system). Dose of fertilizer are used according to the recommendations after the use of the Test Device Wetland, each treatment was repeated four (4) times so that there are twenty plots treated with the size of the plots 4 m x 6 m. Implementation of research activities include seed preparation, seed selection, land preparation, seeding, planting, maintenance, fertilizing, observation, and harvest.

Seeds were used in this study is a new high yielding varieties (VUB) Inpari 7. Seed selection is done by laying eggs in a container of water, the container is added a little salt to the eggs floating around in the middle of the container. Then the seeds to be sown soaked in a salt solution. The seeds that float was discarded while the sank seeds was used for scattering in the nursery. Seedbed given Urea 400 gr., planting space adjusted with a spacing of 25 cm of farmers in general, as well as the spacing of Legowo row that has been modified to suit their treatment, namely Legowo row 2: 1 and Legowo row 4: 1 with 2-3 seeds per clump. While for the SRI cultivation system, transfer of seedlings from the nursery to the plots with seedlings treated using 3 weeks after transplanting (WAT) or 21 WAT. With a spacing of 30 cm x 30 cm, as many as 1 seedling per hill. Parameter observations of plant height, number of tillers, production, grain weight is one thousand grains, the number of filled grain, grain hollow, and the number of grains per tassel.

C. Result

1. Number of Tillers

Cropping systems significantly affect the number of seedlings produced by rice paddy fields Inpari 24 at ages 2 WAT, 4 WAT and 6 WAT. The results of a further test using test Honestly Significant Difference (HSD). The average number of tillers by observation at age 2 WAT, 4 WAT, and 6 WAT.

Table 1 shows that at ages 2 WAT to 6 WAT treatments cropping system significantly compared with the tile system (control). Treatment tile system showed the highest results in the number of tillers compare other treatments.

Table 1. Average Number of Tillers Age 2, 4, 6 WAT Paddy field (*Oryza sativa* L.)

Cropping system	Average Number of Tillers		
	2 WAT	4 WAT	6 WAT
Tilles row (S0)	8.15c	28.45c	43.05b
Legowo 2:1 (S1)	6.95b	28.95c	51.00c
Legowo 4:1 (S2)	6.95bc	23.25b	37.20a
SRI (S3)	1.90a	18.10a	44.30b
HSD 0.05		2.80	
HSD 0.01	1.16		4.30

Description: The figure followed by the same letter are not significantly different at the level of advanced HSD test 0.05 and 0.01. WAT: Weeks After Crop.

2. Plant Height

Results of statistical analysis of high accretion rice plant during the observation to observation 2 MST, 4 MST, 6 MST is as follows

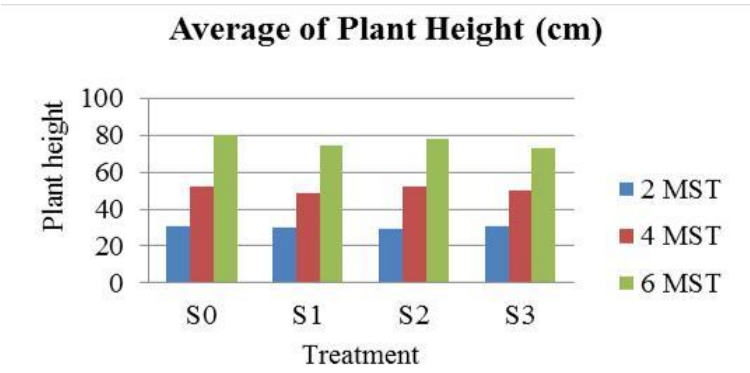

Figure 1. Average of Plant Height

Figure 1 shows that treatment of cropping systems provide a significantly different effect compared to the control treatment. The highest treatment is treatment of tiles compared to other treatments

3. Number of Productive Tiller

The observation of the number of productive tillers and statistical analysis are not significantly affected all treatments. Diagram of average number of seedlings each treatment can be seen in figure 2.

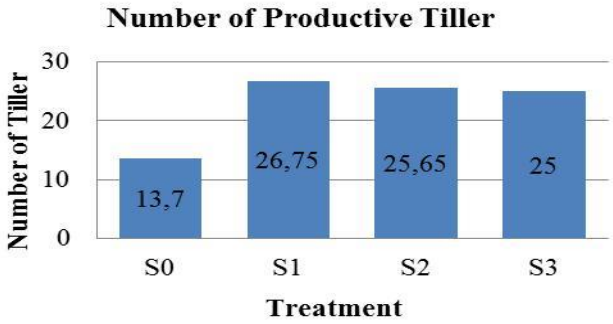

Figure 2. Number of Productive Tiller

Figure 2 shows that treatment of cropping system Legowo 2: 1 showed the highest yield compared with treatment with other cropping systems. The treatment of system Legowo 4: 1 and system of S.R.I shows the number of tillers that is higher than the cropping system tiles.

4. Production of grain/plot (kg)

Results of statistical analysis for the treatment of cropping systems on the production of grain / plot are as follows:

Table 2. Average production of Grain / Plot Paddy field (Oryza sativa L.)

Treatment	Average of Production
	Grain/Plot (kg) in Water content 22 % (kg)
Tilles row (S0)	28.85 a
Legowo 2:1 (S1)	48.00 c
Legowo 4:1 (S2)	38.40 b
SRI (S3)	33.60 b
BNT 0.01	6.96

Description: The figure followed by the same letter are not significantly different at the level of advanced HSD test 0.05 and 0.01.

Table 2 shows that the treatment system of Legowo row planting and cropping system of S.R.I provide a significantly different effect than tiles cropping systems (control). Treatment Legowo row planting system 2: 1 showed the best results compared to the treatment of other cropping system.

5. Grain Weight of 1000 grains (g)

The observation of grain weight of 1000 grains and statistical analysis showed no real effect on each treatment. Diagram of 1000 grain weight of each treatment can be seen in figure 3

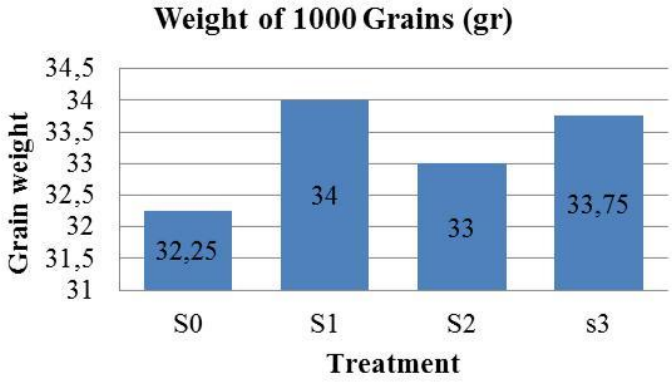

Figure 3. Weight of 1000 grains

Figure 3 shows the treatment using Legowo row planting system 2: 1, Legowo 4: 1, S.R.I cropping system showed a higher yield than the cropping system tiles. The treatment of cropping systems 2: 1 showed the grain weight of 1000 grains that is the highest as compared to the control treatment.

D. Discussion

At age 2 MST, tiles cropping systems produce the most number of suckers compared to four other cropping systems. This is due to the age of 2 weeks after planting, planting system tiles are commonly grown by farmers as much as 5-8 seeds/hill more than seeds planted 2-3 seeds/hill at planting system Legowo and SRI are only 1 seeds/hill. But at the age of 4 WAT and 6 WAT, the number of seedlings produced Legowo system 2: 1 began to evolve to become the most widely compared cropping system tiles and SRI. This is consistent with results of previous studies that the cropping system Legowo 2: 1 can increase the number of tillers up to 15-20%.

Legowo cropping systems, particularly Legowo 2: 1 result in the production of highest grain/plot with 48.00 kg/plot is significantly different from that of grain production/plot of four other cropping systems. This is in line with the Legowo planting system that can increase the number of tillers through clumps of plants inset on the edge. Increasing the number of chicks that influential to the amount produced panicles and grain/panicle formation. Through the planting system Legowo 2: 1 open space (Legowo) becomes greater that causes photosynthesis role in grain filling to be optimal. Excellence Legowo row planting system, when compared to tile cropping system is the number of plants per unit area more, so productivity is more, with the distance of alternating air circulation and causes the incoming sunlight more.

Higher yields achieved by Legowo cropping system than the system of tiles. The wider spacing of tillers produce more, better root growth compared with a spacing narrower, but to get grain quality grain seeds are better used Legowo 2: 1. Legowo 2: 1 is able to reduce the void caused by the effects of plant roadside (Badan Litbang Pertanian, 2007). Results of research of Abdulrahman *et al.* (2011) showed that in cropping Legowo 2: 1 with a spacing (25 x 12.5 x 50) cm, is able to increase the yield between 9.63 to 15.44% compared to the model of the tiles.

Ease obtained on the system Legowo according Kamandalu *et al*. (2006) in the way of weeding, fertilizing and plant maintenance, while the problems still faced by farmers in the application of planting Legowo system, inter alia: the farmers are not yet convinced of the technology cropping system Legowo, lack capital, lack of agricultural machinery, and the lack of detailed information on cropping system Legowo.

Production of rice from the research results in the conversion of hectares that each treatment S0 = 12, 02 tons/ha, S1 = 20.00 tons/ha, S2 = 10.98 tons/ha, S3 = 16.00 tons/ha and S4 = 14.00 tons/ha. Thus it can be seen that among the tested treatments, treatment Legowo row planting system 2: 1 provides the highest result among other treatment.

E. Conclusion

1. The Legowo cropping systems in general may increase the number of tillers and grain production/plot cropping system than the tiles and the SRI system. The production is converted into hectares that each treatment S0 = 12.02 tons/ha, S1 = 20.00 tons/ha, S2 = 10.98 tons/ha, S3 = 16.00 tons/ha, and S4 = 14.00 tons/ha.
2. Planting system Legowo 2: 1 is the best cropping systems that can significantly increase the number of tillers and grain production/plot.

F. References

Abdulrachman, S., Agustiani, L.M., Zarwazi, & I., Syarifah. (2011). Peningkatan efisiensi penggunaan air pada padi sawah (>2%) melalui sistem aerobik. Laporan Hasil Penelitian. Balai Besar Penelitian Tanaman Padi.

Balai Litbang Pertanian. (2007). Petunjuk Teknis Lapang Pengelolaan Tanaman Terpadu (PTT) Padi Sawah Irigasi. Departemen Pertanian. Jakarta. 40p.

[BPS] Badan Pusat Statistik. (2012). Data Produksi dan Produktivitas Padi. Gorontalo. *http://gorontalo.bps.go.id*. *Accessed* on july 2016.

Kamandalu, A.A.N.B., I.B.K., Suastika, & I.K.D., Arsana. (2006). Kajian sistem tanam jajar legowo terhadap produksi padi sawah. Prosiding seminar nasional percepatan transformasi teknologi pertanian untuk mendukung pembangunan wilayah. Balai Besar Pengkajian dan Pengembangan Teknologi Pertanian. Bogor. 586 p.

Nazlah. (2011). Pengaruh Penerapan teknologi sistem tanam legowo terhadap Pendapatan. *http://repository.usu.ac.id.* Accessed on August 2016.

Sakti, J., & Ihwan. (2012). Kepadatan Populasi *Scirphopaga Innotata* Walker (lepidoptera ; Pyralidae) pada Sistem Tanam Legowo 2 : 1 dan Sistem Tanam Tandur Jajar. [Skripsi]. Universitas Hasanuddin, *http://repository.unhas.ac.id*. Accessed on August 2016.

Agrotech Journal
ATJ
Url: http://usnsj.com/index.php/ATJ
Email: editor.atj@usnsj.com

Estimation of Genetic Parameters, Correlation, and Genetic Relationship of Tomatoes Genotype in Lowland

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ARTICLE INFO

ISSN: 2548-5121
Vol. 1, No. 1, December 2016
URL: http://usnsj.com/index.php/ATJ/article/view/ATJ004

Abstract

The cultivation of tomato in lowland experience many obstacles, such as low produvtivity. One effort to increase tomato productivity in lowland is through selection of tomato genotype for high yield and yield component in lowland. This study aims to determine the variability based on genetic information, heritability and correlation of characters as well as the yield components of tomato genotypes relationship patterns in the lowlands. A Randomized Complete Block Design was used to characterization base on best genotype of yield component character, genetic variability, broad sense heribility and correlation to yield. Genotype of tomato tested had diverse characteristics. Best genotypes based on the yield character is IPB T1, based on the number of fruit per plant is IPBT30, based on the fruit length and day to flowering is IPB T74, based on the fruit diameter is IPB T73 and fruit thickness is IPBT60. Wide genetic diversity has a high heritability. Number of fruit per plant, fruit length, fruit diameter, and fruit thickness has a wide genetic diversity and high heritability. Yield characters has a narrow genetic diversity and heritability is low. Characters that have a direct impact on the yield are the fruit diameter. Based on the cluster analysis, tomato genotypes are grouped into five groups. Group I consists of seven genotypes (IPBT1, IPBT58, IPBT60, IPBT64, IPBT78, IPBT80 and IPBT82), group II consists of one genotype (IPBT74), group III consists of three genotypes (IPB T13, IPB T73 and IPB T86), group IV consists of five genotypes (IPBT3, IPBT33, IPBT43, IPBT53, and IPBT3) which is characterized by fruit thickness, fruit length and days to flowering, and group V consists of one genotype (IPBT30).

Keywords: cluster analysis, genetic variability, heritability, lowland

A. Introduction

Tomato is one of the vegetables that have priority to be developed in Indonesia. Tomato as a vegetable commodities market has a bright prospect. Tomatoes have many uses, both as a vegetable and as raw material for the food and beverage industry. The market potential tomatoes can also be seen in terms of price that is affordable by all segments of society, thus opening up greater opportunities to the market uptake.

When viewed from the average production, it turns out tomatoes in Indonesia is still low, at 6.3 ton/ha compared with countries Taiwan and India were respectively 21 ton/ha and 9.5 ton/ha. The low productions of tomatoes in Indonesia likely due to the varieties grown are not suited to the environmental conditions. Most tomato varieties is only suitable grown in the highlands, but often occurs planting tomatoes regardless of environmental conditions, so that the yield and quality of the fruit produced is very low. Tomato ability to produce fruit is highly dependent on the interaction between plant growth and environmental conditions (Wijayani & Widodo, 2005).

In Indonesia, tomato cultivated in the highlands (60%) and in the lowlands (40%) (Purwati, 2007). The average yield of tomato cultivation in the lowlands are generally around 6.0 ton/ha, whereas in the highlands reached 26.6 ton/ha. Shifting the tomato planting area to the lowlands is causing downside risks to the quality and fruit production. High temperatures not only affect the time of fruit ripening, but also on the growth rate in tomato fruit (Adams, Cocksshull & Cave, 2001). The increase in temperature of 2 – 4$_o$C of the optimum temperature reported to influence the development of gametes and inhibit the formation of fruit resulting in lower production of tomatoes (Peet *et al.*, 1997; Sato *et al.,* 2001; Firon *et al.*, 2006).

The low production in the lowlands is partly due to the limited varieties of potentially high yield (Purnamaningsih, 2008; Purwati, 1997). Therefore, the use of high yielding varieties of tomatoes that are adaptive lowland is seen as an effective way to solve the problems on tomatoes grown in lowland.

The first step that must be done in the activities of plant breeding for resistant varieties is the formation of a population base with high variability (Poespodarsono, 1988). High genetic diversity is crucial to establish a successful breeding of improved varieties (Mangundidjojo, 2003). The genotypes that have been collected was then characterized, analyzed the diversity and relationships are to facilitate the activity of plant breeding. In addition, please also known heritability characters that will be targeted selection (Pinaria *et al*., 1995). In this study, estimation of genetic variability, heritability and genotype grouping character based production components to determine the selection criteria. The objective of this research was to determine genetic variability base on genetic information, heritability, correlation and genetic relationship of tomoto genotype at lowland.

B. Methodology

The experiment was conducted in March 2012 - August 2012 at the IPB Research Field, Leuwikopo Bogor (250 m above sea level). The type soil is latosol. The study was conducted using Randomized Complete Block Design with three replication. Each experimental unit consisted of 20 plants. Plant material used were consisted of 17 tomato genotypes collection of Plant Breeding Laboratory of Agricultural Department IPB, namely IPBT1, IPBT3, IPBT13, IPBT30, IPBT33, IPBT43, IPBT53, IPBT58, IPBT60, IPBT63, IPBT64, IPBT73, IPBT74, IPBT78, IPBT80, T82IPB, IPBT86.

Cultivation techniques used are standard in tomato cultivation techniques. Tomato seeds germinated the seedling tray containing sterile growing media until age 4 Weeks After Planting. After giving the manure and basic, beds covered with black plastic mulch silver. Spraying pesticides, insecticides and fungicides is done according to recommended dosage. Characters are observed is the number of fruits per plant (fruit), fruit weight per plant (g), fruit length (mm), fruit diameter (mm), fruit thickness (mm), day to flowering (HST), and hardness of fruit.

C. Result and Discussion

Tests on some genotypes showed a marked influence on the character of the amount of fruit production, fruit length, fruit diameter (Table 2). The number of fruits per plant genotypes best in IPBT3 (104.24) and vary with other genotypes except IPB T30, T33 IPB, IPB T33 and T53 IPB. The number of fruits per plant genotype lowest in IPBT74 is 18.92. Best production on the genotype IPB T1 (1696.4 g per plant) and the lowest in genotype IPB T74 (669.4 g per plant). Production IPB T1, IPB T3, IPB T13, IPB T33, IPB T43, IPB T58, IPB T60, IPB T63, IPB T64, IPB

T73, IPB T78, IPB T80, IPB T80, IPB T82 and IPB T86 better than IPB T30 IPB T53, T74 IPB. The fruit length of the best fruit in the IPB T74 genotype (52.22 mm) and the shortest at IPB T30 genotype (27.19 mm). IPBT58, T60IPB, IPBT74, IPBT78, IPBT80 and IPBT82 have the best fruit length compared to other genotypes. The fruit diameter of the largest is IPBT73 and different from other genotypes except IPB T1, IPBT60, and IPB T86, whereas the diameter of the smallest fruit in IPBT30 genotype (27.69 mm).

Table 2. Average of characters of tomato production

Genotype	Number of Fruit (fruit/plant)	Fruit weight (g per plant)	Fruit Length (mm)	Fruit Diameter (mm)
IPB T1	43.46 bc	1696.4 a	41.01 cd	48.18 ab
IPB T13	50.25 bc	1470.6 ab	39.94 cd	43.57bcd
IPB T30	126.29 a	914.6 bc	27.19 e	27.69 f
IPB T33	128.82 a	1171.6abc	29.04 e	31.51 f
IPB T43	48.64 bc	1023.2abc	37.7 d	37.67 de
IPB T53	113.33 a	916.0 bc	28.90 e	30.16 f
IPB T58	31.80 bc	995.0abc	49.00 ab	40.03cde
IPB T60	32.86 bc	1041.5abc	45.94abc	45.85abc
IPB T63	54.33 b	1194.0abc	39.10 cd	37.55 e
IPB T64	45.68 bc	1083.5abc	45.02bcd	41.81cde
IPB T73	53.87 b	1420.4 ab	27.67 e	51.46 a
IPB T74	18.92 c	669.4 c	52.22 a	38.73 de
IPB T78	31.29 bc	1015.1abc	51.31 ab	42.12cde
IPB T80	37.28 bc	1217.2abc	45.78abc	45.24 bc
IPB T82	47.04 bc	1271.6abc	46.20abc	40.02cde
IPB T86	63.38 b	1484.1 ab	27.35 e	48.62 ab

Description: Figures followed by the same letters in the same column are not significantly different at DMRT 0.05

Table 3. Average of production of component of tomato germplasm

Genotype	Fruit Thick (mm)	Days to Flowering (HST)	Fruit Hardness
IPB T1	4.55 def	32.0 ab	1.58abcde
IPB T3	4.40 ef	27.6 c	1.69abcde
IPB T13	4.81cde	29.3 bc	1.31 cde
IPB T30	3.59 fg	27.6 c	0.93 e
IPB T33	3.66 fg	30.6 bc	1.19 ed
IPB T43	4.24 efg	30.6 bc	0.96 e
IPB T53	3.38 g	31.3 abc	1.55abcde
IPB T58	5.67 bc	32.0 ab	2.10 abc
IPB T60	5.51 bc	33.3 ab	2.18 a
IPB T63	4.9 cde	30.6 bc	1.83 abcd
IPB T64	6.28 ab	30.6 bc	1.71abcde
IPB T73	4.08 efg	27.6 c	1.47abcde
IPB T74	5.40bcd	35.0 a	2.12 ab
IPB T78	5.51 bc	30.6 bc	1.34 bcde
IPB T80	6.68 a	30.6 bc	1.23 de
IPB T82	5.96 ab	31.0 bc	1.40abcde
IPB T86	4.22 efg	29.3 bc	1.52 bcd

Description: Figures followed by the same letters in the same column are not significantly different at DMRT 0.05

Table 3 shows that the character of thick fruit, days to flowering, fruit hardness and water content fruit real effect on genotype was observed. The range of values observed thickness of the fruit is 3:38 mm - 6.68 mm. Genotype best for fruit character is IPB T80 thickness (6.68 mm), IPB T64 (6:28 mm) and IPB T82 (5.96 mm). While the genotype with the smallest

thickness of the fruit is IPB T53 (3:38 mm), IPB T30 (3:59 mm), IPB T33 (3.66 mm), IPB T43 (4:24 mm), IPB T73 (4:08 mm) and IPB T86 (4:22 mm). Genotypes with a faster flowering date is IPB T74 (35 HST) and the longest flowering date on IPB IPB T30 and T73 respectively 27.6 HST. Violence is best fruit IPB T60 (2.18) and genotype with the thinnest thickness of the meat is IPB T30 (0.93), while for the water content of the highest fruit on IPB T1 (89.95%) and the lowest in the IPB T60 (4.93%).

Selection is the basis of all plant improvements to get new varieties. Genetic variability plays a very important because the higher the genetic variability the greater the chance of getting a source of genes for the character to be repaired. Table 4 presents the coefficient of genetic variability of some character of tomato yield component. The coefficient of genetic variability (CGV) ranges between 1:47% to 55.17%. CGD highest value on characters number of fruits per plant. Based on the classification Pinnaria *et al*. (1995) shows that the characters have a broad genetic variability is the number of fruit per plant, fruit length, fruit diameter, and thickness of the flesh of the fruit, while a character with low genetic variability is the fruit weight per plant, days to flowering, and fruit hardness.

Extensive genetic variability is a condition of the course of the selection process effective because it will provide more flexibility in the process of selecting a genotype. Extensive genetic variability showed a genetic influence is more dominant compared to environmental influences. Characters with low genetic variability tends to be influenced by environmental factors, a quantitative controlled by many genes (Martono, 2009).

Table 4. The coefficient of genetic variability, genetic variability predictive value and heritability

Characters	CGV	σ_2 G	$2\,\sigma\,\sigma^2{}_G$		h^2_{bs}	
			Value	Criteria	Value	Criteria
Number of fruits per plant	55.17	1120.41	811.09	Large	79.84	High
Fruit weight per plant	11.62	18083.37	48302.57	Narrow	11:56	Low
Fruit length	22:48	77.27	55.12	Large	82.85	High
Fruit diameter	17:04	44.42	31.82	Large	81.99	High
Fruit thickness	2:33	0.87	0.64	Large	76.90	High
Day of flowering	5:03	2.37	2.61	Narrow	35.59	moderate
Fruit hardness	18.80	0.08	0.10	Narrow	33.27	moderate

Description: CGD: Coefficient of Genetic Variability, σ_2 G: Genetic variance, $\sigma\,\sigma_{2\,G}$: standard deviation of genetic variance, h_{2bs} : Broad sense heritability.

The heritability estimates ranged characters were observed between 11:56% to 82.85% (Table 4). The heritability estimates a character you need to know to predict whether the character is more influenced by environmental or genetic factors. High heritability indicates that genetic factors influence the phenotype is greater compared to environmental influences. High heritability values that play a role in improving the effectiveness of selection (Syukur *et al*., 2010).

Characters that have a heritability in the broad sense that higher is the number of fruit per plant, fruit length, fruit diameter, and thickness of the fruit. While the characters have a low heritability is the production of fruits per plant. Program Selection of a character less effective when estimating the heritability is low. In this study, the production of fruits per plant cannot be used as selection criteria because it has a low heritability.

Table 5. Correlation of the observed phenotypic characters

Characters	FN	FL	FD	FT	DF	FH	Prod
FN	1.00	-0.634**	-0.529**	-0.601**	-0.365**	-0.308*	0.189
FL		1.00	0.358*	0.784**	0.477**	0.184	-0.0005
FD			1.00	0.446**	0.067	-0.035	0.523**
FT				1.00	0.255	0.112	0.052
DF					1.00	0.435**	-0.257
FH						1.00	-0.262
Prod							1.00

Note: * = significantly correlated to the level of 5%. ** = Highly significant correlation at level 1%. NF = number of fruits per plant (fruit per plant), Prod = Production, weight per plant (g per plant), FL =Fruit Length (mm), FD = fruit diameter (mm), FT = Thickness of fruit (mm), DF = day to flowering (DAT), FH = fruit hardness.

On tomato plants, fruit weight per plant, the main character is expected to be high. Inheritance of these characters is complex and may involve a number of other characters. Therefore, the selection of which is aimed at improvement of production need to consider the other characters. Results of correlation analysis shows that the characters positively and significantly correlated with yield (fruit weight per plant) are the fruit diameter (Table 5). Character number of fruit, and thick fruit was positively correlated but not significant. While the character of fruit length, days to flowering and fruit hardness negatively correlated and not significant. Determination of characters that can be used as effective selection criteria can be seen from the correlation with the yield (weight per plant). In addition, the information of genetic variability and heritability also determine the selection criteria. Based on these three things, characters that can be used as selection criteria in this study is the fruit diameter.

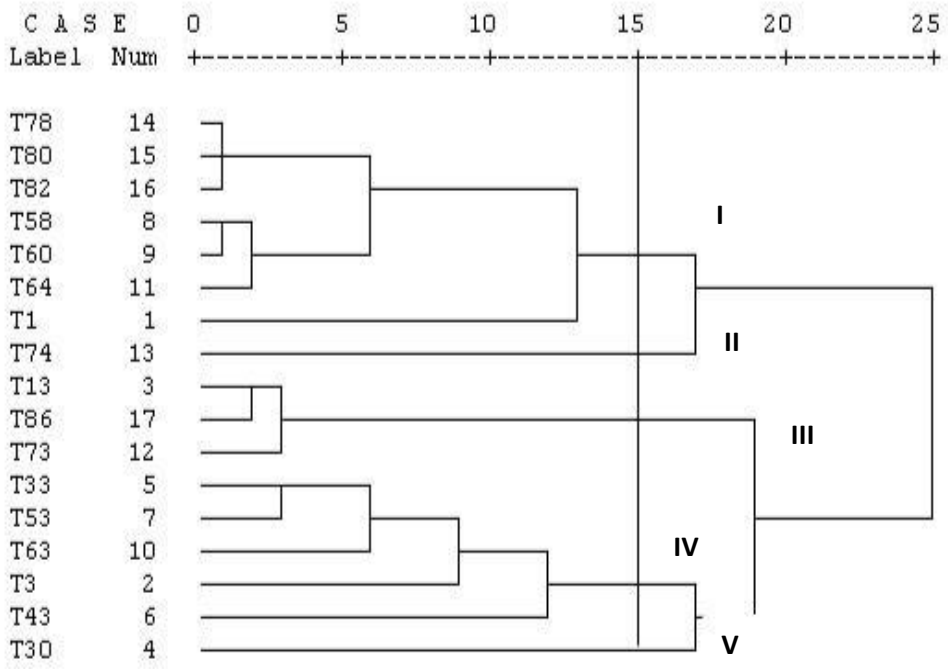

Figure 1. Dendogram tomato based character of production and component production.

Relationship patterns more accurately done by grouping based on relationships between genotypes were analyzed. Analysis conducted clump aims to group data (observations) into several classes, so that members in the class is more homogeneous (similar) compared to members in another class. Grouping criteria are based on a similarity measure (Djuraidah, 1991). Santoso (2004) states that one technique is a technique of grouping hierarchy, which start two or more objects by grouping the closest similarity, so as to form a sort of tree where there is a clear level between objects of the most similar to least like.

Cluster analysis performed on 17 genotypes of tomato with 8 characters produces Dendogram as in Figure 1. At 85% similarity level, 17 tomato genotypes were grouped into five cluster. Group I consists of seven genotypes (IPB T1, IPB T58, IPB T60, IPB T64, IPB T78, IPB T80 and IPB T82), group II consists of one genotype (IPB T74), group III consists of three genotypes (IPB T13, IPB IPB T73 and T86), group IV consists of five genotypes (IPB T3, T33 IPB, IPB T43, T53 IPB and IPB T3), and group V consists of one genotype (IPB T30).

Principal component analysis was conducted to determine traits or characters that distinguish individual genotypes by cluster analysis just knowing grouping based on a particular character, but cannot know with certainty distinguishing these groupings. The results of principal component analysis based on the character of yield and yiled components presented in the scatter diagram indicates that no genotype group based on the character of fruit weight per plant, and number of fruits (Figure 2). Genotype IPB T3, T33 IPB IPB T30 and T53 IPB clustered based on the character of fruit hardness, fruit length and days to flowering. This approach is based on the analysis grouping clump in group IV consisting of IPB IPB T3, T33 IPB and IPB T53. While genotype IPB T1, IPB T13, IPB T43, IPB T58, IPB T60, IPB T63, IPB T64, IPB T73, IPB T74, IPBT78, IPB T80, IPB T82, IPB T86 clustered based on fruit diameter and thickness of the fruit on principal component analysis.

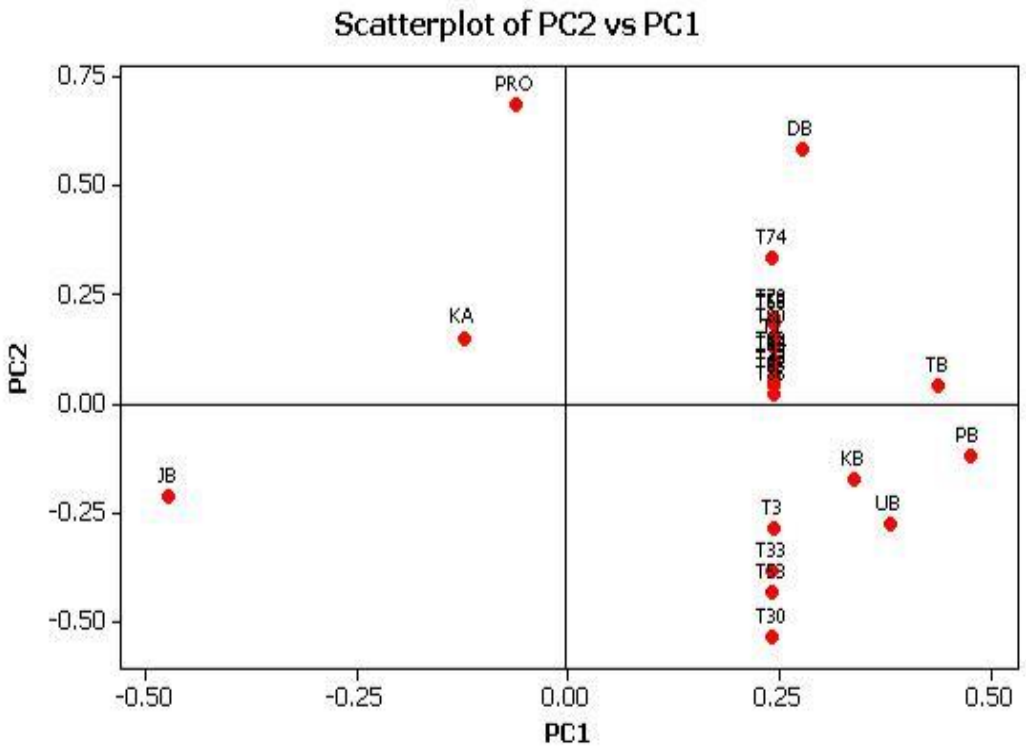

Figure 2. Diagram scatter of tomato based character of production and component production.

D. Conclusion

Genotype tomato plants tested had diverse characteristics. Best genotypes based on the character of yield (fruit weight per plant) is IPB T1, based on the number of fruit per plant is IPB T30, based on the character fruit length and day to flowering is IPB T74, based on the fruit diameter is IPB T73 and fruit thickness is T60. Wide genetic variability has a high heritability. Character number of fruit per plant, fruit length, fruit diameter and fruit thickness has a wide genetic variability and high heritability rate. Characters production has a narrow genetic variability and low heritability. Characters that have a direct impact on the fruit weight per plant are the fruit diameter.

Based on the cluster analysis, tomato genotypes are grouped into five groups. Group I consists of seven genotypes (IPBT1, IPBT58, IPBT60, IPBT64, IPBT78, IPBT80 and IPBT82), group II consists of one genotype (IPBT74), group III consists of three genotypes (IPB T13, IPB T73 and IPB T86), group IV consists of five genotypes (IPBT3, IPBT33, IPBT43, IPBT53, and IPBT3) which is characterized by fruit thickness, fruit length and days to flowering, and group V consists of one genotype (IPBT30).

E. References

Adams, S.R, K.E. Cockshull, & C.R.J. Cave. (2001). Effect of Temperature on the Growth and Development of Tomato Fruits. *Annals of Botany* , 88, 869-877.

Djuraidah, A. (1991). Simulasi Analisis Gerombol Dengan Pendekatan Penguraian Sebaran Campuran Normal Ganda pada data MSS LANDSAT. [Tesis]. Fakultas Pascasarjana. IPB. Bogor.

Firon N, R. Shaked, M.M. Peet, D.M Pharr, E. Zamski, K. Rosenfeld, L. Althan, & E. Pressman. (2006). Pollen Grains of Heat Tolerant Tomato Cultivars Retain Higher Carbohydrate Concentration under Heat Stress Conditions. *Scientia Horticulturae*, 10, 212-217.

Mangoendidjojo, W. (2003). *Dasar-dasar Pemuliaan Tanaman*. Yogyakarta: Kanisius.

Martono, B. (2009). Keragaman Genetik, Heritabilitas dan Korelasi Antar Karakter Kuantitatif Nilam (*Pogostemon* sp.) Hasil Fusi Protoplas. *Jurnal Littri* 15 (1): 9-15.

Peet M.M., D.H., Willits, & R.G., Gardner. (1997). Responses of Ovule Development and Postpollen Production Processes in Male-Sterile Tomatoes to Chronic, Sub-Acute High Temperature Stress. *Journal of Experimental Botany*, 48, 101-111.

Pinaria, S., A. Baihaki, R., Setiamihardja, & A.A., Daradjat. (1995). Variabilitas Ganetik dan Heritabilitas Karakter-karakter Biomassa 53 Genotipe Kedelai. *Zuriat* 6(2): 88-92.

Poespodarsono, S. (1988). Dasar-dasar Ilmu Pemuliaan Tanaman. Pusat Antar Universitas, Institut Pertanian Bogor. Bogor.

Purnamaningsih, R. (2008). Perakitan Tanaman Tomat Partenokarpi untuk Meningkatkan Produksi Tomat Di Dataran Rendah. *Warta Biogen* Vol. 4, No. 2, Agustus 2008. Purwati, E. (2007). Varietas Unggul Harapan Tomat Hibrida (F1) dari Balitsa. IPTEK Hortikultura 3: 34-40.

Santoso, S. (2004). *SPSS Statistik Multivariat*. Jakarta: Elex Media Computindo.

Sato, S., Peet, M.M., & Gardner, R.G. (2001). Formation of partenocarpic fruit, undeveloped flowers and aborted flowers in tomato under moderately elevated temperatures. *Scientia Horticulture*, 90:243-254.

Syukur M., Sujiprihati S., Yunianti R., & Nida K. (2010). Pendugaan Komponen Ragam, Heritabilitas dan Korelasi untuk Menentukan Kriteria Seleksi Cabai (Capiscum annum L.) Populasi *F5*. *J. Hort. Indonesia* 1(3):74-80.

Wijayani, A. & W., Widodo. (2005). Usaha meningkatkan kualitas beberapa varietas tomat dengan sistem budidaya hidroponik. *Ilmu Pertanian* Vol. 12 No.1: 77 - 83

Agrotech Journal
ATJ
Url: http://usnsj.com/index.php/ATJ
Email: editor.atj@usnsj.com

The Effect of Natural Guano Organic Fertilizer on Growth and Yield of Spring Onion (*Allium fistulosum* L.)

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ARTICLE INFO

ISSN: 2548-5121
Vol. 1, No. 1, December 2016
URL: http://usnsj.com/index.php/ATJ/article/view/ATJ005

Abstract

A field experiment was aimed at investigating the effect of natural guano organic fertilizers on growth and yield of Spring Onion (*Allium fistulosum* L.). The experiment was conducted from September to Nopember, 2014 in Unamendaa Village, Kolaka District. It was prepared by using a randomized block design (RBD) with single factor namely doses of natural guano organic fertilizers. The treatments consisted of 4 levels were : (1) G_0 = control or no treatment, (2) G_1 = dose of 6 kg unit^{-1} (equivalent to 5 t. ha^{-1}), (3) G_2 = dose of 12 kg unit^{-1} (equivalent to 10 t. ha^{-1}) and (4) G_3 = dose of 18 kg unit^{-1} (equivalent to 15 t. ha^{-1}), respectively. Every treatment was replicated 3 times, therefore overall there were 12 experimental units. Data was collected on growth and yield parameters of Spring Onion : (1) plant height, (2) number of leaves, (3) number of tillers, (4) diameters of stem and (5) yield (plant fresh weight unit-1). Data obtained were analyzed using Analysis of Variance (Anova) and followed by Duncan's Multiple Range Test (DMRT) at the 1 % level. The result of experiments showed that fertilizations using natural guano organic was significantly affected on : plant height, number of leaves, number of tillers, diameter of stem and plant fresh weight, respectively. Untill fertilization of 18 kg unit-1 (G_3) were able to increased the growth and yield of Spring Onion, hence it was showed better performance on all parameters.

Keywords: Allium fistulosum, fertilizer, guano, natural, organic, spring onion

A. Introduction

Leek (Allium fistulosum L.) is one of the important vegetable that has the potential to be developed intensively and commercial production for marketing prospects not only for the domestic market in the domestic market but also overseas (exports), (Laude & Tambing, 2010). In Indonesia, scallions are used as a food seasoning or a mixture of various foodstuffs are highly favored by almost everyone and has a relatively high nutrient content (Rukmana, 1995 in Nazari, 2010). According to Sunaryono (1996), nutrient content scallion shallot higher than that among other things contains a lot of vitamin A, Vitamin C and slightly Vitamin B.

Plant leeks are less demanding requirements specific soil and climate for growth. Good drainage clay, organic matter content enough or loose structure, soil pH range 6-7, grows well in the lowlands to the highlands (2000 m), contain enough nutrients and need intensive watering during its growth are some of the important factors plants need scallion (Sutarya & Grubben, 1995).

Fertilization is one way to meet the availability of nutrients for plants in dry lands due to various problems nutrient such as erosion and run off that many away the nutrients elsewhere,

brought at the time of harvest, organic matter content is low, the content of macro nutrients are low and etc. According to Adiningsih (2005), intensive dry land planted with no or little action returns organic matter and fertilizer, as well as supported by the rugged topography, generally have low organic matter content (less than 1%). Satari (1987) adds that the content of macro nutrients N, P, K, Ca and Mg on dry land is low and the level of toxicity of Al and Mn high enough lead to lower soil fertility. Farming conventionally tend to use inputs of inorganic fertilizers and synthetic pesticides in high doses and intensively, it can improve results in the short term but in the long term can lead to many problems such as the hardening and soil compaction, dewatering several micro-nutrients, groundwater pollution and the resurgence of certain types of pests and diseases that decrease the productivity and quality of land (Suwandi *et al*., 2015) and are not sustainable or environmentally friendly (Reijntjes *et al*., 1999 ; Narkheda *et al*., 2011).

Utilization of organic fertilizer is an alternative to overcome the problem of degradation of soil fertility as a result of the use of synthetic inorganic fertilizers were excessive and intensive (Suwandi *et al*., 2015). Subhan *et al*., (1998) stated that the use of organic fertilizers and the whole system utilization in vegetable production is aimed to improve the yield and quality of vegetables, improving the quality of soil fertility, reduce the input of synthetic inorganic fertilizers as well as environmentally friendly and sustainable. One type of organic fertilizer rich in nutrients but often overlooked is the natural fertilizer guano.

Fertilizer guano nature, derived from bat droppings or bird that had long to settle in the cave (Sediyarso, 1999, in Amrizal, 2012) and has been mixed with the soil and bacterial decomposition (Sintia, 2010) and has an abundance of organic matter are very high (Rahmadi, 2004). The content of the fertilizer guano natural origin bat droppings in general is 10% N, 3% P and 1% K (Wiyatna, 2002) while according to Sediyarso (1999) that the fertilizer guano from bat droppings generally contain 15% N, 4.4 to 5.2% P and 1.7% K. Jamil *et al*., (2014) stated that in addition to containing macro nutrients N, P, K, Ca, Mg, S, C, H and O, the fertilizer natural guano also contains micronutrients Fe, Mn, Zn, Cu, B, Mo and Cl.

Results of research Harahap *et al*., (2003) on natural guano fertilizers on growth and yield of potatoes in medium plateau in South Tapanuli shows that the highest tuber yield of 15.75 tons ha-1 derived from guano fertilizer dosage 15 ton ha-1, followed successively: the tuber yield 15.42 tons ha-1 at a dose of 20 tons of guano fertilizer ha-1, the tuber yield 15.20 tons ha-1 at a dose of 15 tons of guano fertilizer ha-1, the tuber yield 13.10 tons ha -1 doses of cow manure 20 ton ha-1, the tuber yield 12 tons ha-1 at a dose of 5 tons of guano fertilizer ha-1, and the lowest tuber yield of 8.6 ton ha-1 was obtained from the control treatment (without organic fertilizer).

Natural guano fertilizer application to plant onion and other vegetable crops have not been widely publicized, both in doses guano fertilizer plant species (varieties) as well as a variety of guano fertilizer combined with other organic fertilizers or inorganic fertilizers. The purpose of this study was to determine the effect of natural guano fertilizer on the growth and yield of leek (*Allium filostaum* L.). Results are expected to be an alternative solution in the field of the use of organic fertilizers, particularly on vegetable crops, to improve productivity and quality of dry land that has been widely degraded by the use of inorganic fertilizers and synthetic pesticides excessive.

B. Material and Method

Research conducted in September until November 2014 in the village of Unamendaa Kolaka on lowland wetland. Materials used are onion seeds of local species, organic fertilizer derived from natural guano cave in conservation forest areas in the district Mangolo Latambaga Kolaka.

The study was designed according to a randomized block design to a single factor, namely natural guano fertilizer dose. The treatment consisted of 4 levels, namely: (1) G0 = control or without fertilizer, (2) G1 = dosage of 6 kg plot^{-1} or equivalent 5 ton ha^{-1}, (3) G2 = dose of 12 kg plot^{-1} or equivalent 10 ton ha^{-1} and (3) G3 = dose of 18 kg plot^{-1} or the equivalent of 15 tons ha^{-1}; and repeated 3 times so that altogether there are 12 experimental units. Each unit consists of a trial plot area of 4 m x 3 m and a sample of observations taken diagonally as much as 5 plants (excluding crop edge).

Before planting, the ground plowed beforehand twice and created experimental plots measuring 4 m x 3 m. Guano fertilizer before use, dried in advance for one day to remove acids and bad odor. Fertilization is done seven days before planting during the second treatment but no inorganic fertilizers are applied. Planting is done with a spacing of 30 cm x 20 cm. Maintenance is done manually include replanting, weeding, tilling, watering, fertilizing and pest or disease. Pesticides are prepared only to anticipate if the physical-mechanical control is not

successful in controlling pests / diseases. Harvesting is done at the age of 60 hst and observations were made at the plant shortly before the harvest time.

Observations parameter in terms of height (cm), number of leaves (leaf), the number of tillers (stems), stem diameter (cm) and yield in the form of fresh stover weight per plot (kg). Data were analyzed using analysis of variance (ANOVA) while difference between couples treatment done using Duncan's Multiple Range Test or Duncan's Multiple Range Test (DMRT) at the level of 1%.

C. Result

Recapitulation of observations on the effect of organic manure natural guano against average plant height, number of leaves, number of tillers, stem diameter and yield fresh Stover per plot, can be seen in Table 1.

Table 1. Summary of Responses Plants Due Fertilization Natural Guano

Guano Fertilizer Natural	Plant height (cm)	Number of leaves (leaf)	Number of Tillers (rod)	Diameter (cm)	Fresh stover results per plot (kg)
G0	32.14 a	24.40 a	4.73 a	2.37 a	31.57 a
G1	36.02 b	32.17 ab	5.47 a	3.30 a	41.65 ab
G2	38.03 bc	34.07 ab	6.20 ab	3.37 a	47.01 ab
G3	39.99 c	43.43 b	7.86 b	4.77 b	57.36 b

Description: The numbers followed by different letters in the same column, significantly different according to Duncan's Multiple Range Test (DMRT) at the level of 1%.

1. Plant Height

Statistical analysis showed that the dose of natural fertilizer guano very significant effect on plant height at 60 days after planting. Treatment G3 (dose 18 kg plot-1 or the equivalent of 15 tons ha-1) tends to increase plant height scallion (39.99 cm), even though the treatment was not significantly different from G2 treatment (dose of 12 kg plot-1 or equivalent 10 ton ha-1), (38.03 cm) but significantly different with G1 treatment (dose 6 kg plot-1 or equivalent to 5 ton ha-1), (36.92 cm) and G0 treatment (control), (32 , 14 cm). G0 treatment (control) generating plant height lowest of all treatments were attempted but this treatment was not significantly different with the treatment G1 and G2 but highly significant with the treatment G3. The relationship between the dose of fertilizer guano and the average height of the plants is presented in Figure 1.

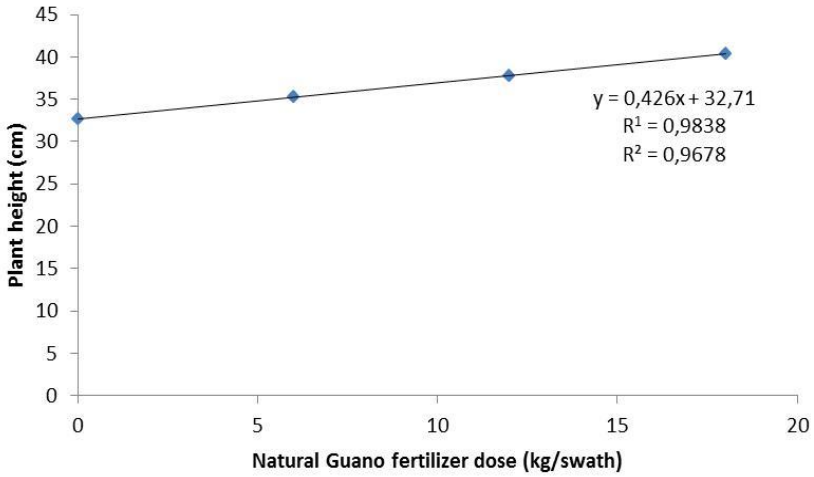

Figure 1. The relationship between the dose of natural fertilizer guano and the average height of the plants.

2. Number of Leaves

Statistical analysis showed that the dose of natural fertilizer guano very significant effect on the number of leaves at the age of 60 HST. Treatment G3 produces the highest number of leaves (43.43 piece), although not significantly different from the treatment of G2 and G1 (respectively at 34.07 and 32.17 piece) but highly significant with G0 treatment (control), (24, 40 strands). Control treatment resulted in the lowest number of leaves and this treatment was not

significantly different with the treatment of G1 and G2, but highly significant with the treatment G3. The relationship between the dose of guano fertilizer and the number of leaves is presented in Figure 2.

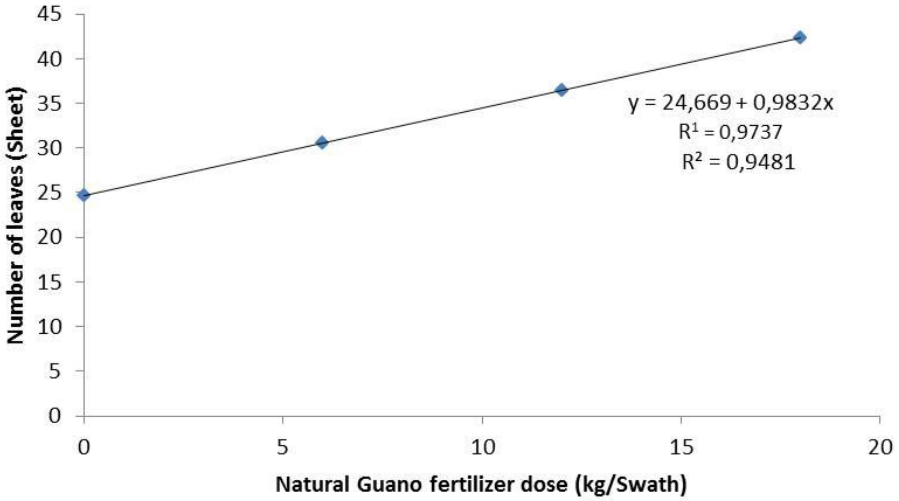

Figure 2. The relationship between the dose of natural fertilizer guano and the average number of leaves

3. Number of Tillers

Statistical analysis showed that the dose of natural fertilizer guano very significant effect on the number of puppies at the age of 60 HST. The number of chicks produced by treatment of G3 (7.86 bars) and this treatment was not significantly different to the treatment of G2 (6.20 bars) but highly significant with the treatment G1 (5.47 bars) and the control treatment (4.73 bars), Control treatment resulted in the lowest number of tillers and this treatment was not significantly different to the treatment G1, G2 and G3 but highly significant with the treatment G3. The relationship between the dose and the number of tillers guano fertilizer is presented in Figure 3.

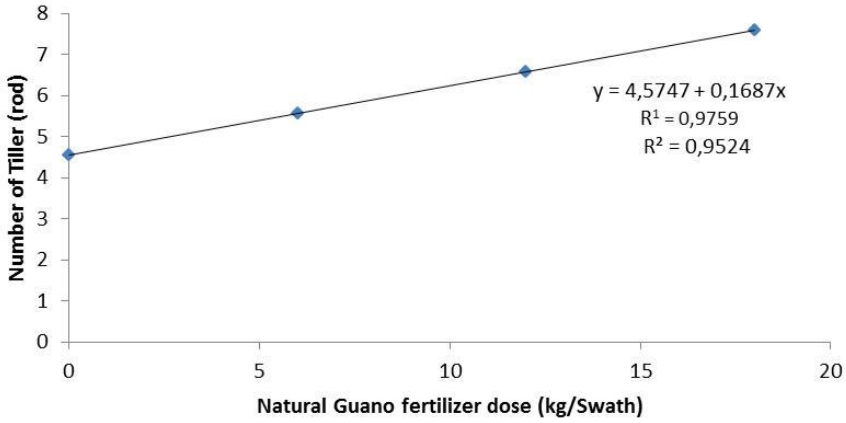

Figure 3. The relationship between the dose of natural fertilizer guano and the average number of tillers

4. Rod Diameter

Statistical analysis showed that the dose of natural fertilizer guano very significant effect on stem diameter at age 60 HST. The highest stem diameter obtained in the treatment G3 (4.77 cm) and the treatment of this highly significant with G2 treatment (3.37 cm), G1 (3.30 cm) and G0 or controls (2.37 cm). Lowest trunk diameter produced by G0 treatment, although not significantly different from G1 and G2 treatment but highly significant with G3 treatment. The relationship between the dose of fertilizer guano and stem diameter, is presented in Figure 4.

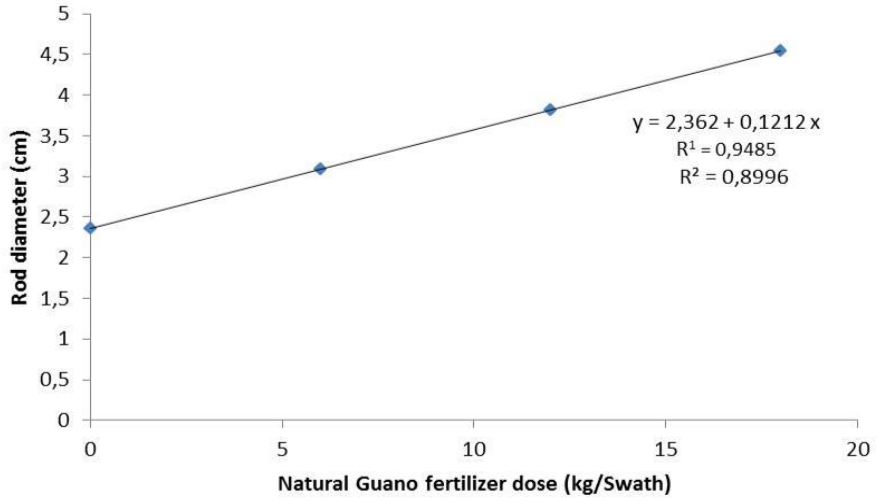

Figure 4. The relationship between the dose of natural fertilizer guano and the average diameter of the rod

5. Result Fresh Stover per Plot (kg)

Statistical analysis showed that the dose of fertilizer guano very significant effect on the results of fresh Stover per plot was weighed at age 60 HST. G3 treatment still showed the highest results fresh Stover (57.36 kg) and the treatment was not significantly different from the treatment of G2 (47.01 kg) and G1 (41.65 kg) but highly significant with G0 or control treatment (31.57 kg). Lowest fresh Stover results obtained G0 or control treatment, although not significantly different from G1 and G2 treatment but highly significant with G3 treatment. The relationship between the dose of guano fertilizer and plant fresh Stover results, presented in Figure 5.

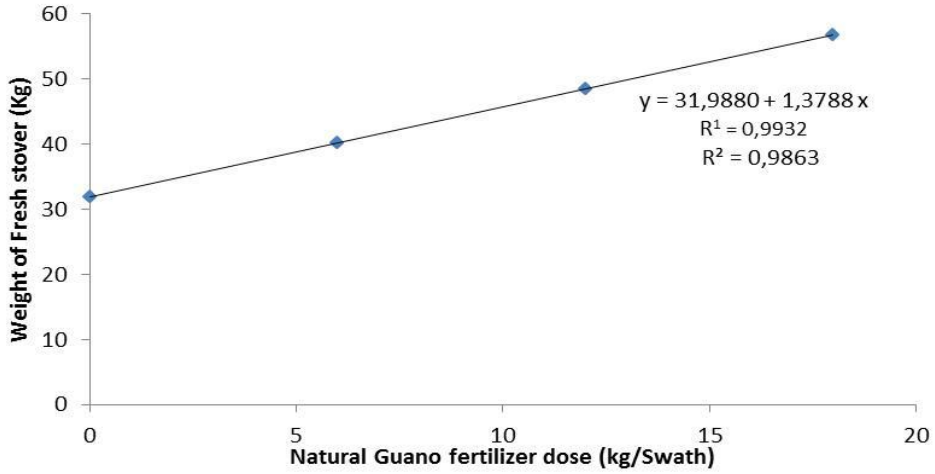

Figure 5. The relationship between the dose of natural guano fertilizer and yield (Weight of fresh Stover)

D. Discussion

The results showed that fertilization using organic fertilizer guano natural up to a dose of 18 kg plot-1 or the equivalent of 15 tons ha^{-1} (G3) was still increasing parameter plant height, number of leaves, number of tillers, stem diameter and yield Stover fresh per plot , It is presumed that the organic fertilizer guano is a complete fertilizer that contains lots of macro nutrients such key N, P, K, Ca, Mg, S and micro nutrients like Fe, Mn, Zn, Cu, B, Mo and Cl (Jamil *et al*., 2014) which is needed in increasing the growth and yield.

Setyamidjaya (1999) asserts that nitrogen (N) plays an important role in stimulating the vegetative growth of the plants (roots, stems, leaves) so that the plants sprout, stem enlarged and increase the number of tillers, make the plants become greener because it contains chlorophyll which is involved in the process of photosynthesis as well as a basic material building blocks of protein and fat. Phosphorus (P) plays a role in accelerating the growth of the roots so that the process of absorption of water and nutrients take place optimally, accelerate

flowering and ripening, increasing the magnification seeds for plants producing seeds/fruit and the core building blocks of cells, fat and protein. Potassium (K) serves expedite the process of photosynthesis, helping the formation of proteins and carbohydrates, hardened rods/straw, increases resistance to the quality of lodging and increase crop yields. Mg element plays activate an enzyme involved in the metabolism of carbohydrates and as the building blocks chlorophyll. Elements Ca stimulate the formation of root hairs, grains, as a catalyst in the cells adjacent to each other and help improve the process of cell division. Elements S boost in vitamins and protein helps the formation of chlorophyll and enhances the formation of nodules on the plant Leguminosae. Elements Fe mainly helps the formation of chlorophyll, Mn assist in the preparation of chlorophyll and photosynthesis, seed and fruit development. Zn and Cu was instrumental in the preparation of enzymes and chlorophyll formation and important element in improving the quantity and quality of fruit plants and vegetables as well as plants Leguminosae and takes on organic soils. Mo is needed for the process of nitrogen fixation and Cl to improve the quantity and quality of crops.

According to Hardjowigeno (2003) in addition to contributing nutrients for plant growth, organic fertilizers have other privileges because it can improve the physical properties of the soil (soil structure), increasing the capacity of soil aggregates in binding of water and nutrients, improve soil aeration and porosity. Subsequent impact is well developed root system, water and nutrient absorption takes place optimally and affects plant growth and development systems. Djuarnani *et al*., (2005) states that the provision of organic fertilizers, the availability of nutrients in the soil can be improved and CEC increased due the cations freed from the bonds of absorptive soil colloids into free ions that can be absorbed well by plants.

In Figure 1, 2, 3, 4 and 5 it appears that the influence of fertilization guano nature until at doses of 18 kg plot^{-1} or the equivalent of 15 tons ha^{-1} (G3) was still linear positively to the parameters plant height, leaf number, number tillers, stem diameter and yield fresh Stover. The correlation coefficients of each regression, very strong (greater than 0.90) means fertilizers very strong influence on all parameters observed and yet obtained optimum dose. This means also that fertilization with organic manure natural guano until the dose is still a good effect on the physical properties of soil and subsequent positive effect on the growth and yield. Lingga and Marsono (2003) asserts that organic fertilizers can improve soil physical properties and further increase the availability and uptake of nutrients by plants. Lakitan (2000) states that at a later stage, the process of formation of carbohydrates and protein metabolism in the body increases plant in which carbohydrates are formed, partly used for energy production (growth and development of plants) and partly kept as a reserve of food. Sintia (2010) mentions that organic fertilizer guano is a natural fertilizer rich in elements of macro and micro nutrients that are needed for the growth and production of crops, mainly N, P, K, Ca, Mg, S, Fe, Mn, Zn, Cu, B , Co, Cl and Mo.

E. Conclusion

1. Organic fertilizers natural guano, very significant effect on plant height, number of leaves, number of tillers, stem diameter and yield fresh stover leek (Allium fistulosum L.).
2. Dose of fertilizer 18 kg plot-1 or the equivalent of 15 tons ha-1, still promote the growth and yield of leek (positive linear).

F. References

Adiningsih. (2005). *Pedoman Bertanam Bawang.* Yogyakarta: Kanisius.

Amrizal, A. (2012). Pengaruh Pemberian Pupuk Guano dan Tithonia (*Tithonia diversifolia*) Terhadap Pertumbuhan dan Hasil Jagung Manis (*Zea mays saccharata* Strurt.). Padang: Faculty of Agriculture, Andalas University.

Djuarnani, N., Kristian & Setiawan. (2005). *Cara Cepat Membuat Kompos*. Jakarta: Agromedia.

Harahap, D., A. Jamil & K.E., Ramija. (2003). Pemanfaatan Pupuk Guano Alam untuk Tanaman Kentang di Dataran Medium Kabupaten Tapanuli Selatan. Balai Pengkajian Teknologi Pertanian Provinsi Sumatera Utara. Medan. *www.nad.litbang.deptan.go.id.* Dowloaded on Nopember 2016.

Hardjowigeno, S. (2003).*Ilmu Tanah*. Jakarta: Akademika Pressindo.

Jamil, A., L.R., Widowati, & W., Hartatik. (2014). Kesuburan Tanah Manajemen dan Inovasi untuk Mendukung Pertanian Organik. Prosiding Seminar Nasional Pertanian Organik. Bogor, 18-19 Juni 2014.

Lakitan, B. (2000). *Dasar-Dasar Fisiologi Tumbuhan*. Jakarta: PT Radja Grafindo Persada.

Laude, S., & Y., Tambing. (2010). Pertumbuhan dan Hasil Bawang Daun (*Allium fistulosum* L.) pada Berbagai Dosis Pupuk Kandang Ayam. Jurnal Agroland, 17(2) : 144-148.

Lingga, P. & Marsono. (2003). *Petunjuk dan Penggunaan Pupuk*. Jakarta: Penebar Swadaya.

Narkhede, S.D., S.B., Attarde & S.T., Ingle. (2011). Study on Effect of Chemical Fertilizers and Vermicompos on Growth of Chili Pipper Plant (*Capsicum annuum* L.). *Journal of Applied Sciences in Environmental Sanitation, Vol. 6 (3) : 327-332.*

Nazari, A.P.D. (2010). Respons Tanaman Bawang Daun dari Berbagai Dosis dan Waktu Pemberian Ampas Teh yang Telah Difermentasi dengan EM-4. Jurnal Zira'ah, Vol. 27 (1) : 1-8.

Rahmadi, C. (2004). Koleksi dan Pengenalan Biota Goa : Arthropoda Goa. *www.cavernicoles.files.worldpress.com*. Downloaded on July 2015.

Reijntjes,C., B., Haverkort & A., Water-Bayer. (1999). The Future of Farming. Introduction to Low External Input Agriculture Sustainable Agriculture, ILEIA. Yogyakarta: Kanisius. Yogyakarta.

Satari. (1987). *Budidaya Bawang*. Jakarta: Penebar Swadaya.

Sediyarso, M. (1999). Fosfat Alam Sebagai Bahan Baku dan Pupuk Fosfat. Pusat Penelitian Tanah dan Agroklimat. Bogor

Setiamidjaya, D. (1999). *Dasar-Dasar Ilmu Tanah*.Jakarta: Universitas Terbuka.

Sintia, M. (2010). Pupuk Organik dari Guano Alam. http://guanophosphat.blogspot.com. Downloaded on November 2016.

Subhan, A. Hidayat & N., Gunadi. (1998). Penggunaan Pupuk Nitrogen dan Pupuk Kandang Ayam pada Tanaman Cabai di Lahan Kering. *J. Hort,* 8 (3), 1178-1183.

Sunaryono, H. (1996). Kunci Bercocok Tanam Sayur-Sayuran Penting di Indonesia. Seri Produksi Hortikultura II. Bandung: PT Sinar Baru Algasindo.

Sutarya R., & G., Grubben. (1995). Pedoman Bertanam Sayuran Dataran Rendah. Yogyakarta: Gajah Mada University Press Cooperating with Indonesia Procea and Horticultural Research Lembang.

Suwandi, G.A., Sopha & Yufdy. (2015). Efektivitas Pengelolaan Pupuk Organik, Pupuk NPK dan Pupuk Hayati Terhadap Terhadap Pertumbuhan dan Hasil Bawang Merah. Balai Penelitian dan Pengembangan Pertanian. Balai Penelitian Tanaman Sayuran, Lembang. Bandung.

Wiyatna, M.F. (2002). Potensi Indonesia Sebagai Penghasil Guano Fosfat Kelelawar. *http://tumoutou.net.* Downloaded on November 2016.

Agrotech Journal
ATJ
Url: http://usnsj.com/index.php/ATJ
Email: editor.atj@usnsj.com

Effectiveness of Some Nitrogen Dose and Cellulolytic Microorganism (MOS) toward Decomposition Rate of Tan and Empty Aerobic Palm

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ARTICLE INFO

ISSN: 2548-5121
Vol. 1, No. 1, December 2016
URL: http://usnsj.com/index.php/ATJ/article/view/ATJ006

Abstract

This study aims to determine the effect of nitrogen levels, cellulolytic microorganisms and the interaction of both the aerobic decomposition rate of oil palm empty fruit bunches. The research was conducted at Home Compost STIP-AP Medan in April until July 2016. Research used a factorial randomized block design consisting of two factors and three replications. The first factor is the dose of nitrogen consisting of four levels i.e. N0 = without urea, N1 = dose of Nitrogen 2% of the dry weight of TKS which is 40% as much as 48 grams, N2 = dose of Nitrogen 4% of the dry weight of TKS which is 40% as much as 96 grams, N3 = Nitrogen dose of 6% of the dry weight of TKS which is 40% as much as 144 grams. The second factor is the cellulolytic microorganism isolates comprising four levels i.e. M0 = without cellulolytic microorganisms isolates, with isolates MOS M1 = 10 ml, M2 = isolate MOS 20 ml, isolate MOS M3 = 30 ml. From the research the effectiveness of multiple doses of nitrogen and cellulolytic microorganisms (MOS) on the rate of decomposition of oil palm empty fruit bunches can be deduced as follows, namely addition of nitrogen dose was able to reduce levels of C/N was 76.4% of the levels of C/N beginning. The best treatment is contained in N3 treatment. Addition of Microorganisms treatment cellulolytic (MOS) is able to reduce levels of C/N as much as 74.6% of the levels of C/N beginning. The best treatment is contained in M3 treatment. Interaction between giving treatment cellulolytic microorganisms Nitrogen and reducing levels of C/N as much as 79.4%. Interaction best treatment there in treatment N3M3.

Keywords: nitrogen, MOS, oil palm of empty bunches

A. Introduction

The solid waste generated by the mill is available in large quantities throughout the year. The availability of oil palm empty fruit bunches almost equivalent to crude palm oil produced. Utilization of solid waste which is currently implemented TKS is used as mulch and nutrient sources in a manner stocked around the plant on the palm plantations (Darmosarkoro &

Rahutomo, 2000). How to use is not always applicable, especially in hilly plantation areas, which are located a hill or away from the plant caused by the cost of distribution to be expensive.

In principle composting oil palm empty fruit bunches (TKS) to lower the C / N ratio contained in bunches in order to approach the C / N ratio of land. C / N ratio is approaching the C / N ratio of land to be easily absorbed by plants (Fauzi et al., 2008)

TKS decomposition process that is scattered in the planting area is naturally slow that take between 6-12 months. Attempts to accelerate the decomposition can be done through physical, chemical and biological. Biological treatment is generally performed by adding the inoculums decomposers those cellulolytic microorganisms and multiple doses of Urea. MOS is a micro-organism that is capable of overhauling celluloses, hemicelluloses and lignin so that it can accelerate the decomposition process.

Research that has been done by using isolated microorganisms Wahyuni (2004) and Tariq (2011). TKS decompose aerobically with cellulolytic microorganisms as well as amendments to the chicken manure, cow and wastewater PKS, the conclusion is the provision of chicken manure amendment very significant effect on a decrease in C / N ratio. Giving cow dung very significant effect on a decrease in C / N ratio. Tariq (2011) decompose TK with the addition of cellulolytic microorganisms and EM manure. The provision of cellulolytic microorganism significant effect on decreasing C / N compost. The result of C / N value is best obtained from the interaction of both treatment.

Special purpose in this study to determine the effect of nitrogen (urea), MOS and the interaction of both the aerobic decomposition rate of TKS. The contribution of this study are expected to be useful for business people in the use of solid waste plantation palm oil mills in the form of empty fruit bunches to be processed into compost which can minimize the cost of fertilizer and expected to be input in the processing of solid waste TKS.

B. Methodology

The research was conducted at Home Compost land STIP-AP Medan Practices conducted in April-July, 2016.

This study uses a completely randomized factorial design with 2 treatments and 3 replications. Treatment 1 was dose Nitrogen (Urea) consists of 4 levels: N0: Control, N1: 2% of the dry weight of TKS, N2: 4% of the dry weight of TKS, N3: 6% of the dry weight of TKS. Treatment 2 is Microorganisms cellulosic (MOS) consists of 4 levels: Mo: Control, M1: 10 ml, M2: 20 ml, M3: 30 ml.

C. Findings and Discussion

1. Daily temperature

The temperature of the organic material TKS for all treatments achieved at the start composting is between 350C to 400C, this temperature is achieved due to the TKS organic material used is still fresh visible from the steam coming out of the EFB. In the first week the temperature composting of compostable material increased to 450C - 500C. Entering the second week the temperature dropped to the initial temperature of the composting ranged 400C. Then in the third week the temperature fell back to near room temperature composting. Constant temperature begins composting at room temperature according to the fourth week until the end of the composting.

2. Nutrient levels C of organic compost TKS

Nutrient content C of organic compost palm bunches were observed at the end of the study can be seen in Table 1 below:

Table 1. Average levels of C of organic compost TKS

Treatment	N0	N1	N2	N3	Total	Mean
	Control	48 gr	96 gr	144 gr		
M0 Control	30,38	21,33	20,34	20,77	92,82	23,20
	EFG	A	A	A		
M1 10 ml	27,74	22,97	19,17	22,04	91,91	22,98
	DEF	AB	A	A		
M2 20 ml	24,81	21,68	23,00	20,10	89,59	22,40
	ABCD	A	ABC	A		
M3 30 ml	26,47	19,43	21,97	18,42	86,29	21,57
	BCDE	A	A	A		
Total	109,39	85,41	84,48	81,33		

Mean	27,35 B	21,35 A	21,12 A	20,33 A

Description: Figures followed by the same letter (A, B) in the same column are not significantly different at α = 1% by BNT test.

Value of organic C empty oil palm bunches before compostability are 44,3 %.

According to Table 1 for granting MOS can be seen that the organic C content was lowest for the treatment of M3 is 21.57 and the highest in the treatment M0 is 23.20. M3 nutrient content of organic C is lower than the 7.02% M0. When compared with the initial organic C content TKS (fresh TKS 44.3%), the decline in nutrient content of organic C by 51.3%. The response is in line with the results of the observations made by Tariq (2011). Tariq's In the study, addition of MOS treatment resulted in decreased levels of organic compost C for 40-50% of the initial content of organic C.

Effect of N (nitrogen) in the process of composting organic C- namely TKS against impairment C-organic. The C-lowest for the treatment of organic N3 is 20.33 and the highest in treatment N0 is 27.35. Levels of C-organic N3 25.66% lower than the N0. If compared with the initial levels of C-organic TKS then decreased levels of 54.1% of C-organic.

Interaction between N and M showed decreased levels of C-organic, lowest for the treatment N3M3 is 18.42 and the highest in N0M0 treatment is 30.38. N3M3 nutrient content of organic C lower than N0M0 39.36%, while on the nutrient content of organic C N3M3 early treatment can lower nutrient content of organic C as much as 58.41%. This occurs because the microorganisms contained in the compost are growing due to the availability of nutrients for microorganisms that are effective in lowering the value of C-organic oil palm empty fruit bunches.

3. N Nutrient levels of TKS Compost

Levels of N compostable palm bunch were observed at the end of the study can be seen in table 2 below:

Table 2. Average levels of N of compost TKS

Treatment	N0	N1	N2	N3	Total	Mean
	Control	48 g	96 g	144 g		
M0 Control	1,57	1,74	1,68	1,69	6,68	1,67
M1 10 ml	1,66	1,66	1,71	1,74	6,77	1,69
M2 20 ml	1,70	1,71	1,72	1,76	6,89	1,72
M3 30 ml	1,69	1,72	1,66	1,74	6,82	1,70
Total	6,62	6,84	6,77	6,93		
Mean	1,65	1,71	1,69	1,73		

Description: The annotated figures do not show unreal the influence.

Based on table 4.2 above can be seen that the value of N compost TKS levels showed no real results. Effect of M (MOS) at the highest levels of N compost at treatment M2 is 1.72 and the lowest in the treatment M0 is 1.67. M2 treatment nutrient content higher than 2.92% M0. When compared with the initial N content TKS (0.7%), the levels increase by 59.3% N compost. The response is in line with the results of the observations made by Tariq (2011). In addition to Tariq's research MOS produce compost treatment with the highest N content of 1.77%.

Effect of treatment of N (nitrogen) to the value of N compost TKS levels highest in N3 treatment is 1.73 and the lowest for the treatment of N0 is 1.65. N3treatment nutrient content is higher by 4.6% than N0. When compared with the initial N content TKS then caused a significant increase of 59.5% of N compost.

Interaction treatment of N and M that shows the highest levels of N compost at treatment N3M2 is 1.76 and the lowest in treatment N0M0 is 1.57. Levels of N compost N3M2 10.79% higher than the N0M0. When compared with the levels of N early then caused a significant increase of 60.22% of N compost.

4. Analysis of C/N Compost TKS

Analysis C / N compost carried out in the research that after 60 days of composting. From the analysis of variance showed that M (cellulolytic microorganism) has significant effect, treatment of N (nitrogen) was highly significant, and interaction of N and M very significant effect on the maturity of compost. Mean analysis of C / N compost with nitrogen treatment and MOS can be seen in Table 3:

Table 3. Average C / N compost treatment TKS Nitrogen (N) and Microorganism cellulolytic (MOS) after 60 days of composting

Treatment	N0	N1	N2	N3	Total	Mean
	Control	48 gr	96 gr	144 gr		
M0 Control	24,15	15,72	14,86	17,02	71,76	18,02
	EFG	A	A	A	A	b
M1 10 ml	21,64	19,97	15,76	14,72	72,08	17,94
	CDEF	ABCDE	A	A	A	a
M2 20 ml	19,45	14,82	16,75	14,87	65,90	16,47
	ABCD	A	A	A	A	a
M3 30 ml	18,540	14,64	17,97	13,17	64,32	16,08
	ABC	A	AB	A	A	a
Total	83,79	65,16	65,35	59,78		
Mean	20,95 B	16,29 A	16,34 A	14,94 A		

Description: Figures followed by the same letters (a, b), (A, B) in the same column are not significantly different at α = 5%, α = 1% by BNT test.

The C-organic oil palm empty fruit bunches before compostability are 44.3% and a nitrogenous nutrient content of 0.7% by the C/N ratio is 63.4.

According to Table 3 for the provision of M can be seen that the C/N ratio was lowest for the treatment of M3 is 16.08 and the highest in the treatment M0 i.e. 18.02. C/N ratio M3 is lower than the 10.76% M0. When compared with the C / N early TKS (fresh TKS 63.4) then there is a decrease of C/N of 74.6%.

Effect of N (nitrogen) in the composting process TKS against C/N ratio value C/N was lowest for the treatment of N3 is 14.94 and the highest in treatment N0 is 20.95. C/N ratio N3 28.68% lower than the N0. If compared with the C/N early TKS then decreased C/N 76.4%. Interaction between N and M which shows a decrease in C/N was lowest for the treatment N3M3 is 13.17 and the highest in N0M0 treatment is 24.15. C/N ratio N3M3 lower than N0M0 45.46%, while the C/N N3M3 early treatment can lower C/N as much as 79.2%. If seen from the results of this study the effect of treatment N and M already decreasing C/N excellent compost. The response is in line with the results of the observations made by Wahyuni (2004), in the study produce compost with high levels of C/N value lows ranged from 9.8 to 14.4.

D. Conclusion

1. The addition of nitrogen can lower levels of C/N was 76.4% of the levels of C/N beginning. The best treatment is contained in N3 treatment.
2. Provision of Microorganisms cellulolytic (MOS) is able to reduce levels of C/N as much as 74.6% of the levels of C/N beginning. The best treatment is contained in M3 treatment.
3. The interaction between the administration of Nitrogen and cellulolytic microorganisms able to reduce levels of C/N as much as 79.4%. Interaction best treatment there in treatment N3M3.

E. References

Darmosarkoro, W. & S., Rahutomo. (2000). Tandan Kosong Kelapa Sawit Sebagai Bahan Pembenah Tanah. Technical Meeting Proceedings Palm Oil 2000-II, 13 to 14 June 2000. Oil Palm Research Center. Medan.

Fauzi, Y., Yustina, E.W., Imam, S., & Rudi, H. (2008). *Kelapa Sawit : Budidaya, Pemanfaatan Hasil dan Limbah Kelapa Sawit, Analisa Usaha dan Pemasaran*. Jakarta: Penebar Swadaya.

Tariq. (2011). Efektivitas Dekomposisi Tandan Kosong Kelapa Sawit dengan Penambahan Mikroorganisme Selulolitik (MOS) dan EM Kotoran Hewan. Thesis College of Agricultural Sciences Agribusiness Plantation (STIPAP) Medan. Unpublished Thesis.

Wahyuni, M. (2004). Laju Dekomposisi Aerob dan Mutu Kompos Tandan Kosong Kelapa Sawit dengan Penambahan Mikroorganisme Selulolitik, Amandemen dan Limbah Cair Pabrik Kelapa Sawit. Thesis Graduate Program North Sumatra University (USU) in Medan.

Agrotech Journal
ATJ
Url: http://usnsj.com/index.php/ATJ
Email: editor.atj@usnsj.com

Polymorphism of Simple Sequence Repeat Regions of Sulawesi Ebony (*Diosphyros celebica* Bakh.) in Experimental Forest of Hasanuddin University Provenance

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ARTICLE INFO

ISSN: 2548-5121
Vol. 1, No. 1, December 2016
URL: http://usnsj.com/index.php/ATJ/article/view/ATJ007

Abstract

Polymerase Chain Reaction (PCR)-based molecular techniques have been used to detect the polymorphism in plants. The utilization of molecular markers plays essential role in germplasm characterization and plant breeding since the information of DNA marker technology can be exchanged between laboratories and should have standard method to be reproducible. The molecular aspect has been commonly linked to DNA isolation protocol and polymorphic molecular marker, thus can be used for molecular research recommendation purposes. The objectives of this study were to evaluate the capability of microsatellite marker of Ebenaceae Family for amplifying Ebony DNA, and to determine the appropriate PCR annealing temperatures. The DNA isolation of Ebony leaves from Experimental Forest of Hasanuddin University Provenance was carried out using Genomic DNA Mini Kit (Plant) Geneaid protocol. Nine of seventeen selected primers from the Genus Diospyros were able to amplify Ebony DNA. Amplification products produced polymorphic bands with different annealing temperatures (ranged from 53 to 56°C). These nine polymorphic primers will be recommended to use for future studies in genetic diversity as well as pollen dispersal pattern analyses.

Keywords: polymorphism, microsatellite marker, ebony, annealing temperature, primer screening

A. Introduction

Ebony (*Diospyros celebica* Bakh.) known as "black-wood" is endemic to Indonesia that distributes from Northern Sulawesi (i.e in Minahasa, Bolaang, Mongondo) and Central Sulawesi (i.e in Parigi, Poso, Donggala, Toli-Toli, Kolonedale, Luwuk) to Southern Sulawesi (i.e in Barru, Luwu, Mamuju) (Hartati and Kamboya 2007). Its wood durability and strength levels are classified to class I which mean the wood can be usable more than five years under moist soil condition (Departemen Kehutanan 2013; Akbar and Rusmana 2013).

Ebony belongs to the Ebenaceae Family and is categorized as vulnerable species. Prevention of Ebony extinction requires the species conservation through breeding program which is supported by genetic-based molecular information. Molecular data would be valuable to shorten and facilitate the future breeding programs in Ebony.

Molecular data can be obtained through a molecular marker. Molecular markers are DNA fragments that representing differences in genome level. The molecular marker should be polymorphic, evenly distributed in the genome, able to distinguish genetic differences, easy to apply, less time and less DNA sample required for processing, has lingkage to discriminate phenotypes and not require any prior information of the organisms' genome (Agarwal *et al.* 2008). One comonly used molecular marker is SSR or microsatellite marker.

Ease of SSR marker in amplifying and detecting DNA fragments as well as high polymorphism level causing this method capable of analysing genetic diversity with numerous number of DNA samples. Moreover, PCR technique in SSR markers only requires less amount of DNA with amplification region ranged 100 to 300 base-pair (bp) from whole genome. SSR method can be applied without damaging the plants because only need less leaf tissue sample or other tissue parts, such as seed and pollen, in DNA extraction process (Kalia *et al.,* 2011). SSRs markers are also multiallelic and easily repeatable, thus their applications are more interesting for analysing genetic diversity among different genotypes (Rao *et al*., 2011). Another advantage of this method is PCR products can be separated not only by agarose gel but also by acrylamide gel, in particular for allele of a character that has low polymorphic level (Macaulay *et al*., 2001).

Some of the other considerations that SSR markers have been widely used in genetic diversity analyses are abundantly and evenly distributed in the genome, very high variability level (multiple alleles per locus) and co-dominant nature with the known genome location. Therefore, microsatellite markers are useful tools that present high reproducibility and accuracy used in distinguishing genotypes, testing seed purity, mapping gene as well as providing efficient tool for selection strategy, genetic population study and genetic diversity analysis. Recently, numerous published studies have broadly used this approach, for instance, genetic diversity analysis and characterization in coconut and teak (Larekeng, 2016; Kumar *et al*. 2011), mating system and study of xenia effect in Kopyor coconut (Maskromo *et al*. 2016, Larekeng *et al.* 2015a).

However, the information about microsatellite marker in Ebony has not been reported before. Eventhough no prior information on DNA marker of ebony is available, molecular data of this species can still be obtained. DNA markers from other species either in same genus or family are applicable to use to acquire molecular data. The closer taxonomic relation between evaluated individuals with selected markers, the higher success rate of markers to produce amplified DNA products (Nurtjahjaningsih *et al*., 2012). In this study, our objective was to obtain SSR primers of Ebony from selected SSR primers from the genus *Diospyros* using primer screening method. By this study, we would like to support the conservation and breeding programs of ebony.

B. Material and Methods

1. Genetic Material

Ebony leaf samples were collected from experimental forest of Hasanuddin University, Maros, South Sulawesi, Indonesia. As many as 12 leaf samples were harvested from different trees and then wrapped in plastic before stored at -20^{0}C until needed for extraction.

2. DNA Isolation and Primer Screening

DNA isolation was carried out following the Genomic DNA Mini Plant (Geneaid) kit protocol. Extracted DNA quality was tested with 2% agarose gel electrophoresis and then followed by amplifying the DNA using 17 SSR primers from the Genus *Diospyros* (Liang *et al.,* 2015). The 17 primer sequences used in this study are describe in Table 1.

Table 1. SSR Primers of The Genus Diospyros used in Primer Screening

No	Locus name/genbank accession no.	Repeat motif	Primer sequence (5'-3')	Tm* (oC)	Allele size (bp)
1	1430 DC588341	(GAG)5	F: TCA GTA AAG CTG CGG GCA TC R: ACG GTT CTC CTG ATC CTC ACG	56	190 –250
2	1554 DC586537	(CAT)6	F: CAC CGC ATC CTC TTC GAC ATC C R: ACG CAT CCG TCA AAT CAC AAC A	56	190 –223
3	4379 DC585084	(GAG)9	F: TGA CTC TGC TCC ACA GGC ACT TC R: CTC GTC TGG CAA TTC TGC TTC G	56	208 –235
4	5553 DC585710	(GTAGTG)3	F: CCA GTT GAT GGC AAT GGG AGG C R: GGT GCG ATG TTG GAG GGA AGA G	56	226 –254
5	6615 DC585737	(CTT)7	F: ACA CTC CAC TCT ACC CAA ATA CC R: GAC ATC ATA AGT CAA AGC ACG AA	55	244 –268
6	6665 DC592790	(TA)9	F: TGA CCA ACC CCA AAG TGT GGG AG R:AGG TCC CTC TGG TGA GCA CAT GC	60	171 –209
7	8125 DC592401	(GGC)4	F: TTA TCC CAT CAA AGC AAC CCA C R: CTG CCA ACT TCT TCT CCA TCT CC	55	189 –207
8	8917 DC591591	(AT)10	F: ACA CGT TCA GTA CCA GGA GGG A R: AGT ACC ACA AAC CAC CAG TGG	55	166 –197
9	9004 DC591297	(GCAGGA)3	F: GCC ACA AAC TTC ACA GAG GAC C R: AGG CGA GTG CGA GTA AGA CGA A	55	251 –272
10	DKs76 DC585435	(AGG)7	F: TCGGCTTCACCTATGTTG R: CGATTCCTTGGACCTTTG	52	111 –138
11	DKs91 DC592713	(AG)7	F: CGGAAGAGGGAGAAATCG R: GAATCGGGAAAGCAAGTT	55	191 –207
12	mDp17 EF567410	(GA)21	F: CCA AAT CAT TCG AAG CCA AT R: CCT TCA CCG ATG TCC TTT GT	52	128 –168
13	ssrDK11 DQ097479	(GA)16	F: ATGTTTCAGGGGTTCCATTG R: TCACTCGTCTTTGCCTTTCC	53	155 –195
14	ssrDK14 DQ097482	(AG)16	F: GTGAAGGAACCCCATAGAA R: CCATCATCAGGTAGGAGAGA	52	158 –192
15	ssrDK16 DQ097484	(GA)12	F: ACTACAACGGCGGTGAGAAC R: GTCCTTCACTTCCCGCATT	55	136 –172
16	ssrDK29 DQ097497	(CCTTT)8	F: ATCATGAGATCAGAGCCGTC R: CACGTTAACGTTACGGAACA	53	112 –152
17	ssrDK31 DQ097499	(CT)15	F: AGTTCTTGCGATGGGATTTG R: GATGAGATGGGCTGATTGCT	60	191 –207

*Tm : Melting temperature

The DNA amplification protocol was conducted using 96 well-PCR(Sensoquest Thermocycler, Germany) with these following steps : one cycle of pre-amplification at 94°C for 180 seconds, 35 cycles of amplification steps at 94 °C for 30 s (template denaturation), annealing at ± 5oC from the given melting temperature (Table 1) for 30 s (primer annealing), and 72 °C for 60 s (primer extension), and one cycle of final primer extension at 72 °C for 300 s. Amplification products were then separated using 3% Super Fine Resolution (SFR) agarose with TAE 1x buffer at 100 V for 90 minutes (Seng *et al* 2013).

C. Result and Discussion

The DNA quality test showed that not all individuals in each family consistently obtained DNA band. The DNA quality test is presented in Figure 1. The quality test in the extracted DNA rubber plant was done using 2% agarose. Ebony DNA isolation procedures was conducted using Genaid kit protocol. Ying and Zaman (2006) stated DNA isolation using kit protocols have widely used in plants and tended to show high success level. This method is practically easy to implement and produces high quality of extracted Ebony DNA like this rubber DNA (Ain 2011). Haris *et al* (2003) previously reported that DNA quality affects amplified DNA fragment

products. Less concentration of DNA would visually produce thin or no fragment on agarose, and vice versa.

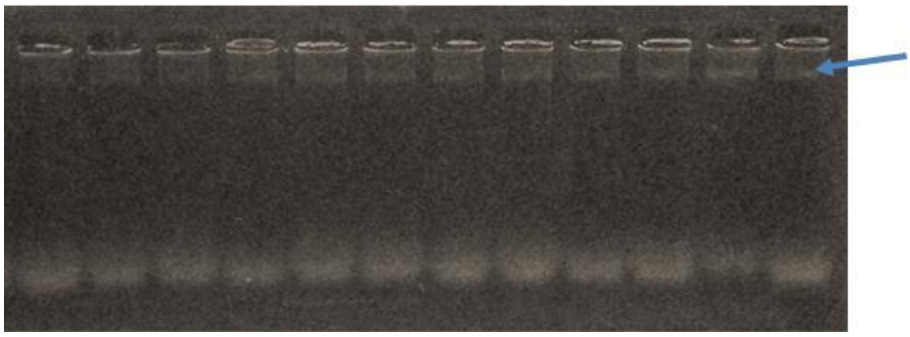

Figure 1. The extracted DNA quality of Ebony from experimental forest of Hasanuddin University. Arror : DNA band position.

The separation by agarose electrophoresis showed the extracted DNAs were good, eventhough almost all DNA samples displayed slight smear on bands. Smear is frequently shown due to contaminations either by RNA or incorrect DNA isolation protocol (i.e centrifugation, incorrect temperature or solution treatment). Smear may also affected by too much concentration of DNA or unstable electrical voltage during electrophoresis process (Ausubel *et al. 1990)* and purity level of extracted DNA. Purity level of more than 2.0 means the DNA samples were contaminated by RNAs, whereas that of lower than 1.8 were contaminated by proteins (Yuwono 2006). In this study, smear did not affect subsequent analysis since PCR process in microsatellite markers analysis required less amount DNA sample (even with low quality of DNA) (Acquaah 2007). Another advantage of SSR markers is capable of amplifying DNAs with intermediate quality and relatively less concentration of DNA (Gupta *et al.* 1996).

Table 2. SSR Primer Names of the Genus Diospyros that succeeded to amplify Ebony DNA

No	Locus name/genbank accession no.	Repeat motif	Primer sequence (5'-3')	Tm *($_o$C)	Allele size (bp)
1	1430 DC588341	(GAG)5	F: TCA GTA AAG CTG CGG GCA TC R: ACG GTT CTC CTG ATC CTC ACG	56	190 –250
2	1554 DC586537	(CAT)6	F: CAC CGC ATC CTC TTC GAC ATC C R: ACG CAT CCG TCA AAT CAC AAC A	56	190 –223
3	4379 DC585084	(GAG)9	F: TGA CTC TGC TCC ACA GGC ACT TC R: CTC GTC TGG CAA TTC TGC TTC G	56	208 –235
4	5553 DC585710	(GTAGTG)3	F: CCA GTT GAT GGC AAT GGG AGG C R: GGT GCG ATG TTG GAG GGA AGA G	56	226 –254
5	6665 DC592790	(TA)9	F: TGA CCA ACC CCA AAG TGT GGG AG R:AGG TCC CTC TGG TGA GCA CAT GC	60	171 –209
6	8125 DC592401	(GGC)4	F: TTA TCC CAT CAA AGC AAC CCA C R: CTG CCA ACT TCT TCT CCA TCT CC	55	189 –207
7	ssrDK11 DQ097479	(GA)16	F: ATGTTTCAGGGGTTCCATTG R: TCACTCGTCTTTGCCTTTCC	53	155 –195
8	8917 DC591591	(AT)10	F: ACA CGT TCA GTA CCA GGA GGG A R: AGT ACC ACA AAC CAC CAG TGG	55	166 –197
9	DKs76 DC585435	(AGG)7	F: TCGGCTTCACCTATGTTG R: CGATTCCTTGGACCTTTG	52	111 –138

*Tm : Melting temperature

Primer is a short DNA fragment produced artificially and consisted of 10 to 25 nucleotides (Finkeldey 2005). The sequences of primer pair that have been determined to be able to anneal with the sequence DNA targets are used during PCR process. DNA fragment that is located between two meeting points of primers will be amplified in PCR process. Primers function as starting points of synthesis, called as *DNA polymerase* which was derived from *Thermus aquaticus*. This enzyme is also known as *Taq DNA polymerase.* It is suitable for amplification process because it can withstand the high temperature up to 95$_0$C, though the optimal heat of

this enzymes' activity is 72$_0$C. After primers annealing are done, the primers extension process begin at 72$_0$C.

Primer screening is required to obtain strong and clear polymorphic-band pattern of PCR products by selecting random primers that can produce amplification products, as not all tested nucleotide primer pairs may turn out to have amplified products (positive primer) and, other than that, not all positive primer pairs yield good polymorphic DNA fragments (Siregar *et al*. 2008). The results concluded that there were seventeen out of twenty RAPD primers showed good amplification products and polymorphisms for Kayu Kuku DNA amplification along with specific PCR temperature in each primer. In future studies of Kayu Kuku, weanticipate increasing the number of RAPD charactersand the number of species to provide a greater understanding of the genetic resources of the genus*Pericoopsis* (Larekeng *et al,* 2015b).

In this recent study, the PCR amplification test was done by 17 SSR primers from *Diospiros kaki* (Table 1). The result showed that nine of 17 SSR primers were able to produce polymorphic, strong and clear alleles on Ebony DNA from Maros provenance. These selected primer pairs are displayed in Table 2. Moreover, there was one primer pair that produced monomorphic band, primer 6615 DC585737.

Polymorphic primer (Figure 2) is primer that can distinguish one individuals' genetic material from the others by detecting alleles in evaluated population. Primer pair is categorized as polymorphic primer if it can detect the variation in alleles at least 1% (Emrani and Arbabe 2011). The primers used in genetic diversity analysis should be not only polymorphic, but also able to obtain strong and clear PCR-band products. Primers which performed unclear or smear bands were discarded, in order to avoid miscoring of alleles resulting errors in the analysis. For instance, a primer pair which generated either unclear or smear bands using primer 9004 DC591297 is presented in Figure 3. Only for primers that produced unclear and smear bands, the PCR amplification processes need to be repeated by more specific annealing temperature and then validated by Qiaxcell fragment analysis for more specific base-pair differences.

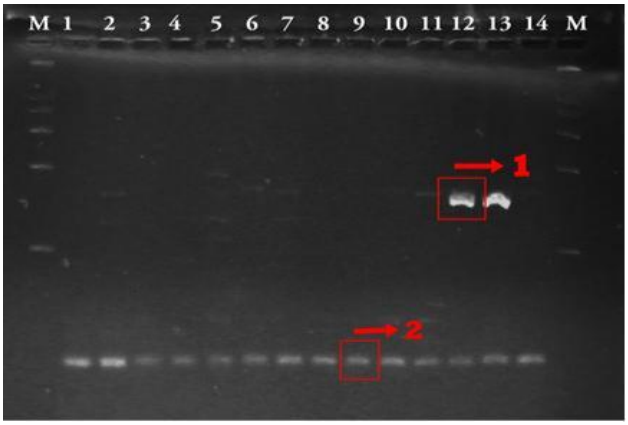

Figure 2. Electropherogram of allelic scoring variation in amplified DNA fragments using primer 8917 D591591. Column 1-14 : DNA samples, column M : DNA ladder (100 bp of *DNA ladder*). Position 1-2 indicate alleles in the evaluated primer.

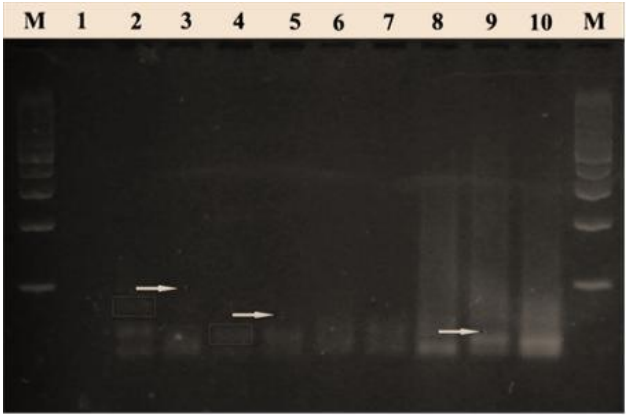

Figure 3. Electropherogram of allelic scoring variation in amplified DNA fragments using primer 9004 DC591297. Column 1-10 : DNA samples, column M : DNA ladder (100 bp of *DNA ladder*). Position 1-3 indicate alleles in the evaluated primer.

The disappeared band pattern can be caused either by less DNA volume used during electrophoresis process, unbalanced mixture between DNA solution and other solutions (primer and PCR mix solutions), less DNA extracted from leaf samples, or DNA wasted during extraction process. Another cause is the contamination of DNA by protein, RNA, phenol or organic compounds. To do the molecular genetic analysis, high purity and concentration of DNA are required,but extracted DNA from plant tissues with high DNA purity level is often difficult to achieve.

The presence of primers without any amplified DNA products can be induced by unmatched primer pairs with DNA sequence that used as DNA template. The SSR marker locus is single strain nucleotide having at least 15 nucleotides in length. Primers are required as starting point of DNA amplification during PCR process. According to Acquaah (2007), PCR processes using SSR marker loci do not require large amount of DNA (approximately 50-5000 µg of DNA), hence, do not influence subsequent analysis. It is proved by the emergence of SSR band pattern shown at agarose and polyacrylamid gels.

The result showed that only nine (53%) of 17 SSR primers from Diospyros could generate strong, clear and polymorphic bands at the 12 tested random samples of Ebony from Maros provenance. It revealed higher number of polymorphic primers compared to that of reported by Nurtjahjaningsih *et al* (2012). In their study, they used as many as 12 SSR primers from three pine species (*Pinus densiflora*, *Pinus pinaster* and *Pinus taeda*) to amplify *Pinus merkusii* DNA, but failed to produce polymorphic allele. In contrast to previous report by Yang *et al* (2015), 13 (93%) of 14 SSR primers from *Diospyros kaki* could amplify DNA from *Diospyros glaucifolia*, *Diospyros lotus*, *Diospyros oleifera* and *Diospyros* sp, and only primer mDP08 could not generate PCR-product in *Diospyros glaucifolia.*

DNA amplification of SSR markers in Ebony from experimental forest of Hasanuddin University provenance becomes an initial step on the usage of specific primer for the molecular genome research. SSR markers are intensively used in various molecular analyses, such as genetic diversity analysis between and among populations, genetic stability analysis in clonal plants derived from in vitro somatic embryogenesis, parents and progeny arrays and pollen dispersal analysis. Alcalá *et al* (2014) previously used eight microsatellite primer pairs to evaluate genetic structure and diversity of Mahagony (*Swietenia macrophylla*) in Mexicos' forest ecosystem. Marum *et al.* (2009) also reported the genetic stability analysis in Pine (*Pinus pinaster*) derived from somatic embryogenesis using seven microsatellite marker loci. Another previous study by Prabha *et al.* (2011) investigated mating system and gene flow analysis of Teak in natural forest using microsatellite primers.

D. Conclusion

Microsatellite primers from *Diospyros kaki* species could be used for obtaining molecular data in Maros provenance of Ebony. Based on alleles visualization, nine of 17 evaluated SSR primers were recommended to be used for amplifying all Ebony DNA samples for subsequent genetic diversity analyses.

E. Acknowledgment

This research was supported by Forest Seed Centre Region II. The authors acknowledge the assistance and also appreciate for the help of Yuni Fitri and Mirza Arsiaty for field and lab activities.

F. References

Acquaah, G. (2007). *Principles of Plant Genetics and Breeding.* United Kingdom: Blackwell Publishing.

Agarwal, M., N., Srivastava, & H., Padh H. (2008). Advances in Molecular Marker Techniques and their Applications in Plant Sciences. *Plant Cell Report,* 27, 617-631.

Ain, Y.K. (2010). Isolasi DNA Daun Tanaman Karet dengan Menggunakan Metode Khanuja, Kit Komersial, dan Castillo [Laporan Praktik Lapang]. Bogor (ID): Institut Pertanian Bogor. Unpublished

Alcalá R.E., H. Salazarl, Gutiérrez-Granados, & L.K., Snook. (2014) Genetic Structure and Genetic Diversity of Swietenia macrophylla (Meliaceae): Implication for Sustainable Forest Management in Mexico. *Journal of tropical ForestScience* , 26(1), 142-152.

Ausubel, F.M. (1990). *Current Protocols in Molecular Biology*. Kanada (CA): John Willey & Sons.

Emrani, H., C. Aminiria, & M.A.R., Arbabe. (2011). Genetic Variation and Bottleneck in Japanese Quail (Coturnix Japonica) Strain Using Twelve Microsatelitte Markers. *African Jour. of Biotch,* 10(20), 4289-4295.

Finkeldey, R. (2005). Pengantar Genetika Hutan. Translator by Edje Djamhuri, Iskandar Z. Siregar, Ulfah. J. Siregar & Arti W. Kertadikara. Bogor: ASEAN-EU University Network Programme (AUNP), Faculty of Forest, IPB.

Gupta, P.K., H.S., Balyan, P.C., Sharma & B., Ramesh. (1996). Microsatellites in Plants: a New Class of Molecular Markers. *Curr Sci,* 70, 45–54.

Haris, N., H. Aswidinnoor, Toruan, Nurita & A., Purwantara. (2003). Kemiripan Genetik Klon Karet (*Hevea brasiliensis* Muell. Arg.) Berdasarkan Metode Amplifies Fragment Length. *Menara Perkebunan*, 71, 1-15.

Hartati, R.A., & Kamboya. (2007). *Diospyros celebica* Bakh. Seed Leaflet. 115.

Kalia, R.J., M.J. Rai, S. Kalia, R. Singh, & A.K. Dhawan. (2011). Microsatellite Markers: an Overview of the Recent Progress in Plants [review]. *Euphytica*, 177, 309-334.

Kumar, P., R., Manimekalai, & R., Kumari. (2011). Microsatellite Marker Based Characterization of South Pacific Coconut (*Cocos nucifera* L.) Accessions. *International Journal of Plant Breeding and Genetics,* 5(1), 34-43.

Larekeng, S.H., N., A'ida, Y.F., Cahyaningsih, Gusmiaty, & M., Restu. (2016). Keragaman Genetik Jati Berbagai Provenans Pada Kebun Pangkas Bpth Wil II Di Kabupaten Gowa. Proceedings of the National Seminar on Silviculture IV. Mulawarman University, Samarinda.

Larekeng, S.H., I. Maskromo, A. Purwito, N.A. Mattjik, & Sudarsono, (2015a). Pollen Dispersal and Polination Patterns Studies in Pati Kopyor Coconut Using Molecular Markers. *Cord International Journal on Coconut R & D,* 31:1.

Larekeng, S.H, M., Restu, & Gusmiaty. (2015b). The Use of RAPD Marker on KayuKuku's (*Pericoopsismooniana* THW) Breeding Program. Presented at International Seminar on Challenges of Sustainable Forest Plantation Development 26th November 2015 in Yogyakarta, Indonesia.

Liang, Y., H., Weijuan, S., Peng, L., Jinjun, W., Tana, L., Fangdong & J., Fu. (2015). Genetic Diversity among Germplasms of Diospyros Kaki Based on SSR Markers. *Scientia Horticulture*, 186, 180-189.

Macaulay, M, L., Ramsay, W., Powell, & R., Waugh. (2001). A Representative, Highly Informative, 'Genotyping Set' of Barley SSRs. *Theor Appl Genet*, 102, 801-809.

Marum, L., M., Rocheta, J., Maroco, M.M., Oliveira, & C., Miguel. (2009). Analysis of Genetic Stability at SSR Loci During Somatic Embryogenesis in Maritime Pine (*Pinus pinaster*). *Plant Cell Report*, 28, 673-683.

Maskromo, I. S.H. Larekeng, H. Novarianto, & S. Sudarsono. (2016). Xenia Negatively Affecting Kopyor Nut Yield in Kalianda Tall Kopyor and Pati Dwarf Kopyor Coconuts . *Emirates Journal of Food and Agriculture*, 28(9), 644-652.

Nurtjahjaningsih, I.L.G, A.Y.P.B.C. Widyatmoko, P. Sulistyawati, & A. Rimbawanto. (2012). *Screening Penanda Mikrosatelit Shorea curtisii Terhadap Jenis-Jenis Shorea Penghasil Tengkawang.* Center for Forest Biotechnology and Tree Improvement. P. 1-8.

Nurtjahjaningsih, I.L.G. (2010). Pengembangan Penanda Microsatelite pada *Pinus merkusii* Menggunakan Metode Dual Supresion dan Screening Penanda. *Jurnal Pemuliaan Tanaman Hutan.*, 4(1), 25-35.

Prabha, S.S., E.P. Indira, & P.N. Nair. (2011). Contemporary Gene Flow and Matting System Analysis in Natural Teak Forest Using Microsatellite Markers. *Current Science*, 101(9), 1213-1219.

Rao, E.S., K. Palchamy, C.S. Rachael, G. Subramaniam, & W.E. Andreas. (2012). Using SSR Markers to Map Genetic Giversity and Population Structure of *Solanum pimpinellifolium* for Development of a Core Collection. *Plant Genetic Resources*: *Characterization and Utilization,* 10(1), 38–48. doi:10.1017/S1479262111000955.

Seng, Y.T., R. Singh, Q.Z. Faridah, S.G. Tan, & S.S.R.S. Alwee. (2013). Recycling of Super Fine Resolution Agarosae Gel. *Genetic Molecular Research* ,12 (3), 2360-2367.

Siregar, I.Z., Yunanto, Tedy, Pamoengkas, & Prijanto. (2008). Implikasi Genetik Metode Pembiakan Tanaman Shorea Johorensis Foxw pada Sistem Silvikultur Tebang Pilih Tanam Jalur (tptj). *Biodiversitas*, 9 (4), 250-254.

Yang, Y., Z.B. Jing, X.F. Ruan, & J.M. Cheng. (2015). Development of Simple Sequence Repeat Markers in Persimon (*Diospyros* L) and Their Potential Use in Related Species. *Genetic and Molecular Research,* 14(1), 609-618.

Ying, S.T., & F.Q. Zaman. (2006). DNA Extraction from Mature Oil Palm Leaves. *Journal of Oil Palm Research*, 18, 219-224.
Yuwono, T. (2008). *Bioteknologi Pertanian*. Yogyakarta: Gadjah Mada University Press.

Agrotech Journal
ATJ
Url: http://usnsj.com/index.php/ATJ
Email: editor.atj@usnsj.com

Potency of Dregs Coconut Fermentation (*Cocos nucifera*) as an Alternative Feed for Fish and Poultry 'PA-BIO'

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ARTICLE INFO

ISSN: 2548-5121
Vol. 1, No. 1, December 2016
URL: http://usnsj.com/index.php/ATJ/article/view/ATJ008

Abstract

People of Kolaka accustomed to using coconuts as well be used as a food supplement or a mixture of additives in processed foods, cakes and other confectionary. Therefore utilizing coconut pulp as feed fish and poultry should be made to minimize the potential for household waste. Feed from coconut pulp is a transfer of science and technology to the people who are expected to help poor people to be productive. Fermentation is one method to process coconut pulp into feed ingredients. The fermentation process is done by using spores of *Aspergillus niger*. The fermentation process is done in stages, by aerobic fermentation followed by anaerobic fermentation (enzymatic process). In short the process of making feed "PA-BIO" from coconut pulp is: Dregs of coconuts added water, stirred and steamed. Cooled and then stirred together with a mixture of minerals, Aspergillus niger spores are added and stirred again until evenly distributed. The mixture was then fermented aerobically and unaerobically. Dregs fermented and then dried and packaged for later in packing. Based on the results of research that the utilization of coconut dregs as cattle feed and fish is potential. Miskiyah et al. (2006), increase protein content after fermentation of coconut pulp 11.35% to 26.09%, or by 130% and decreased fat content of 11.39%. The results also showed that the feed produced quite safe for livestock, namely the aflatoxin content <20 ppb. Feed from coconut pulp is also good for fish farming. Goenarso et al. (2002) on tilapia (*Oreochromis niloticus* L.), the faster fish growth with increasing the feed protein content of 25%, 30%, 35%, 40% and 45%.

Keywords: coconuts dregs, fermentation

A. Introduction

Plants coconuts (*Cocos nucifera* L) including plants that have a multi-function, this is because almost all parts of the plant can be utilized. Old coconut fruit contains high calories, amounting to 359 cal per 100 grams; old half coconut meat contains 180 calories per 100 grams 8 cal and young coconut meat contains calories by 68 cal per 100 grams. Medium average calorific value

contained in coconut water around 17 calories per 100 grams. Green coconut water, compared with other types of coconuts contains a lot of tannins or antidote (antivenom) is the highest. The content of other chemicals that stand out in the form of an enzyme that is able to break down toxic properties. Composition of chemical substances is contained in coconut water include ascorbic acid or vitamin C, protein, fat, carbohydrate, calcium or potassium. The minerals are contained in coconut water is iron, phosphorus and sugar consisting of glucose, fructose and sucrose. The water content is contained in coconuts amount of 95.5 grams per 100 grams (Direktorat Gizi Depkes RI, 1981).

Coconut dregs byproduct of the manufacture of pure coconut oil still has fairly high protein content. This led coconut pulp potential to be used and processed into feed. According to Derrick (2005), the crude protein contained in coconut pulp reached 23%, and the fiber content is easily digested is a distinct advantage to make good energy source that can be used as animal feed, such as feed material calf (calf), especially to stimulate rumen and animal origin is also proven coconut pulp, cattle can produce a more condensed milk and taste delicious.

Fermentation is one way to cultivate coconut pulp into feed ingredients. In the fermentation process in which the reaction occurs complex compound is converted into simpler compounds by freeing up water molecules. Fermentation using fungi allow the overhaul of component materials that are difficult to digest more easily digested, so it is expected to improve the nutritional. The quality depends on the type of microbial fermentation and a solid medium used. Treatment of fermentation in the manufacture of feed has been employed in previous studies. Research conducted Purwadaria et al. (1995) mentions that coconut meal fermented with *Aspergillus niger* able to increase the protein content and digestibility of feed produced. *Aspergillus niger* is used to produce the enzyme lipase, so that the fat contained in the cake can be reduced.

The fat contained in coconut cake may affect digestibility. Further, described by Helmi et al. (1999) that the lipase activity during fermentation will reduce levels of fat coconut cake of 52.3% and 61.6%. The process of making pulp to feed the fermentation is done using spores of *Aspergillus niger*. The use of this method can affect the nutrient content of feed products. Still high fat content can be reduced in the presence of lipase activity from *Aspergillus niger* during fermentation.

Coconuts can easily be found in Kolaka, based on data from the Central Statistics Agency (BPS) Kolaka (2014) oil production ranks second as smallholder tree crops: 4,842.50 (ha), therefore the utilization of coconut pulp is proper concern not to become waste. Fish and poultry are also many types of businesses run by people Kolaka. Poultry, in this case the chicken pieces, its availability throughout the year there are always in the market Kolaka, when the Lebaran arrived, the price of chicken in the traditional market will also increase by reason of feed prices go up, therefore seek alternative raw materials that can be used as poultry feed is an intelligent way to be able to suppress the rise in prices of poultry, especially chicken pieces are from year to year continue to increase. In the market Mekongga Kingdom, the traditional market Kolaka, the current price of broilers at 60,000 / tail rise of the price of 45,000 / tail.

Feed is the single food ingredient or a mixture, whether treated or untreated, which is given to the animal's survival, production, and breed. Feed is a major factor in business success factors in addition to seed farm development and management. Forage quality will support an increase in the production and reproduction of livestock. Miskiyah et al. (2006), states that increase protein content after fermentation of coconut pulp 11.35% to 26.09%, or by 130% and decreased fat content of 11.39%. Dry matter and organic matter increased respectively from 78.99% and 98.19% to 95.1% and 98.82%. The results also showed that the feed produced quite safe for livestock, namely the aflatoxin content <20 ppb. Feed from coconut pulp that has a high protein content is also very good for business to develop aquaculture, research Goenarso et al. (2002) on tilapia (*Oreochromis niloticus* L.), the faster fish growth with increasing the feed protein content is 25 %, 30%, 35%, 40% and 45%). It has been reported also that earthworms are mixed in the feed, as much as 10%, has been able to increase the weight of fish Gurame aged 6 months. Therefore obtain alternative feed raw materials are easy to obtain, if you lack the high protein (nutritious) and the cost will directly be able to support the successful development effort poultry and fish farming communities in Kolaka.

1. Partners' Problem

The high price of feed is the reason that always echoed by the poultry farmers and poultry traders in the Pasar Raya Mekongga Kolaka thus raising poultry prices cut them from year to year. Therefore the search for alternative feed the raw material of its readily available, which is able to utilize the remaining major food were generally remnants of food are wasted and

become waste, has a high protein content (nutritious) and can be obtained at low prices is one of the solutions can be offered to suppress the increase in the selling price of poultry, especially chicken pieces and can support increased livestock production and reproduction. Coconut dregs is used as an alternative feed is not only good for poultry feed but also good to feed the fish because it has a protein content after fermentation.

Community Kolaka used to use coconuts as a mixture of main meal, or as a mixture of processed traditional cake, so no wonder the coconut is very easy encountered in selling in the market, even oil production ranks second after cashew as smallholder tree crops : 4,842.50 (ha) in Kolaka, so the utilization of coconut pulp is one of the steps that need to be taken to avoid the accumulation of coconut pulp which if not utilized will be able to be a waste, where the waste is waste or residue resulting from a process or activity of industrial and domestic (household).

The results of the last survey by the Central Statistics Agency (BPS) Kolaka (2014), there are 64,510 poor people in Kolaka or 20:46 percent of the total population of Kolaka as many as 210 060 people. Poor people in Kolaka on local partners are the people who are in the Village District of Latambaga Kolakaasi, the daily lives of their economies depend on marine products. While mothers and children inherit sell marine products are obtained in the market or for the results of certain marine they process into dried fish, this is what causes a lot of kids in the neighborhood dropped out of school, because it helps their parents to meet economic needs.

As Science and Technology for the Society (IbM program), the “Potency of Dregs Fermentation Coconut (*Cocos Nucifera*) as an Alternative Feed for Fish and Poultry 'PA-BIO” can be an alternative business community Kolaka. Broadly speaking, two main targets in the IbM program are women and children, women in this case is a group of mothers of households that are not economically productive and children are adolescent girls unmarried who have dropped out of school so expect two groups of partners this can be economically independent through the fish feed business and household-scale poultry.

B. Solution and Target Outputs

Fermentation is one of the methods used in processing coconut pulp into feed using Aspergillus niger spores. The fermentation process is done in two stages, namely aerobic fermentation and anaerobic fermentation (enzymatic process), had previously been done on coconut cake (Purwadaria et al., 1995; Helmi et al., 1999).

The growth of Aspergillus niger in the fermentation process characterized by mycelium. Visually growth of mycelium can be seen with the onset of the fibers resembles fine threads and solidifying the dregs. Treatment of fermentation to produce the structure, color, odor, and also a different chemical composition of coconut pulp that has not been fermented, especially in increasing the levels of protein and lower in fat. Fermentation also causes loss of the dry weight of the dregs, i.e. 16.67% in the fermented dregs aerobically and 5% after enzymatic process. Analysis of the loss of dry matter represents a significant loss of water weight during the fermentation process. It is caused by the change of complex compounds into simpler compounds during the fermentation process, which at the time was also the release of water molecules. Visually the release of water molecules can be seen in the presence of water on the plastic that is used as a container / dregs place is fermented.

The use of coconut pulp to 12% Fermentation very real efficient than using coconut pulp, this shows the ability of chickens to consume 1 kg of ration can form an average of 0.59 kg live weight was using coconut pulp only able to form weighted average life 0.45 kg. Fermented coconut pulp can improve the quality of foodstuffs and easily digested by the broiler. Based on the above data, the utilization of coconut pulp as raw material for fish feed and poultry is worth doing.

C. Methodology

Cultivate coconut pulp as feed material, i.e. through a fermentation process. Fermentation is a chemical change in the process of aerobically or anaerobic microorganisms to produce products. Mold that is used for the fermentation process coconut pulp is *Aspergillus niger*. In the fermentation process in which the reaction occurs complex compound is converted into simpler compounds by freeing up water molecules. The quality of fermentation depends on the type of microbes used (Miskiyah et al., 2006). *Aspergillus niger* is a member of the genus Aspergillus fungi. *Aspergillus niger* including mesophilic microbial with maximum growth at a temperature of 35 ° C - 37 ° c. The degree of acidity for microbial growth is 2 to 8.8 but growth would be better in acidic or low pH. Based on the research results Miskiyah et al. (2006), fermented coconut pulp have potential as feed because it has a protein content of 26.9%; In vitro dry

matter digestibility of 95.1% and organic matter digestibility in vitro 98.82%. The fermentation process can lower the fat content of coconut pulp amounted to 11.39%. Feed produced in the fermentation process is quite safe for consumption if the animals because it contains aflatoxin B1, B2, G1, and G2 feed <20 ppb.

Phase of fish and poultry feed manufacturing with raw materials coconut pulp to 3 kg of coconut pulp is as follows:

a. mashed + 2.5l of water and 1 kg of chopped leaves of bean
b. steamed for ½ hour
c. refrigerate until the temperature reaches ± 70 ° c
d. add a mixture of 100 grams of urea, TSP 50 grams, 4 grams of KCl and mineral b12
e. add 2.4 grams of *Aspergillus niger*
f. toss well and fermented aerobically for 2 days
g. enzymatic process anaerobically for 2 days
h. dried and packaged

D. Results

The first step in the implementation of the IbM program methods to overcome the problems faced by partners:

a. Partner of IbM program are people who are not economically productive is a group of mothers of households that do not work that also raise poultry or livestock on a small scale poultry in their homes and both partners are children in this case are women yet married / dropout.
b. Furthermore, the dissemination to the program partners on the benefits and importance of information technology to broaden the knowledge to exploit the potential of the environment and natural resources available
c. Activities in the form of training to partners of IbM program to achieve desired outcomes, namely Feed Products "PA-BIO"
d. PA-BIO feed products made from coconut pulp, coconut pulp is household waste. Coconut pulp obtained approximately 30% of the weight of the solid oil processed, easily rotten and rancid, so in terms of the environment can cause water and air pollution, while from an economic standpoint coconut pulp as material to dispose of that potential becomes waste.
e. Coconut dregs can be improved benefits for livestock feed of high nutritional value when added to other ingredients such as chopped leaves of beans, urea, TSP and KCl, through the process of fermentation. The purpose of fermentation is to reduce the water content and oil content; improve the nutritional value; and increase the price of waste.

1. Activities of feed manufacturing of the coconut dregs PA-BIO

Materials used are: coconuts dregs, bean leaves, Urea, TSP, KCl, mineral B12, and *Aspergillus niger*. The tools used are: Scales, cookers, steamers, stirrers, trays, nampah, cormorant, plastic barrel caps, plastic packaging and press equipment.

The processing of coconut dregs to feed the fermentative done, using spores of *Aspergillus niger*. For the manufacture of 3 kg of feed coconut dregs stages are: mashed + 2.5l of water and 1 kg of chopped leaves of bean. Steamed for ½ hour. Refrigerate until the temperature reaches ± 70 ° c. Add a mixture of 100 grams of urea, TSP 50 grams, 4 grams of KCl and mineral b12. Add 2.4 grams of *Aspergillus niger.* Toss well and fermented aerobically for 2 days and enzymatic process anaerobically for 2 days. Dried and packaged (Figure 1)

Figure 1. Feed "PA-BIO" in packs of 1 kg

Ways of feeding the coconut dregs on poultry: use the fermented feed about 3% of the weight of poultry. Give to the poultry in the morning and evening.

E. References

[BPS] Badan Pusat Statistik. Kolaka. (2014). Kolaka dalam Angka 2014. *https://www.kolakakab.bps.go.id/* Accessed *on* August 2016.

Derrick. (2005). Protein in Calf Feed. *https: //www. winslowfeeds.co.nz/pdfs/feedingcalvesarticle/* Downloaded on August 2016

Direktorat Gizi Departemen Kesehatan RI. (1981). Jakarta: Daftar Komposisi Bahan Makanan. *https://Kemkes.go.id/* Accessed on August 2016.

Goenarso, D. & Gunawan, G.G. (2002). Pengaruh Pencampuran Ampas Kelapa Pada Pakan Terhadap Laju Pertumbuhan ikan mas *Cyprinus carpio* L. PBI-XVII Seminar, Andalas University. Padang.

Helmi Hamid, T.. Purwadaria, T. Haryati & A.P. Sinurat (1999). Perubahan nilai bilangan peroksida bungkil kelapa dalam proses penyimpanan dan fermentasi. *JITV*, 4 (2), 102-106

Miskiyah G, I. & Haliza Mulyawati, W. (2006). Pemanfaatan Ampas Kelapa Limbah Pengolahan Minyak Kelapa Murni Menjadi Pakan. Proceedings. National Seminar on Technology Livestock and Verteriner: 830-83

Purwadaria, T., T. Haryati, J. Darma & O.I. Munazat (1995). In vitro digestibility evaluation of fermented coconut meal using Aspergillus niger NRRL 337. Bul. Anim. Sci. pecial ed.pp. 375– 382.

Agrotech Journal
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Url: http://usnsj.com/index.php/ATJ
Email: editor.atj@usnsj.com

The Effect of Fertilizer Urea and KCl on Ultisol and Inceptisol toward Soil Chemical Properties on Corn (*Zea Mays* L.) Growth

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ARTICLE INFO

ISSN: 2548-5121
Vol. 1, No. 1, December 2016
URL: http://usnsj.com/index.php/ATJ/article/view/ATJ009

Abstract

The research was conducted at green house of Agriculture Faculty, North Sumatera University. The research was done to study on the Urea and KCl fertilizer of chemical effect characteristic and growth of corn plant at Ultisols and Inceptisols. The research designed by randomized block factorial with two factors and four dosage replications. The first factors were kind of soils (Ultisols and Inceptisols). The second factor was Urea and KCl fertilizer, each others at 0 ppm, 100 ppm, 200 ppm, 300 ppm N and 0 ppm, 100 ppm, 200 ppm, 300 ppm K_2O. The result showed that application of Urea and KCl fertilizers increased height and dry weight of corn plants, soil acidity, nitrogen content and exchangeable Kalium at Inceptisols. Dosage excess of Urea was more at 100 ppm N responsible on height and weight of corn plant.

Keywords: corn *(Zea mays* L.*)*, urea, KCl, ultisol, inceptisol

A. Introduction

The growth and production of crops is influenced by factors of soil, climate and plant itself, all of which interact with each other. Soil or land as a place to grow plants do not always contain sufficient nutrients and in a state ready to be absorbed by plants. This situation often creates problems in increasing crop production. In poor soil nutrient should be a provision of nutrients known as fertilization. Most nitrogen in the soil combined with organic material. In this form of nitrogen is protected from the liberation by microbes, a year only 2-3% mineralization in alkaline state. Approximately, half the known organic nitrogen is in the form of amino compound.

Provision of ammonium nitrogen in large quantities in the soil is very alkaline pressing the second stage from the nitrification. It turned out that ammonium is toxic to nitrobacter but not harm nitrosomonas. As a result, accumulation of nitrite can occur until the amount of toxins that cause ammonium-containing compound is added to the soil with a high pH. Similarly, in the land which the urea donate NH4 + ions in the soil due to hydrolysis, the result is also detrimental. Fertilizer N and K are the main macro nutrients that are awarded to the soil in the form of fertilizers such as urea and KCl. With fertilizer application Ultisol and Inceptisol will respond differently to different fertilizer.

Results of Agustina's research (2006), was the benefits of Natural Phosphate fertilizer C.I.R.P significant effect in improving P-Inceptisol available on the ground. While the TSP fertilizer application significantly in improving P-available on Ultisol. Benefits of TSP fertilizer application

and Phosphate C.I.R.P significant effect in increasing soil pH, plant height and plant dry weight. Phosphate treatment is best for giving a response on the ground is 300 ppm TSP.

Dewani's research results (2004), shows that there is interaction between the soil treatment and dosage of NPK fertilizer on leaf area, leaf area index, total dry weight of the plant, and the relative growth rate of plants, while the treated soil and NPK fertilizer significantly affected plant height. Ultisol and Inceptisol the soil is acidic. In Indonesia is the widest part of about 51 million hectares or 29.7% of the broad plains in Indonesia. While widest Inceptisol throughout Indonesia is particularly in Java. This land is potentially the first few years. Many planted with reeds, especially Ultisol.

B. Methodology

This study used Random Design Group (RAK) Factorial. By using two types of soil and Inceptisol Ultisol with 2 factors and 4 doses of fertilizer fertilizing with three replications, thus forming 48 treatment

Using formula : $Yijk = \mu + \alpha i + \beta j + (\alpha\beta)ij + \varepsilon ijk$

Where:

Y_{ijk} = observations to factors A level ke-I, factor B level to-j and at the repetition to-k.

μ = common intermediate result

α_i = influence actor A to-i, level B to-j

β_j = influence factor B level j

$(\alpha\beta)_{ij}$ = interaction AB at level A to-i level B to-j

ε_{ijk} = error experiments to level to-i (A), level to-j (B) ulangan to-k for Ultisol

a. Research procedure

Soil Sampling

Ultisol used came from the District Mancang, Langkat, while the soil from the land Inceptisol came from tanah Enam Ratus Kecamatan Hamparan Perak. Soil was taken at a depth of 0-20 cm in composites with cleaning the weeds that are above the soil surface beforehand. The land wind dried and sieved to 10 mesh sieves, then calculated percent water content of air-dry soil. Then preliminary analyses include soil pH and total-N and K-exchange. Furthermore, soil put in a plastic bucket equivalent of 4 kg weight of oven dry soil.

Labelling

After the soil is inserted into the bucket and fertilizer N and K incorporated in accordance with each dose and incubated for 1 day. Planting of maize seeds 2-3 seeds by soaking them first for 10 minutes with water. Provision of basic fertilizer that is SP-36 (36% P_2O_5) at a dose of 200 ppm P_2O_5 fertilizer, provided treatment dose given. After 2 weeks of planting thinning by choosing healthy plants.

Plant maintenance

Maintenance was done by keeping the field conditions. Do weeding in each bucket.

Harvesting

Harvesting was done when the plant has flowered 75% or until the end of the vegetative.

b. Meaasured parameter

At the beginning of the study in the analysis of soil samples with the following parameters:

1. pH H_2O and KCl by using a pH meter method
2. N- total soil with Kjeldahl Method
3. K- exchange me/100 g by the method of Ammonium Acetate (CH_3COONH_4) 1 M pH : 7

c. Final Soil Analysis

At the beginning of the study in the analysis of soil samples with the following parameters:

1. pH H_2O and KCl by using a pH meter method
2. N- total soil with Kjeldahl Method
3. K- exchange me/100 g by the method of Ammonium Acetate (CH_3COONH_4) 1 M pH : 7

d. Plant growth

At the end of the study measured plant parameters as follows:

1. Total plant dry weight (g)

   Separated parts of the plant next to the top and the roots of plants diovenkan at a temperature of 800 C and then weighed and summed entirely.
2. Plant height (cm)

   Metered after the end of the vegetative period ranging from above ground to the highest leaf.

C. Findings and Discussion

1. Plant growth

Plant height (cm)

From the research and list Fingerprint Variety, indicated that the administration of urea and KCl significantly raise the height of the plant. To determine the mean treatment difference test Urea and KCl can be seen in Table 1.

Table 1. Response of urea and KCl on plant height (cm) at Land Ultisol and Inceptisol

Treatment	Plant height (cm)	
Ultisol 0 ppm N	77.8	g
Ultisol 100 ppm N	104.6	f
Ultisol 200 ppm N	106	f
Ultisol 300 ppm N	89.8	g
Ultisol 0 ppm K_2O	79	g
Ultisol 100 ppm K_2O	104.8	f
Ultisol 200 ppm K_2O	116.1	ef
Ultisol 300 ppm K_2O	125.6	cde
Inceptisol 0 ppm N	123.6	de
Inceptisol 100 ppm N	137.6	abc
Inceptisol 200 ppm N	141.5	ab
Inceptisol 300 ppm N	139.1	abc
Inceptisol 0 ppm K_2O	130.5	bcd
Inceptisol 100 ppm K_2O	131.5	abcd
Inceptisol 200 ppm K_2O	141.5	ab
Inceptisol 300 ppm K_2O	144.8	a

Description: Figures followed by the same notation is not significantly different according to Duncan test (DMRT) 0,05

From Table 2 it can be seen that the highest value in the treatment Inceptisol 300 ppm K2O amounting to 144.8 cm were significantly different with Ultisol Urea 0 ppm N, 100 ppm N, 200 ppm N, 300 ppm, and KCl 0 ppm K2O, 100 ppm K2O, 200 ppm K2O, 300 ppm K2O, and Urea Inceptisol 0 ppm N, and no significant difference in the other treatments on soil Inceptisol.

The dry weight of the plant (g)

From the research and list Fingerprint Variety, indicated that the administration of urea and KCl significantly increase plant dry weight. To determine the mean treatment difference test Urea and KCl can be seen in Table 2.

Table 2. Response Urea and KCl to plant dry weight (g) on Land Ultisol and Inceptisol

Treatment	The dry weight of the plant (g)	
Ultisol 0 ppm N	3.033	k
Ultisol 100 ppm N	9.533	hi
Ultisol 200 ppm N	9.166	ij
Ultisol 300 ppm N	4.466	jk
Ultisol 0 ppm K_2O	3.333	k
Ultisol 100 ppm K_2O	11.26	ghi
Ultisol 200 ppm K_2O	14.3	fgh
Ultisol 300 ppm K_2O	15.7	efg
Inceptisol 0 ppm N	19.36	de
Inceptisol 100 ppm N	22.36	bcd
Inceptisol 200 ppm N	25.23	bc
Inceptisol 300 ppm N	21.03	cd
Inceptisol 0 ppm K_2O	17.86	def
Inceptisol 100 ppm K_2O	27.36	b
Inceptisol 200 ppm K_2O	38.1	a
Inceptisol 300 ppm K_2O	37.43	a

Description: Figures followed by the same notation is not significantly different according to Duncan test (DMRT) 0,05

From Table 2 it can be seen that the highest value in the treatment Inceptisol 200 ppm K2O of 38.1 grams were significantly different with Ultisol Urea 0 ppm N, 100 ppm N, 200 ppm N, 300 ppm N, and KCl 0 ppm K2O, 100 ppm K2O, K2O 200 ppm, 300 ppm K2O, and Urea Inceptisol 0 ppm N, 100 ppm N, 200 ppm N, 300 ppm N and K2O KCl 0 ppm and 100 ppm K2O, and no significant difference in treatment on soil of 300 ppm K2O Inceptisol.

2. Soil Chemical Properties *Soil acidity*

From the research and list Fingerprint Variety, indicated that the administration of urea and KCl significantly raise the soil pH. To determine the mean treatment difference test Urea and KCl can be seen in Table 3.

Table 3. Response of urea and KCl to soil pH on Land Ultisol and Inceptisol

Treatment	Soil acidity	
Ultisol 0 ppm N	5.77	b
Ultisol 100 ppm N	5.69	b
Ultisol 200 ppm N	5.61	b
Ultisol 300 ppm N	5.07	bc
Ultisol 0 ppm K_2O	5.66	b
Ultisol 100 ppm K_2O	5.75	b
Ultisol 200 ppm K_2O	5.77	b
Ultisol 300 ppm K_2O	5.50	bc
Inceptisol 0 ppm N	6.34	a
Inceptisol 100 ppm N	6.40	a
Inceptisol 200 ppm N	6.63	a
Inceptisol 300 ppm N	6.62	a
Inceptisol 0 ppm K_2O	6.52	a
Inceptisol 100 ppm K_2O	6.46	a
Inceptisol 200 ppm K_2O	6.84	a
Inceptisol 300 ppm K_2O	6.67	a

Description: Figures followed by the same notation is not significantly different according to DMRT F 0:05

From Table 3 it can be seen that the highest value in the treatment Inceptisol 200 ppm K_2O of 6.84 which is significantly different from the Ultisol Urea 0 ppm N, 100 ppm N, 200 ppm N, 300 ppm N, and KCl 0 ppm K_2O, 100 ppm K_2O, 200 K_2O ppm, 300 ppm K_2O and not significantly different to Inceptisol Urea 0 ppm N, 100 ppm N, 200 ppm N, 300 ppm N and K_2O KCl 0 ppm, 100 ppm, 300 ppm K_2O.

Nitrogen – Total (%)

Table 4. Response Urea and KCl against N - Total (%) in the Land Ultisol and Inceptisol

Treatment	N – Total (%)	
Ultisol 0 ppm N	0.010	c
Ultisol 100 ppm N	0.020	bc
Ultisol 200 ppm N	0.025	b
Ultisol 300 ppm N	0.025	b
Ultisol 0 ppm K_2O	0.015	bc
Ultisol 100 ppm K_2O	0.015	bc
Ultisol 200 ppm K_2O	0.020	bc
Ultisol 300 ppm K_2O	0.020	bc
Inceptisol 0 ppm N	0.085	a
Inceptisol 100 ppm N	0.085	a
Inceptisol 200 ppm N	0.090	bc
Inceptisol 300 ppm N	0.095	a
Inceptisol 0 ppm K_2O	0.085	a
Inceptisol 100 ppm K_2O	0.095	a
Inceptisol 200 ppm K_2O	0.090	bc
Inceptisol 300 ppm K_2O	0.090	bc

Description: Figures followed by the same notation is not significantly different according to Duncan test (DMRT) F 0:05

From the research and list Fingerprint Variety, indicated that the administration of urea and KCl significantly increase N - total (%). To determine the mean treatment difference test Urea and KCl can be seen in Table 4.

From Table 4 it can be seen that the highest value in the treatment Inceptisol 300 ppm N and 100 ppm K_2O of 0095 were significantly different from the Ultisol Urea 0 ppm N, 100 ppm N, 200 ppm N, 300 ppm N and KCl 0 ppm K_2O, 100 ppm K_2O, K_2O 200 ppm, 300 ppm K_2O and Inceptisol Urea 200 ppm N and Inceptisol KCl K_2O 200 ppm, 300 ppm K_2O. While the treatment of Urea Inceptisol 0 ppm N, 100 ppm N and 100 ppm KCl K2O was not significantly different.

Potassium - Exchange (me/100 g)

From the research and list Fingerprint Variety, indicated that the administration of urea and KCl significantly improve K - Swap (me / 100 g). To determine the mean treatment difference test Urea and KCl can be seen in Table 5.

Table 5. Response Urea and KCl to the K - Exchange (me / 100 g) at Land Ultisol and Inceptisol

Treatment	K - Exchange (me/100)	
Ultisol 0 ppm N	0.08	c
Ultisol 100 ppm N	0.08	c
Ultisol 200 ppm N	0.11	bc
Ultisol 300 ppm N	0.09	c
Ultisol 0 ppm K_2O	0.09	c
Ultisol 100 ppm K_2O	0.09	c
Ultisol 200 ppm K_2O	0.12	abc
Ultisol 300 ppm K_2O	0.15	abc
Inceptisol 0 ppm N	0.11	bc
Inceptisol 100 ppm N	0.14	abc
Inceptisol 200 ppm N	0.27	ab
Inceptisol 300 ppm N	0.14	abc
Inceptisol 0 ppm K_2O	0.16	abc
Inceptisol 100 ppm K_2O	0.24	abc
Inceptisol 200 ppm K_2O	0.36	a
Inceptisol 300 ppm K_2O	0.25	abc

Description: Figures followed by the same notation is not significantly different according to Duncan test (DMRT) F 0:05

From Table 5 it can be seen that the highest value in the treatment Inceptisol 200 ppm K_2O with a value of 0:36 is significantly different from the treatment Ultisol Urea 0 ppm N, 100 ppm N, 200 ppm N, 300 ppm N and KCl 0 ppm K_2O, 100 ppm K_2O and to treatment of Urea Inceptisol 0 ppm N. While on treatment Ultisol KCl K_2O 200 ppm, 300 ppm K_2O and Inceptisol Urea 100 ppm N, 200 ppm N, 300 ppm N and K_2O KCl 0 ppm, 200 ppm K_2O, 300 ppm K_2O no different real.

Based on the research results, visually 4 MST on maize visible difference is striking between the growths of corn plants grown in Ultisol with corn plants grown in soil Inceptisol, the whole treatment of fertilizers applied to the soil Inceptisol very good compared to Ultisol. Clearly, Ultisol responded to K, the more the K the better plant growth. In contrast to N application on the same ground, the high-dose N stunted growth and dwarf but best at 100 ppm N. Means Ultisol dose of 100 ppm N in Ultisol promote plant growth further with increase dose of 200-300 ppm N decrease the growth of plants. Where it is consistent with the results of Sanchez (1992) showed that administration of high doses of N, during the first 4 weeks are not contained in the root area of 10 cm around the track urea or ammonium sulfate. After that, the roots into the path of ammonium sulphate and began to absorb nitrogen. Urea root development round was delayed for 4 weeks until nitrite is converted to nitrate

The highest growth at treatment plants Inceptisol 300 ppm K_2O of 144.8 cm and 77.8 cm in the treatment room Ultisol 0 ppm N. Where in this case, the provision of urea and KCl significantly affect in increasing plant height. This is because the nutrients nitrogen is an element that is very important role in the growth of plants that generally serve to fix nitrogen plant vegetative growth and the formation of proteins. This is consistent with the literature Boswel et al. (1997) Nitrogen is responsible for vegetative growth of dense and dark green leaf color and researches Muhammad (2001) showed that administration of urea provide significant effect on the increase in plant height. While nutrient potassium increasingly being granted to the ground, the better plant growth, since potassium is not toxic to plants. This is consistent

with the literature Hasibuan (2004) which states the actual content of K in the soil there in large numbers, but only a few of the K that can be used by plants.

Based on the observation of the dry weight of the plant is the highest value in the treatment Inceptisol 200 ppm K_2O of 38.1 grams and the lowest at 0 ppm N Ultisol treatment amounted to 3,033 grams. This suggests the provision of urea and KCl significant effect in increasing plant dry weight. The higher the dose given to the treatment of 300 ppm N Ultisol plant growth by nearly approached without fertilizer N. While on treatment Ultisol K and Inceptisol K are better plant in dry weight. With the provision of urea fertilizer and KCl significant effect in raising the pH of soil. The highest soil pH that is in the treatment Inceptisol 200 ppm K2O of 6.84 while terandah 5:07 on Ultisol 300 ppm N. This is because the concentration of H + ions in the soil after being treated to be reduced and replaced by the OH- ions. Where this is in accordance with the literature Hasibuan (2004) that urea is organic clam compound fertilizers from CO $(NH_2)_2$, solid fertilizers granulated little rounded. This fertilizer has the N content 45-46%. Urea can be completely soluble in water and does not acidify soil.

With the provision of urea fertilizer and KCl significant effect in increasing N - total (%). Nitrogen - the highest total in the treatment Inceptisol 100 ppm N and 300 ppm K2O by 0095 while lowest 0010 on Ultisol 0 ppm N. This shows the low availability of nutrients N on Ultisol than Inceptisol. Although a statistically significant increase in N-total on every additional dose of the same on both soil types, but nonetheless the availability of N in Ultisol much lower than Inceptisol, this is because the chemical properties of acid soils. According to Munir (1996) that Ultisol is poor soil chemical and physical properties, besides having a constraint Ultisol soil acidity, high Al-dd saturation, low cation exchange capacity, low nitrogen content, phosphorus and potassium and highly susceptible to erosion.

With the provision of urea fertilizer and KCl significant effect in raising K - exchange (me / 100 g). K - Exchange (me / 100 g) as the highest, at 200 ppm K_2O Inceptisol treatment for 0:36 while lowest 0:08 on Ultisol 0 and 100 ppm N. This shows the low availability of nutrients K on Ultisol than Inceptisol. Although a statistically significant increase in K - Rates on every additional dose of the same in the two types of land, but still nutrient availability K on Ultisol much lower than Inceptisol, this is because the chemical properties of acid soils. According to Munir (1996) that Ultisol is poor soil chemical and physical properties, besides having a constraint Ultisol soil acidity, high Al-dd saturation, low cation exchange capacity, low nitrogen content, phosphorus and potassium and highly susceptible to erosion.

D. Conclusion

1. Provision of Urea and KCl increased plant height and dry weight of plants on soil Inceptisol.
2. Provision of urea and KCl increase the soil pH, Nitrogen - Total and Potassium - Exchange Inceptisol soil.
3. Provision of urea and KCl best shows the response as follows: at a dose of Urea excessive growth of corn plants decreased in Ultisol. At excessive doses of urea increased growth of corn plants on soil Inceptisol. At doses of KCl excessive plant growth of maize increased ground Ultisol and Inceptisol.

E. References

Agustina, S. (2006). Respon Pupuk Fosfat Pada Tanah Ultisol dan Inceptisol Terhadap Pertumbuhan Tanaman Jagung (*Zea mays* L.). Thesis Department of Soil Science FP-USU, Medan. P. 21.33. Unpublished Thesis.

Boswell, C.F., J.J Meisinger & N.J., Case. (1997*). Produksi, Pemasaran dan Pengunaan Pupuk-pupuk Nitrogen*. In O.P. Engelstad. Technology and the use of fertilizers, Yogyakarta: Gadjah Mada University Press.

Dewani, M. (2004). Pengaruh Pemberian Dosis Pupuk N, P dan K Terhadap Pertumbuhan dan Hasil Tanman Jagung Manis. *Journal of Habitat*, 15(1), 31.

Hasibuan, B.E. (2004). *Pupuk dan Pemupukan*. Medan: USU Press.

Muhammad, A. (2001). Pengaruh Pemberian Beberapa Jenis Pupuk Nitrogen Terhadap Pertumbuhan Tanaman Sawi (*Brassica juncea* L.). Thesis Department of Soil Science, North Sumatera University. Unpublished Thesis.

Munir, M. (1996). Tanah-Tanah Utama Indonesia. Karakteristik, Klasifikasi dan Pemanfaatannya. Jakarta: Dunia Pustaka Jaya.

Sanchez, P.A. (1992). Sifat dan pengelolaan tanah tropika. Translation Properties and Management in the Tropics. Bandung: ITB.

Agrotech Journal
ATJ
Url: http://usnsj.com/index.php/ATJ
Email: editor.atj@usnsj.com

The Estimation of Peatlands Reserve on Carbon in the Forest and Shrubs That Has Been Drained

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ARTICLE INFO

ISSN: 2548-5121
Vol. 1, No. 1, December 2016
URL: http://usnsj.com/index.php/ATJ/article/view/ATJ010

Abstract

Global warming and greenhouse gas emissions (GHGs) became a hot issue in the world today. An increased concentration of carbon in the atmosphere becomes one of the serious problems that can affect life on Earth. Peatlands pointed out as one of the sources of GHG emissions. Drainage of peatlands cause decreased water level so that the decomposition process is faster on a layer above the groundwater table, thus affecting the chemical characteristics of peat. In addition to affecting the ground water level, drainage also leads to a decrease in surface height peat soil (subsidence). Given the magnitude of the role of drainage and land use types in affecting carbon stocks and emissions of CO2 on peat soil, this study is to measure carbon stocks and emissions of CO2 on peat soil in forests and shrubs that have been drained. CO2 emissions increase with the closer spacing of the drainage channel that is at a distance of 50 m to 500 m of drainage channels. Meanwhile, at a distance of 5 m and 10 m of the drainage channel can not be concluded because of the condition of ground water that is stagnant at the time of sampling gas, so be very low CO2 emissions. CO2 emissions on the use of forest land are higher than the shrub land.

Keywords: carbon, peat land drainage

A. Introduction

Demands the fulfillment of the food and the industry in order to improve people's welfare encourages the use of peatlands for agriculture and industry with the opening of the peatland. The utilization is much related to government policies in forest conversion, timber industry, transmigration and settlement as well as the expansion of agricultural land. Practice is usually done by deforestation, followed by the construction of canals or drainage channel to drain the water stored in peatlands (Murdiyarso et al. 2004). Activity logging and timber transport and land clearing cause deterioration of ground water and marsh ecosystem change, resulting in changes. characteristics of peat. Action drainage and cultivation techniques in oil palm plantations resulted in disruption of the stability of the peat that the subsidence due to compaction, increased organic matter decomposition, so that the CO2 emissions will increase (Klemedtssons *et al*. 1997).

Drainage of peatlands cause decreased water level so that the decomposition process is faster on a layer above the groundwater table, thus affecting the chemical characteristics of peat. In addition to affecting the ground water level, drainage also leads to a decrease in surface height peat soil (subsidence). Research Silins and Rothwell (1998) suggest that the drainage effect on the increase in bulk density and occurrence of subsidence, and a decrease in soil water retention. Agus and Wahdini study (2008) showed that the bulk density of the peat that has been converted into oil palm acreage reached a value of 0.3 g / cm3 at a depth of 0-50 cm. Decreased water level, followed by a more rapid decomposition process, will affect carbon stocks in peat.

Loss of C-organic through oxidation will produce CO2. Factors that influence the loss of C-organic, among others, namely temperature, O2, pH, and Eh peat. Peat is the main temperature controller on the rate of decomposition of peat, and will be very dominant role when interacting with O2 (Chapman et al. 1996). Temperature and humidity both air and peat soils in the tropics are strongly influenced by the type and density of vegetation cover. In the closed state forests, peat temperatures ranging from 27.5 ° C - 29.0 ° C and if the open state ranges from 40.0 ° C - 42.5 ° C. The high temperature in an open state will stimulate the activity of microorganisms so that an overhaul of peat faster (Noor, 2001).

Given the magnitude of the role of drainage and land use types in affecting carbon stocks and emissions of CO2 on peat soil, this study is to measure carbon stocks and emissions of CO2 on peat soil in forests and shrubs that have been drained.

B. Methodology

Observations and measurements in the field include:

1. Measurement of the depth of the water table peat in each of the drill hole depth of the ground water level is measured using a meter from peat soil surface to the water table soils.
2. Measurement of surface height peat

High measurement surface peat soil carried on a balance of water which is conducted every distance of one meter up to a distance of ten meters from drainage channels, and every five meters from a distance of ten meters to 25 meters from drainage channel, then measured every 25 meters up to a distance of 500 m from the drainage channel.

1. Sampling CO_2

Gas samples were taken from the forest transects and transects scrub with a sample point position similar to the position that is drilling 5m, 10m, 50m, 250m, and 500m from the drainage channel.

Laboratory analysis covering:

1) Determination of Levels of ash and organic C levels

Determination of ash content do menggukan tools furnace. Peat soil samples placed in a porcelain container then put into the furnace. The temperature in the furnace is set at 550º C. Combustion performed for 4-6 hours until all of the carbon in the peat disappear until all that remains is a mineral material contained in peat.

2) Measurement of fiber content

Measurement of fiber content in the laboratory was done by comparison of the amount of fiber in injections (siringe), that is by determining the number of soil samples in particular an injection volume as V1, then the soil samples were rinsed with water using a 100 mesh sieve and then be re-defined as the volume V2. Peat has fibric maturity when V2 / V1> 66%, hemik if V2 / V1 between 33% - 66%, and sapric if V2 / V1 <33%. But in this study were modified fiber content to determine ripeness degree to maturity fibric peat that is has a fiber content of> 40%,

the level of maturity hemik have a fiber content of 20% - 40%, and the maturity level sapric have a fiber content of <20%. Determination of the percentage of fiber content is due to the fiber content results obtained by the method of injection are lower than the determination in the field.

3) Measurement of CO2 emissions is done in two transects are forests and shrubs. Capturing CO2 from soil using a mask (closed chamber) which in turn is measured using a gas chromatograph.

2. Data analysis

Analysis of data using regression analysis for carbon stocks and a comparative analysis of average with the T test for CO2 emissions. Data analyzed using SPSS Ver.13. Regression model used is:

$Y = a + bx + cx_2$

Y = dependent variable a =
Constanta regression

b, c = coefficient of regression
x = independent variable

C. Result and Discussion

1. The Dept of the Ground Water Level and Hingh Ground

The depth of peat soil water level from the ground surface ranging from -40 cm contained on old rubber land at a distance of 500 m from the drainage channel to -120 cm contained in the shrub land at a distance of 5 m from drainage channels. The depth of the peat water level from the soil surface is presented in Table 2.

From the observation depth of the ground water level is known that the ground water level is getting in with the closer of the drainage channel. Forest on peat soil, groundwater level decline looks quite significantly on transect II is at a distance of 5, 10, and 50 m of drainage channels. And on peat soil scrub decreased water level was significant transects III, and IV, at a distance of 5, 10, and 50 m of drainage channels. It shows that the transect II, III, and IV high hydraulic conductivity so that the manufacture of drainage channels greatly affects the depth of the ground water level. From the observation of high ground, it is known that the land subsidence occurred at a distance of 5 m, 10 m, and 50 m of drainage channels. Meanwhile, at a distance of 250 m and 500 m of drainage channels drainage effect is very small or even non-existent. Connected with land use, decreased water level appear higher on peat soils in shrub than peat forest where the deepest ground water level in the peat forest is -87 cm at a distance of 5 meters from the drainage channel, while on peat soil scrub advance the deepest ground water reaches -120 cm.

2. Maturity of Peat

From the observation can be seen that the level of maturity of peat based on the fiber content measurement and scrub forest transect (Transect I, II, III, IV, and V) have a maturity level fibric, hemik and sapric. Fibric maturity level has a fiber content of> 40%, the level of maturity hemik have a fiber content of 20-40%, and the maturity level sapric have a fiber content of <20%. Fiber content in peat forests and shrubs is ranging from 10% to 90%.

3. Ash Content (%)

The ash content ranged from 0.45% to 51.57%. The ash content indicates the influence of peat and mineral materials related to levels of C-organic peat. The greater the ash content, the organic-C levels would be lower.

4. Levels of C Organic (%)

Levels of C-organic ranged between 25.48% - 57.86%. The highest levels of organic C 57.86% contained in the transect V at a distance of 250 m from the channel at a depth of 100-150 cm, the lowest 25.48% contained in the transect II at a distance of 500 m from the channel at a depth of 800-850 cm. At these depths are 31 cm deep layer of clay is starting depth of 819-850 cm.

5. Peat Carbon Stock

The range of carbon stocks is 386 Mg / ha to 3240 Mg / ha. On peat soils to forest land use (transects I and II), the thickness of the peat> 900 cm, while on peat soil with the use of shrub land, peat thickness of the lowest land use old rubber thickness of 98 cm, and the highest in

the land use shrubs + pineapple + rubber 8 months of age, 793 cm thickness. On the use of shrub land is seen that the thickness of the peat and carbon stocks lower with the closer spacing from drainage channels. This indicates that the decomposition process is faster at a distance closer to the drainage channel. The thickness of the peat and carbon stocks in each land use is presented in Table 1.

Table 1 Thickness of peat and carbon stocks in each of the sampling points in each land use

Land Use	Distance from the channel drainage (m)	Peat thickness (cm)	carbon stocks (Mg / ha)
Forest	5	> 900	> 2770
(Transect I)	10	> 900	> 2853
	50	> 900	> 2451
	250	> 900	> 2391
	500	> 900	> 2437
Forest	5	> 900	> 2683
(Transect II)	10	> 900	> 2769
	50	> 900	> 2687
	250	> 900	> 2389
	500	> 900	> 2244
Scrub +	5	663	2672
pineapple + rubber age 8	10	612	2471
month	50	600	2457
(Transects III)	250	650	3240
	500	793	2275
Shrubs	5	284	879
(Transect IV)	10	300	1019
	50	369	1456
	250	379	993
	500	518	1158
old rubber	5	98	386
(Transect V)	10	139	491
	50	170	513
	250	262	1081
	500	168	485

Stocks with the Reference Thickness of 200 cm From the Ground

Distance from the drainage channel affects the depth of the ground water level. It is generally known that the drainage affects the rate of decomposition of the peat. The decomposition process is faster on a layer above the groundwater table, while the peat layers below the groundwater level is relatively more stable. For the count of stocks with reference to 200 cm from the ground. Reference thickness of 200 cm was taken from the highest ground level on a transect. Stocks with reference to 200 cm thickness ranging between 144.42 Mg / ha to 408.94 Mg / ha. The thickness of the peat and carbon stocks with the reference thickness of 200 cm from the soil surface highs on a transect is presented in Table 2.

Stocks with the reference thickness of 200 cm from the ground indicate that the reduction in carbon stocks in peat land use shrubs (transect III, and IV) is relatively higher than the carbon stocks in forest land use (transects I and II) with a pattern of curves which showed an increase in carbon stocks that the greater the distance from the drainage channel, while the visible decline of forest land use and enhancement of carbon stocks, but the decline and the increase is very small, look at the pattern of relatively flat curve. This suggests that the process of decomposition of the peat with the shrub land use faster than peatland forest land use.

Table 2. The thickness of the peat and carbon stocks with the reference thickness of 200 cm from the ground level to the top of each land use

Land Use	Distance from the channel drainage (m)	Peat thickness (cm)	carbon stocks (Mg / ha)
Forest	5	183	285.68
(Transect I)	10	200	317.63
	50	197	326.72
	250	168	263.47
	500	183	279.85
Forest	5	159	363.02
(Transect II)	10	159	315.48
	50	161	304.46
	250	178	370.24
	500	200	361.16
Scrub +	5	65	146.87
pineapple + rubber	10	71	144.42
age 8 months	50	108	267.99
(Transects III)	250	170	216.53
	500	200	373.7
thicket	5	132	306.19
(Transect IV)	10	142	310.18
	50	176	294.7
	250	200	408.94

6. Emission CO_2

CO2 emissions on forest land ranged from 28.17 mg / m2 / hour - 2146.06 mg / m2 / hour. CO2 emissions in shrub land ranged from 83.99 mg / m2 / hour - 1513.71 mg / m2 / hour. T test results on the amount of emissions in forests and shrub land showed that the average amount of emissions on forest land is higher than shrubs, but not statistically different from the value of 0.366 t <t table (4; 0,025) is 2,776. Total emissions at any point on their respective land use are presented in Table 3.

Table 3 Total CO2 emissions on peat soil with the use of forest land and shrubs

Use	distance from land	code channel (m)	Emission	Mean CO_2 (mg / m_2 / h)	F	t	
	Forest	5	H11	28.17	924.28	0.269	.366
		10	H12	562.68			
		50	H13	2146.06			
		250	H14	1212.88			
		500	H15	671.63			
	Bush	5	S11	1013.09	760.63		.366
		10	S12	977.26			
		50	S13	1513.71			
		250	S14	215.12			
		500	S15	83.99			

From the observation depth of the ground water level, it is known that the ground water level is getting in the closer spacing of drainage channels. On peat soils of forests, decreased water level was significant transect II is at a distance of 5 m, 10 m, and 50 m of drainage channels, and on peat soil scrub, decreased water level was significant transect III, and IV a distance of 5 m, 10 m, and 50 m of drainage channels. These results suggest that transect II, III, and IV hydraulic conductivity thus making the high peat drainage channels greatly affects water peat soil subsidence. Reduced levels of ground water due to drying peat cause reduced soil

water retention power. It is caused by a decrease in the concentration of COOH functional groups and phenolic OH hydrophilic and polar (Azri, 1999). Regarding the effect of drainage on soil water retention, research Silins and Rothwell (1998) in the peat soil Albarta Canada showed that after 7 years of drainage, soil water retention down from -5 to -15 000 cm or decline 66% larger than the area that is not drained peat.

In general, the level of decomposition of the peat layer above the groundwater level is higher / more than a layer of peat below the groundwater table. But the result of the determination of the level of maturity of peat by volume of fibers with injection method can not explain it. On peat soils of forest seen the phenomenon in which the maturity level of the peat below the ground water level is higher than with a layer of peat above the groundwater level. This is caused by the influence of the peat fires that occurred in the heating process peat. This can be seen from the samples taken showing the layers of peat, burnt black as charcoal. Warming due to the burning of peat resulting in loss of moisture and the resulting properties of resistance to water and dry properties are not behind. As a result of peat forming what is called false sand (pseudo sand). This fake sand has the ability to hold water very low. This causes the peat soil samples are not dissolved by water when it is filtered by the water at the time of the determination by the injection method, so that peat is seen to have high fiber content.

The ash content in peat forests and shrubs is ranging from 0.45% to 51.57%. From the measurement of ash content at any depth of 50 cm is shown that the deeper, higher ash content either on the use of forest land and shrubs. This is because the deeper, the greater the influence of mineral matter because it was close to the bottom of peat. According to Noor (2001), peat ash content varied between 5% - 65%. The higher levels of ash, indicating the higher minerals contained in the peat. Increasingly in the thickness of the peat then the lower the ash content to be. The ash content is also associated with fertility soils. Ash and organic matter content has a relationship with the maturity level of peat. The ash content of more than 5% indicates that the peat has been affected by mineral materials or referred to under (peaty mineral), and peat is more fertile than peat no / very little ash content (true peat) due to higher availability haranya. From the results of measurement of C-organic known that levels of C-organic ranged from 25.48% to 57.86%.

From the results of the calculation of carbon stocks, it is known that carbon stocks ranged between 386 Mg / ha to 3240 Mg / ha. Peat soils are peat forests thickness of more than 900 cm at any point of 5 m to 500 m of drainage channels, but sampling can only be done to a depth of 900 cm because of limitations on the drilling tool peat. On peat soils of forest carbon stocks seen that at a distance of 5 m, 10 m, and 50 m of the drainage channel is higher than the distance of 250 m, and 500 m of drainage channels. This is caused by the decomposition process that takes place more rapidly at a point close to the drainage canal, resulting in higher peat maturity and value of BD increases. The effect of BD, where BD at a distance of 5m, 10m, and 50m from the drainage channel is higher than the distance of 250 m, and 500 m of drainage channels. As previously noted, the effect of drainage on the distance of 250 m, and 500 m is very small or even non-existent. So with the same thickness is 900 cm, but the level of maturity of peat and BD are higher resulting in carbon stocks at a distance of 5 m, 10 m, and 50 m of drainage channels higher.

On peat soils shrubs transect III where there are crops of pineapple and rubber age of 8 months, the total carbon stocks within 5 m of the drainage channel is higher than the distance of 10 m, and 50 m of drainage channels. This is caused by the decomposition process that takes place more quickly so that the maturity of the peat increases and BD also increased. Transect III, the highest carbon stocks are at a distance of 250 m from the drainage channel that is equal to 3240 Mg / ha with peat depth of 650 cm. The high carbon stocks at this point due to the influence of the clay layer that resulted BD value is high. But at a distance of 500 m from the drainage channel carbon stocks is lower than the distance of 250 m due to the low value of BD, although the thickness of the peat higher at 793 cm.

On peat soils shrubs transect IV shown increasing carbon stocks at a distance of 5 m, 10 m, and 50 m of drainage channels. Peat thickness showed an increase from a distance of 5 m, 10 m, 50 m, 250 m, and 500 m of the drainage channel that is 284 cm, 300 cm, 369 cm, 379 cm and 518 cm. it showed a decline in high-surface soil (subsidence) in the area close to the drainage canal due to compaction and decomposition faster. So the closer to the drainage channel, the lower the carbon stocks.

On peat soils transects V, visible enhancement of carbon stocks at a distance of 5 m, 10 m, 50 m, and 250 m of drainage channels. Peat thickness showed an increase from a distance of 5 m, 10 m, 50 m, and 250 m of the drainage channel is 98 cm, 139 cm, 170 cm and 262 cm. At a

distance of 500 m from the drainage channel thickness of peat and peat carbon reserves decreased, ie 168 cm thickness, lower than 250 m distance from the drainage channel. This is caused by the presence of a secondary drainage near the 500m point, thus affecting the decomposition process.

It is known that the decomposition process is faster on a layer above the groundwater level. In the calculation of carbon stocks with the reference thickness of 200 cm is known that carbon stocks ranged between 144.42 Mg / ha to 408.94 Mg / ha. On peat soils of forest transect I seen that drainage affecting carbon stocks at a distance of 5 m, 10 m, and 50 m of drainage channels. Likewise on peat soil scrub transect III, and IV that the closer to the drainage channel, the lower the carbon stocks. Stocks with the reference thickness of 200 cm from the ground indicate that the reduction in carbon stocks in peat land with the shrub land use (transect III, and IV) is relatively higher than the carbon stocks in forest land use (I and II). This suggests that the process of decomposition of the peat with the shrub land use faster than peatland forest land use. The decomposition process is faster on peat with shrub land use is also indicated by the value of BD higher than peat soil forest land use. BD value is also related to the maturity of the peat. The more mature peat, the BD will be higher. This means that on peat soil bushes, stocks with reference thickness of 200 cm is affected by the distance from drainage ditches, drainage channels closer to the lower carbon stocks. It shows that emissions at points adjacent to the drainage channel are higher than much of the drainage channel. This is because the points are often in a state of saturation so that the decomposition process runs faster and produced higher emissions.

CO2 emission measurement results on the use of forest land and scrub showed that CO2 emissions on peat soil forest ranged from 28.17 mg / m2 / hour - 2146.06 mg / m2 / hour. CO2 emissions in shrub land ranged from 83.99 mg / m2 / hour - 1513.71 mg / m2 / hour. T test results on the amount of emissions in forests and shrub land showed that the average amount of emissions on forest land is higher than shrubs, but not statistically different from the t value 0.366 <t table (4; 0,025) is 2,776. Forest on peat soil, the amount of emission at a distance of 5 m and 10 m of the drainage channel is smaller than the amount of emissions at distances of 50, 250, and 500 m of drainage channels. It is caused by conditions on the ground at the time of sampling gas which at a distance of 5 m from the drainage channel of peat in a state of stagnant conditions, and at a distance of 10 m from the drainage channel of ground water is very shallow, so the amount of emissions is low. But at a distance of 50 m, 250 m, and 500 m of drainage channels noticeable decrease in the amount of emissions with increasing distance from the drainage channel. Similarly in the shrub land is seen that the amount of emissions at the point of 5 m, and 10 m of the drainage channel is lower because of the influence of ground water that is shallower due to the conditions during the rainy season. At a distance of 50 m, 250 m, and 500 m of the drainage channel is seen that the lower the amount of emissions by getting away from the drainage channel. From the findings, it seemed that CO2 emissions on the use of forest land are higher than the shrub land. This can be caused by the maturity level of peat on the use of forest land is lower than the shrub land so that the CO2 emissions would be higher. The decomposition process that takes place faster in shrub land causes the peat to be higher maturity. The higher the level of maturity of the peat, then CO2 emissions would be lower. CO2 emission is strongly influenced by environmental factors, especially temperature and precipitation, and peatlands are very sensitive to both of them (Adger and Brown, 1995). At the time of low temperature and the condition of the ground water level is saturated or very shallow, the CO2 emissions in the peat will be very low or even no emission occurs.

D. Conclusion

Based on the research results, we can conclude the following:

1. The carbon stocks in peat soil with the use of the lower shrub land with the closer spacing of drainage channels. While the use of forest land within the influence of the drainage channel is relatively small.
2. The carbon stocks in forest land use are higher than the shrub land.
3. CO2 emissions increase with the closer spacing of the drainage channel that is at a distance of 50 m to 500 m of drainage channels. Meanwhile, at a distance of 5 m and 10 m of the drainage channel can not be concluded because the condition of the ground water level is stagnant when gas sampling, so it becomes very low CO2 emissions.
4. CO2 emissions on forest land use are higher than the shrub land.

E. References

Adger, N.E., & K. Brown. (1995). *Land Use and The Causes of Global Warming.* New York: John Wiley & Sons.

Agus, F. & W. Wahdini. (2008). Assessment of Carbon Stock of Peatland at Tripa, Nagan Raya Districk, Nanggroe Aceh Darussalam Province of Indonesia.

Azri. (1999). Sifat kering tidak balik tanah gambut dari Jambi dan Kalimantan Tengah : Analisis berdasarkan kadar air kritis, kemasaman total, gugus fungsional COOH dan OH-phenolat [Tesis]. Bogor: Institut Pertanian Bogor. Unpublished Thesis.

Chapman, S. J., K. Kanda., H. Tsuruta., & K. Minami. (1996). Influence of Temperature and Oxygen Availability on the Flux of Methane and Carbon Dioxide From Wetlands: A Comparison of Peat and Paddy Soils. *Soil Sci. Plant Nutr*, 42,269 – 277.

Klemedtsson A.K, L. Klemedtsson., K. Berglund., P. Martikainen., J. Silvola., & O., Oenema. (1997). Greenhouse Gas Emissions From Farmed Organic Soils: a Review. *Soil Use and Management,* 13,245-250.

Murdiyarso, D., U. Rosalina., K. Hairiah., L. Muslihat., I.N.N. Suryadiputra., & A. Jaya. (2004). Petunjuk Lapangan. Pendugaan Cadangan Karbon pada Lahan Gambut. Wetland International-Indonesia Programme.

Napitu. J.P. (2007). Sistem Pengelolaan Hutan Upaya Penurunan Emisi Carbon Pengembangan Proyek CDM. Yogyakarta. Yogyakarta.

Noor, M. (2001). *Pertanian Lahan Gambut. Potensi dan Kendala*. Yogyakarta: Kanisius.

Silins. U., & R. L. Rothwell. (1998). Forest Peatland Drainage and Subsidence Affect Soil Water Retention and Transport Properties in Alberta Peatland. *Soil Science Society of American Journal*, 62, 1048-1056