EFFECTS OF BOKASHI AND APPLICATION OF MONOSODIUM GLUTAMATE (MSG) AS FOLIAR FERTILIZER ON SOIL CHARACTERISTICS AND GROWTH PERFORMANCE OF OKRA (*Abelmoschus Esculentus*)

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DECLARATION

I hereby declare that the work embodied in this report is the result of the original research and has not been submitted for a higher degree to any universities or institutions.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS/ ABBREVIATIONS

Symbols/Abbreviations	Refers Meaning
P	Phosphorus
SOM	Soil organic matter
SC	Soil carbon
CRD	Completely randomized design
CRBD	Completely randomized block design

Effects of Bokashi and Application of Monosodium Glutamate (MSG) as Foliar Fertilizer on Soil Characteristics and Growth Performance of Okra

ABSTRACT

The field experiments were conducted at the Agro Techno Park (ATP), Universiti Malaysia Kelantan Jeli Campus, Malaysia. The main objective of this study is to determine the interaction between application of Bokash and MSG toward the growth performance, soil characteristics and yield production of okra plant. Three experiments were conducted by using completely randomized design (CRD). Experiments one and two have five different treatments of Bokashi and MSG respectively where each treatment will have three replications. Both experiment one and two were carried out at the same time by using polybag on controlled environment structure. Experiment three was factorial experiment between Bokashi and MSG application. There are six treatments with three replications where this experiment was conducted at open field. The parameter on soil characteristics, growth performances and yield production were observed and recorded. The growth performance of okra was increased when the rate of Bokashi uses were increased. The growth performance of okra only increase from T1 until T3 with rate of MSG 0 g/1 L of distilled water (29.25 ml/polybag), 3 g/1 L of distilled water (29.25 ml/polybag) and 6 g/1 L of distilled water (29.25 ml/polybag) respectively, however, the growth performance of okra decrease when applied more than 6g of MSG. The best rate treatments applications of single Bokashi were T2, T3 and T4 with rate of Bokashi of 9.75 g/polybags, 19.5 g/polybags and 39 g/polybags respectively, while best rate treatment application of single MSG were T2 and T3 with rate of MSG 3 g/1 L of distilled water and 6 g/1 L of distilled water respectively. Available phosphorus (P) in soil directly could affect root elongation and growth performance of okra. Soil organic matter and soil carbon in soil were increased from transplant to the production of yield and were differences among the treatments. Interaction between Bokashi and application of MSG gave positive feedback and improved the growth performance, soil characteristics and yield production of Okra plant.

Keywords: Bokashi, MSG, Okra, factorial design, growth performance, soil characteristics, yield production

Kesan Bokashi dan Penggunaan Monosodium Glutamate (MSG) sebagai Baja Foliar pada Ciri-ciri Tanah dan Prestasi Pertumbuhan Okra

ABSTRAK

Eksperimen lapangan telah dijalankan di Taman Techno Agro (ATP), Kampus Jeli Universiti Malaysia Kelantan, Malaysia. Objektif utama kajian ini adalah untuk menentukan interaksi antara penggunaan Bokashi dan MSG ke arah prestasi pertumbuhan, ciri-ciri tanah dan pengeluaran hasil tanaman okra. Tiga eksperimen telah dijalankan dengan menggunakan reka bentuk sepenuhnya rawak (CRD). Eksperimen satu dan dua mempunyai lima rawatan berbeza Bokashi dan MSG di mana setiap rawatan akan mempunyai tiga ulangan. Kedua-dua eksperimen satu dan dua dijalankan pada masa yang sama dengan menggunakan polibeg pada struktur persekitaran terkawal. Eksperimen tiga adalah eksperimen faktorial antara aplikasi Bokashi dan MSG. Terdapat enam rawatan dengan tiga ulangan di mana percubaan ini dijalankan di lapangan terbuka. Parameter pada ciri tanah, prestasi pertumbuhan dan pengeluaran hasil telah diperhatikan dan direkodkan. Prestasi pertumbuhan okra meningkat apabila kadar penggunaan Bokashi meningkat. Prestasi pertumbuhan okra hanya meningkat dari T1 hingga T3 dengan kadar MSG 0 g / 1 L air suling (29.25 ml / polybag), 3 g / 1 L air sulingan (29.25 ml / polybag) dan 6 g / 1 L air suling (29.25 ml / polybag), bagaimanapun, prestasi pertumbuhan okra menurun apabila digunakan lebih dari 6g MSG. Kadar rawatan terbaik untuk Bokashi tunggal ialah T2, T3 dan T4 dengan kadar Bokashi sebanyak 9.75 g / polybags, 19.5 g / polybags dan 39 g / polybags masing-masing, sementara aplikasi rawatan kadar terbaik MSG tunggal adalah T2 dan T3 dengan kadar MSG 3 g / 1 L air suling dan 6 g / 1 L air sulingan. Fosforus (P) yang terdapat di dalam tanah secara langsung boleh menjejaskan pemanjangan akar dan prestasi pertumbuhan okra. Bahan organik tanah dan karbon tanah dalam tanah meningkat dari proses penanaman kepada pengeluaran hasil dan perbezaan antara rawatan. Interaksi antara Bokashi dan penerapan MSG memberi tindak balas positif dan meningkatkan prestasi pertumbuhan, ciri-ciri tanah dan pengeluaran hasil tanaman Okra.

Kata kunci: Bokashi, MSG, Okra, reka bentuk faktorial, prestasi pertumbuhan, ciri tanah, pengeluaran hasil

CHAPTER 1

INTRODUCTION

1.1 Background Of Study

Agricultural management practices are important toward growth performance, yield productions and soil characteristics of the plant. The example of agricultural management included supply of fertilizer. Fertilizers are element that is containing chemical substances such as manure or mixture of nitrates that can give benefit to the plant such as improves plants growth. Fertilizer directly or indirectly give nutrition to the soil when undergo maintenance activities toward plant, thus plants can develop resistance against pests like weeds, insects and diseases that can increase aesthetic value and at the same time, price also increase because the high quality production of okra. Application of fertilizer toward okra plant also can increase and support biological life of okra (Tambe, Dhawan & Gourkhede, 2015).

The application of herbicide and insecticide would be reduce, so that production of okra will be healthier. There are three types of fertilizer which are chemical fertilizers, organic fertilizers, and natural fertilizers. The use of organic fertilizer in this crop plantation is the right choice as this type of fertilizer is non-toxic, allow the low capital investment, can preserve the fertility of soil and safe environment. The organic fertilizer, bokashi is the substances that contain active living fertilizer with abundance of effective microbes. Bokashi are produces from leftover from kitchen such as fruit, vegetables and meat that had been mixed together through anaerobic processes. Thus, bokashi can store as much as possible of oxygen, so that when applied to the soil, the soil will be more fertile and the yield produce also can be increase and better quality (Footer, 2013).

Priyono (2017) mentioned that there are many advantages when applied MSG toward crop especially okra included increase the fertility of soil. This is because, MSG contains atrium that can enhance soil fertility and have better soil characteristics when applied MSG in solution form. Other than that, MSG can improve plant growth performance. This is because, MSG can increase time for flowering stage. In addition MSG can act as additive nutrient. Thus, plant are not easy to destroy and wilt, store more water and can supply water during warm season, and avoid plant from any chemical or attract unwanted pests. Furthermore, MSG also can act likely NPK to supply nutrient nitrogen, phosphorus and potassium which is to help in plant growth especially leaves, bulk and root morphology. In addition, MSG was used in foliar form in order to get maximize result of advantage toward crop. This is because, uses of foliar form is more uniform compared to the other form. MSG was the mixture between sodium salt and glutamaric acid that is naturally happen which is non-essential amino acid.

Okra plant is easy to be cultivated either in hot or wet condition and difficult to get infection from pests and disease compared with other lowland crop such as cabbage and mustard. Okra also contain high value of minerals, vitamins and fibre, so that okra suitable for those that follow right diet and athletes. Generally, okra was widely planted in Africa and Tropics area which is in ranked number three in the world most crop planted follow by tomato and pepper. This is because, okra contains high nutritional value, healthier and many parts of its plant can be used for different purposes. Thus, okra can produce more yields with higher quality (Ijoyah & Dzer, 2012).

1.2 Problem Statement

Okra is one of the warm-season vegetables that can grow anywhere with different season. Unfortunately, production of okra in Malaysia still low because cannot fulfilled according to the demand by population in Malaysia. Furthermore, Malaysia still import okra plant from others countries such as Thailand, India and others with RM 12 million/year to meet the demand for domestic market (WITS, 2018).

In addition, Yaseer Suhaimi, Mohamad, Mahamud, Rezuwan, Fadlilah Annaim Huda and Azman (2011) stated that cultivation of crop such as okra are always related to low production, low quality and also easy to damages and wilt because of incorrect agricultural managements which is overdose in application of inorganic fertilizer. This is because use of excess inorganic or chemical fertilizer to the crop can reduce soil fertility and yield production. In order to get better growth performance and higher production of okra, okra was recommended to cultivar with organic fertilizer such as bokashi and foliar fertilizer which is MSG.

In order to get better performance and high quality, there were recommended to use F1 hybrid seed of okra. F1 hybrid seed can avoid okra from getting disease and affection from pests and disease and also this seed can germinate faster compared to the other seeds. Cultivation of okra with bokashi and MSG involves lots of knowledge, technique, systems and need well equipment in order to produce more yields with high quality.

Then, there is limited information about the uses of application of MSG as a foliar fertilizer on okra plant. There is also least information about the optimum rate of bokashi in okra plantation. This is due farmers does not know the importance and benefit on bokashi and MSG in their plantation. In addition, there is also not much research and study that documented the effect of the combination between organic fertilizer, bokashi and application of MSG on okra cultivation.

1.3 Objectives

The objectives of this study were

1) To determine the single effect of bokashi and application of monosodium glutamate (MSG) as a foliar fertilizer on growth performance, yield production and soil characteristics of okra.
2) To evaluate the best treatment level of bokashi and MSG to be applied for growing of okra.
3) To measure the interaction effect between bokashi and application of monosodium glutamate (MSG) in factorial experiment.

1.4 Research scope

This research focuses on a way to improve growth performance, yield production and soil characteristics of cultivation of okra by using bokashi and MSG as foliar fertilizer. The research emphasis agriculture field and laboratory work on okra cultivar.

1.5 Hypothesis

The H0 and H1 as followed:

H0= There are no significant differences on the effect of bokashi and application of Monosodium Glutamate (MSG) as a foliar fertilizer on growth performance, yield production and soil characteristics of okra.

H1= There are significant differences on the effect of bokashi and application of Monosodium Glutamate (MSG) as a foliar fertilizer on growth performance, yield production and soil characteristics of okra.

1.6 Significant of study

This research may not only contribute to the improvements of growth performance, yield production and soil characteristics of okra by using bokashi and MSG as a foliar fertilizer but also paves better means of agricultural managements. Combination between organic fertilizer, bokashi and MSG as foliar fertilizer also can increase yield production of okra compared to others conventional ways that has been usually practiced by many farmers. Furthermore, higher production of okra yield also can improve and able to increase farmer’s income. At the same time, food safety and food security of country also can be achieved and maintain in future if farmers practices a good agricultural management in term of application of fertilizer toward plantation. Continuous production of okra plant also can decrease the percentage of imported okra from others country. Beside application of fertilizer, schedule of planting and harvesting time which is one of the part of outcome of this research can be used and adopted by farmers in order to produce higher yield production with good quality throughout the year.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction on Okra

Okra or *Abelmoschus Esculentus* is one of the mallow family which in green flowering plant and warm season vegetables. Okra belongs to the same plant family with cotton and hibiscus. Okra usually planted at tropical, subtropical and warm temperate region around the world such as Nigeria, Ethiopian, South Asian and West Africa. Beside okra, this plant also known as ladies' fingers, ochro, gombo, okro, vendakkai and bhindi. Okra started to be introduced since 13th centuries from Arabia. Thus, okra can be classified as old world species. The word "okra" introduces the physical of this plant that contain edible seedpods. Thus, okra have unique texture and taste because contain edible seed inside the pod. Okra is cultivated as vegetables and other parts of okra such as leaves, buds, flowers, pods, stems and seeds also can be used as foodstuff, medicine and many more purposes (Mabberley, 1997).

Generally, there are many advantages of okra included okra contains higher nutritional value that beneficial especially for the health-conscious. Nutritional value included potassium, vitamin B, vitamin C, vitamin K, folic acid, calcium, low calories, high fibre content, iron, phosphorus and copper. Thus, okra can help cure and reduce risk in different kind of disease such as diabetes, cancer, and cardiovascular disease. Okra can be used as a media to thicken sauce because contain characteristics of viscous juice (Megan Ware, 2017).

Bhatti and Jain (1977) mentioned that okra can be classification as Kingdom is Plantae, Clade is Angiosperms, Eudicots, Rosids, Orde is Malvales, Family is Malvaceae, Genus is Abelmoschus and Species is *A. esculentus.*

Okra species can be either perennial or annual plant and can be achieved until 2 meter long of plant height. Okra can be cultivated in warm condition and this species is resistance toward pests and disease and can be plant on the less soil moisture. Okra is available in two colours which are green and red where each colour represents different varieties. Both of the varieties will carry same flavour and taste. The fruit of okra is in shape of pentagonal cross-section and containing numerous seed. Okra can be affected by many disease included verticillium wilt, powdery mildew, leaf spot and root-knot nematodes (Martin, 1982).

In order to minimize infection of okra toward pest and disease, F1 hybrid seed is the best seed to use in crop cultivation. Furthermore, F1 hybrid seed can give better growth performance and suitable planted in many condition. F1 hybrid seeds is the selective breeding resulted from cross pollination between two different parental plants (Sood, 2015). Known as F1 because it was the hybrid from first generation of the cross pollination. This F1 generation will carried the dominant characteristics of the parent plants which is better in many ways. The advantage of uses F1 hybrid seed included fast maturity, resistance toward pests and disease, more productivity and better fruit production (Singh, Goswami & Kumar, 2013).

2.2 Okra plant Nutrient Uptake

Nutrient can be classified as natural or artificial substances which have chemical elements to maximize growth performance and yield production of plant either directly apply to the soil, land or plant itself (Barker, Herdt & Rose,2014). Nutrient could be macronutrient, micronutrient, ferum, vitamin and many more. Macronutrient are the nutrient that is needed by plant in large quantity such as nitrogen (N), phosphorus (P) and potassium (K) that more function toward promote plant cell activity, important for many enzyme activity and for plant growth. Micronutrient are the nutrient that required less by plants such as calcium, magnesium, sulphur, iron, copper, zinc and others. Functions of micronutrients included essential for photosynthesis process and component of many enzymes (Guo & Marschner, 1995).

2.3 Application of Fertilizer in Plantation

According to Latifah, Hasyim, Mariyono and Luther (2015), the applications of inorganic fertilizer on plant was inefficient and give disadvantages to the ecosystem and environmental impacts such as soil and water resources. Furthermore, inorganic fertilizer will spread unwanted gas that can cause pollution either water, air or many more type of pollution. The uses of inorganic fertilizer in large amount also cannot be processed and absorbed by the plant and also can affect production system of the crop. Inorganic fertilizers also can affect human health directly in term of contamination of chemical in human body, soil, water and air surrounding. Furthermore, the plantation was not being an environmentally friendly anymore because much pollution unbalanced in nutrient uptake, high salt content which is more acidity or alkalinity and encourages the build of toxic ion. If the amount of inorganic fertilizer was higher, it will affect and decrease the organic elements that already inside the soil. As a solution, organic fertilizer was imply in production system because organic fertilizer was more environmental friendly, improve quality and fertility of soil, so that the plant can absorb nutrient inside soil in maximum value and also the yield production also can be improved and increased from time to time. Fertilizer have different form included solution (foliar) form and solid form. Fertilizer with characteristics of foliar (solution) form were reliable to have better and effectively absorption inside the soil and plant. According to Chauhan, Jabran and Mahajan (2017), fertilizer use is major factors for the continuous increase in yield production since the Green Revolution era. Method of fertilizer application included broadcasting, pellet application and foliar application. Efficient nutrient management can give benefit and positive impact toward plant such as maximize production level, improve plant growth and ensures minimal leakage of applied nutrients to the environment.

According to Dou, Komatsuzaki and Nakagawa (2012), the yield production can be improving through the supply of organic fertilizer and combination between organic and inorganic fertilizer. It is believe that organic fertilizer can increased microbial activity which is improved soil functioning and activity in term of absorb and release nutrient, environmental activity such as absorb water to avoid soil erosion and many more, and also organic fertilizer can increase nitrogen(N) efficiency which is directly enhance plant growth and production of yield. Crop plantation was response toward different type of fertilizer supply. It is believe that Bokashi treatment can improves soil nutrient, yield and quality of crop together with Biochar which is also can give different kind of positive impact to the plantation, food safety, and environament This is also can decrease and reduce the amount of inorganic fertilizer contain in plantation.

2.3 The uses of MSG in Selected Purposes or Field

2.4.1 Uses of MSG in Cooking Purposes

MSG was the mixture between sodium salt and glutamaric acid that is naturally happen which is non-essentials amino acid. MSG was used widely as an agent to enhance flavour in term of umami taste in different kind of dishes either food canned or in cooking. This is because MSG can make the food more delicious and attract smell so that the food will have good smell (Dove, 1948). MSG was used widely in cooking purposes, but not in plantation.

2.4.2 Uses of MSG in Plant

MSG can be applying in plantation as enhance plant growth and production of yield. MSG also can act likely NPK fertilizer, this is because, MSG can apply nitrogen, phosphorus and potassium toward crop plantation. Gresinta (2015) mention that application of MSG will give positive impact and crop can extract nutrition from MSG. Application of MSG in slow release form with concentration of 3 g/stem and 6 g/stem can give beneficial to the crop in term of increase the quality and quantity of yield production, increase the time for flower to appear and enhance plant growth. Furthermore, applications of MSG are suitable for flowering plant because MSG can enhance time for flower to appear.

2.4.3 Use of MSG as a Foliar Fertilizer

Harder, Carlson and Shaw (1982) mention that foliar fertilizer also known as foliar feeding where foliar feeding is the condition where foliar form had been used in orders to apply fertilizer and distribute either directly to the soil or plant itself. The foliar feeding also means as nutrient absorption by above-ground plant parts, extra radical feeding and non-root feeding. There are many advantages of foliar fertilizer included minimize application rates, decrease cost, uniform and better distribution and fast response of nutrients. Moreover, each plant parts will get enough nutrients and hidden hungers can be avoided (Poole, Randall & Ham, 1983). Furthermore, foliar fertilizer techniques may also be a better way to the soil application in order to minimize loss of fertilizer through leaching and also decrease the ground water pollution. Foliar fertilizer techniques had been suggested by several farmers and investigators as an alternative method to maximize yield production and improve growth performance (Reuveni & Reuveni, 1998 ; Sharaf & El-Naggar, 2003).

2.4 Water Soluble Fertilizer or Foliar Fertilizer in Farming System

Deore, Limaye, Shinde and Laware (2010) describe that water soluble fertilizer or foliar fertilizer can be used in way of spray plant according to the schedule. The plant growth and yield of crop will be improved and increase as the concentration of water soluble fertilizer also increase. These result may cause by the higher process of photosynthesis was carry out throughout all of the parts of crop.

Foliar fertilizer was newly established and still up to date in production in farming system. This is because fertilizer in solid form was not easy as water soluble fertilizer to absorb by the soil and plant. There are many benefit and advantages in imply water soluble fertilizer in production system such as can give more efficiency the need of nutrition straight to the soil, improve overall health of crop and plant and it also was design to reduce the problem such as nutrients immobilization and fixation. The yield production and growth performance can be increased and improved by uses the many level of water soluble fertilizer or foliar fertilizer. The foliar fertilizers significantly give positive impacts to the yield in term of fruit length, fruit girth and fruit weight. Any foliar fertilizer such as vermicomposting were reliable to have better effective and highly beneficial for maximizing the yield production when spray along with NPK. This is because, foliar fertilizer that were combined with NPK can supply major nutrients that needed by plant and soil. In addition, these ways would have better and quickly absorption into the soil and plant itself (Muthumanickam & Anburani , 2017a).

2.6 Bokashi as Organic Fertilizer

There are many advantages when applied bokashi as organic fertilizer compare to chemical fertilizer in plantation included increase photosynthesis rate, which is more food and energy can be produced by plant itself, increase transpiration rate and mesophyll rate, so that all parts of the plants and soil can more effectively functioning. Vegetative and reproductive growth of crop also increase and the yield also can be improve and increase. Thus, bokashi was proven as an effective organic fertilizer in agricultural practices and management. The application of bokashi in agricultural practices can improve nature farming crop production, when organic fertilizer was used in the agricultural plantation in order to replace the application of chemical fertilizer. Bokashi was more effective fertilizer for plant growth and get quality of yield compare to the application of NPK. (Pei-Sheng & Hui-Lian , 2002)

2.7 Combination between Organic or Inorganic Fertilizer with Foliar Fertilizer

According to the Muthumanickam and Anburani (2017b), the combination of inorganic fertilizer with water soluble fertilizer which is concentration of NPK was recorded to have highest plant height, the number of primary branches, stem bulk, number of leaves for each plant, diameter of leaves, leaf area index and dry matter of the yield is increase and significantly positive impact compare to normal fertilizer which is supply of NPK in form of solid as slow release fertilizer. Foliar fertilizer was believed to be more effective compare to solid from because solubility, uniformity and can easy to absorb nutrient that has been distributed and easy to process by the crop and soil as well. Furthermore, photosynthesis process need enough water and sunlight to carry out, by getting help from foliar fertilizer which is also one of the sources of water, photosynthesis rate also can be increase and more energy can be produced by the plant to produce good yield. It is proven that combination between inorganic and foliar fertilizer can recorded to have highest growth parameter in crop.

Inorganic fertilizer directly can give negative impact to the plant, soil and environment as well. Thus, as precautions, vermicompost as a foliar fertilizer had been applied with the inorganic fertilizer toward agricultural plantation to appear as a potential for soil fertility and productivity. Vermicompost is a non-thermophillic biodegradation of organic material which is mixture between earthworms and microorganism to interact as a growth media and soil amendments. Application of vermicompost can solve economic and environment problem like to practices nature farming system which is used organic fertilizer, handle waste disposal that can be reuse and recycle to get new fertilizer and need by plantation that need nutrient from organic fertilizer. It is shown that vermicompost concentration as foliar fertilizer will give positive impact to the plant growth parameter compared to the chemical fertilizer which is can give negative impact to the plant, soil and environment such as poluution, contamination and reduce fertility of the crop and it will attract more disease as well. Excessive nutrient from vermicompost are not taken by plant, but it remain in soil, so that if there are other crop was planted, so that the nutrient can be supply to the next plantation. Growth parameter and fertility of soil can increase when we applied organic fertilizer in correct amount time to time. (Narkhede et al, 2011)

Bokashi and vermicompost was significantly giving positive impact to the number of leaves and plant height of the crop. It also increases the yield with higher quality of crop plantation. Combination between Bokashi and vermicompost as foliar fertilizer also can be imply under monoculture, only one type of crop in the field and intercropping culture, mix between two or more crop in same field. The nutrients that contain in the fertilizer was depend on the manufacture and maturity of the elements that used in the vermicompost as foliar fertilizer. The concentration of vermicompost and rate of Bokashi also give effect to the parameter plant growth. The yield produce was different for each treatment and level of concentration of vermicompost and rate of Bokashi. (Álvarez-Solís Et al, 2016).

As a conclusion, Bokashi is one of the organic fertilizers which can give positive impact to the plant, soil and environment. The nature farming system also can be practiced which is plantation without used chemical fertilizer. Even though, foliar fertilizer was still new in application of fertilizer, but it is now widely practices by the farmers because the growth parameter and yield production of crop can be increase. This is because, application foliar fertilizer, the water soluble form of fertilizer was easy to absorb inside the plant and soil, so that it will effectively functioning all the plantation processes such as transpiration and photosynthesis. Other than that, the distribution of fertilizer also can be uniformity for each plant and the excessive of the foliar fertilizer will absorb by soil, so that next crop can take the nutrients that had been store by the soil. Unfortunately, the optimum rate of bokashi and application of MSG in plantation still in debate and cannot be justify yet. This due there are plenty of technology in plantation nowadays that made farmers difficult to choose. So that, main objective of this research is to study the effects of Bokashi and application of Monosodium Glutamate (MSG) as foliar fertilizer on soil characteristics and growth performance of Okra.

2.8 Soil Analysis and Soil Characteristics

Soil analysis is the process of chemical that determines the availability of plant nutrient in the soil included biological, chemical, physical soil properties that is important for plant nutrition which is used for the growth performance of plant itself (Carter & Gregorich, 2008). There are many purposes of soil analysis and soil characteristics included to determine the amount of nutrients contain inside soil, to assume the yield production of crop and its profitability, to calculate the fertilizer that plant required, to suitable the crop planted with the area and many more. A soil analysis and soil characteristic means better growth performance and higher yield production (Tanja Folnovic, 2018). Soil characteristics included soil texture, soil pH, soil temperature, soil moisture contents, soil colour and many more, while soil analysis included availability phosphorus (P), soil carbon, soil organic matter and many more. The information from soil analysis and soil characteristics can manipulate the fertility of the soil. Thus, farmers can know what kind of equipment, personnel, reputation, agricultural management and action that need to take in order to provide and improve growth performance and high yield. Farmers also can assure and sustain the production and profitability of the farm management (Nelson & Sommers, 1996).

CHAPTER 3

METHODOLOGY

3.1 Description of Study Area

Field study was conducted at Agro Techno Park (ATP), Universiti Malaysia Kelantan, Jeli Campus. This research was carried out in two different locations which were in shelter house and in open area. The area of shelter house was 180m^2 with 6m width and 30m length, while the area of open area was 49.41m^2 with 9.15m length and 5.4m width. Wind and humidity of the location were 1.13 m/s and 94% respectively (google weather,2018). The research was conducted from July to December on 2018.

There are three experiments conducted in this research, where experiments one and two were run in same time and experiments three was conducted after getting the result from experiments one and two. Experiment one and two were conducted on controlled environment which is inside shelter house, while experiment three was conducted at open area which is on planting bed.

3.2 Experimental Design

All three experiments were carried out by using completely randomized design (CRD). Thus, each samples would be randomly arrange in shelter house or open area. In first and second experiments, there are five treatments with different concentration level of bokashi and MSG. Each treatment has three replications for experiments one and two. Thus there are 15 polybags were used in first experiment, and another 15 polybags were used in second experiment.

Pei-Sheng and Hui-Lian (2002) suggested that rate uses of Bokashi in the okra cultivation was 3000 kg/ha. Thus, experiment one was used rate that had been suggested and scale down according to the area of polybag. Other treatments were change either higher or lower than rate that had been suggested. Table 3.1 shows the list of treatment used in experiment one. The weight of fertilizer was measured by weighing balance.

Table 3.1 List of treatment used in experiment one

Treatment	**Rate of Bokashi**
Treatment 1 (T1)	0 g/polybags
Treatment 2 (T2)	9.75 g/polybags
Treatment 3 (T3)	19.5 g/polybags
Treatment 4 (T4)	39 g/polybags
Treatment 5 (T5)	58.5 g/polybags

Gresinta (2015) suggested that concentration of MSG with 3 g/stem and 6 g/stem will give advantage to the plant and yield production. Thus, experiment two was used rate that had been suggested and scale down according to the area of polybag. Other treatments were change either higher or lower than rate that had been suggested. According to Adisarwanto (2000) and Dwi Ardiyanto and Tonang (2008), there are positive impact of MSG as foliar fertilizer by using 4.5 L/ha. Thus, each treatment that applied inside polybag were diluted with distilled water and distributed as foliar feeding toward okra plants. Table 3.2 shows the list of treatment used in experiment two.

Table 3.2 List of treatment used in experiment two

Treatment	Concentration of MSG
Treatment 1 (T1)	0 g/1 L of distilled water (29.25 ml/polybag)
Treatment 2 (T2)	3 g/1 L of distilled water (29.25 ml/polybag)
Treatment 3 (T3)	6 g/1 L of distilled water (29.25 ml/polybag)
Treatment 4 (T4)	9 g/1 L of distilled water (29.25 ml/polybag)
Treatment 5 (T5)	12 g/1 L of distilled water (29.25 ml/polybag)

Experiment three was conducted as factorial experiments where there are combination between bokashi and application of MSG for each treatment. Factorial design was conducted when there are two or more factors were combined in one experiment. The successful treatment from experiment 1 which is factor bokashi and from experiment 2 which is factor MSG were observed and implied in experiment 3. Three levels of bokashi rate in experiment one and two level of MSG rate in experiment 2 were selected to be used in experiment 3. Thus, there are 6 treatments for the combination factor of rate bokashi and MSG. Each treatment conducted three times replications. Thus, experiment 3 will have 18 planting bed all together. Table 3.3 shows the list of treatment used in experiment three.

Table 3.3 List of treatment used in experiment three

Treatments	Rate/Level	
	Bokashi	**MSG**
Treatments 1 (T1)	0 g/planting bed	3 g/1 L of distilled water (540 ml/ planting bed)
Treatments 2 (T2)	0 g/ planting bed	6 g/1 L of distilled water (540 ml/ planting bed)
Treatments 3 (T3)	360 g/ planting bed	3 g/1 L of distilled water (540 ml/ planting bed)
Treatments 4 (T4)	360 g/ planting bed	6 g/1 L of distilled water (540 ml/ planting bed)
Treatments 5 (T5)	720 g/ planting bed	3 g/1 L of distilled water (540 ml/ planting bed)
Treatments 6 (T6)	720 g/ planting bed	6 g/1 L of distilled water (540 ml/ planting bed)

3.3 Preparation of Polybag Media

Polybag was used in shelter house. The media or top soil used was collected from ATP's planting plot. Total for each polybag is 13 kg of top soil. Prior to the experiment, the top soil need to be cleared first from any unwanted plants such as weed and stone that can disturb the growth performance of okra before put inside the polybag. There are 30 polybags were prepared where each polybag will have one okra plant. The polybag was put aside at least a week.

3.4 Preparation of Planting Bed

Land preparation such as tillage and drainage was conducted. Tillage can promote dissolve nutrient, uniform water distribution, help plant to recycle nutrient and better management of pest and disease, while drainage can regulate temperature, help reduce excess water and better growth performance. Then, planting bed with area of $1.2m^2$ with 1.2 m length and 1.0 m width were prepared with total of all 18 plant plot. After the construction of drain, the planting beds were covered with silver shine plastic in order to minimize the weed growth and keep the soil moisture. The plant plot was leaves at least a week before apply any fertilizer and transplanting in order to give soil more favourable and ready to plant.

Okra needs at least spacing of 80 cm width and 80 cm length between plants for better growth and reduces competition. Then, planting bed was measured with the planting spacing for okra with meter tape and hole was made so that, transplanting process easier. There are at least 4 okra plants for each plant plot, which is the total is 72 plants.

3.5 Preparation of Okra Seedling

F1 hybrid seedling was used in this research, so that the plants will more resistance toward pests and disease, better growth performance, better quality and higher production of yield. Sowing tray was used in order to sow the seedling, where peat moss was used as the sowing media. Firstly, peat moss was put ¾ in the sowing tray, then seed was added into sowing tray where one seed for one hole. Then, distilled water was sprayed until the media wet by using small sprayer. After that, the sowing tray was covered with plastic and keep from sunlight expose at least 3 days. This is to keep moisture inside the plastic and promote seed germination. After at least there are one seed was germinated, plastic was opened and exposed the sowing tray under sunlight to let the seed to continue germinate. After a week, the okra was ready to transplant either in the polybag or on the planting bed. Preparation of okra seedling for planting bed is the same as polybag seedling preparation.

3.6 Schedule of Fertilizer Application

MSG as a foliar fertilizer was applied toward the plant every week, while bokashi and NPK Blue were applied alternately. Bokashi was applied at a week before transplanting as basal fertilizer which is a week before transplant, week 4 and week 8, while NPK Blue was applied on week 2, week 6, week 10. Jabatan Pertanian Pulau Pinang (2018) suggested to applied 3 tan/ha of NPK Blue toward okra cultivation for three cycles. Thus, the value of NPK Blue that had been recommended was scale down according to the area of planting bed and polybag used.

3.7 Crop Maintenance

Maintenance and management practices such as application of pesticide, watering, weeding and other practices were conducted as usual applied by farmers.

3.8 Data Collection

3.8.1 Parameter of Growth Performance

All parameter of growth performance can directly take from the site and the data was collected every week from transplant until yield production. The number of leaves was manually calculated per plant and recorded the data. The measurement of plant height was from the lower part of bulk until the tip of the plant. The height of the plant and the diameter of bulk were manually measured by using meter tape. The chlorophyll index was used chlorophyll meter (SPAD meter).

3.8.2 Yield of Okra

The yield of okra was measured starting from first okra production on week seven. The weight of yield was measured by using balance after collected the entire yield per polybag for experiments one and two, while collected the entire yield per planting bed for experiments three. Quantity of the yield was manually measure by calculated the total number of okra harvested.

3.8.3 Parameter of Soil Characteristics and Soil Analysis

The soil sample was collected from the study site**.** Soil colour, soil electrical conductivity (EC) and soil texture were measured before execution of the experiments. Soil EC, soil colour and soil texture was analysed once throughout the experiment. Soil color was identified by comparing soil sample with the Munsell color chart.

For soil EC, 5 g of soil sample was mixed with 50 ml of distilled water, then the mixture was shaken at least 15 minutes then left aside for 24 hours before EC reading was observed by using electrical conductivity meter (EC meter) and data was recorded.

For soil texture, hydrometer method was used in this research. Four gram of sodium metaphosphate was dissolved in 100 ml of distilled water and only uses 10 ml of this solution for this experiment. Then, 50 g of soil sample, 10 ml of above solution and 100 ml of distilled water was put inside conical flask and shaken for 15 minutes. After 15 minutes, the mixture was transferred into 1000 ml measuring cylinder and distilled water was added into measuring cylinder until 1130 ml. Stirring rod was used to stir throughout the mixture, then hydrometer was carefully put into a measuring cylinder and first reading was taken after exactly 40 seconds and equation 3.1 was used. Hydrometer was taken out and rinsed with distilled water. The suspension was stirred again and hydrometer was carefully put into a measuring cylinder and second reading was taken after exactly 40 seconds and equations 3.2 and 3.3 were used. The result obtained for both readings were equivalent to the amount of silt and clay of the soil in grams of the sample. Lastly, the suspension stirred again thoroughly the measuring cylinder then third hydrometer reading was recorded after 2 hours and equation 3.4 and 3.5 were used. The calculation for soil texture is as follows (Bouycous, 1962).

For 40 seconds reading:

$$\text{Percentage of sand + silt + clay} = 100\% \tag{3.1}$$

For 40 seconds reading:

$$\text{Percentage of silt + clay} = (a/50) \times 100\% = w \tag{3.2}$$

$$\text{Percentage of sand} = (100-w)\% = x \tag{3.3}$$

After 2 hours reading:

$$\text{Percentage of clay} = (b/50) \times 100\% = y \tag{3.4}$$

$$\text{By differences: Percentage of silt} = w - y = z \tag{3.5}$$

Soil pH, soil temperature and soil moisture content was measured directly to the soil at the study site. The data recorded every week. Firstly, soil pH and soil temperature was determined by using Soil pH meter. Soil pH meter will measures the acidity and alkalinity expressed as pH in soil through the hydrogen-ion activity in water-based solutions. Soil pH meter was inserted into the soil sample near to the okra plant, then pH and temperature reading can directly read from the soil pH meter. Then, soil moisture content was determined by using GMS (granular matrix sensor). This instrument will gives and provides accurate readings of moisture content through direct measurement of soil moisture. GMS was inserted into the soil sample near to the okra plant, and then soil moisture content reading can directly read from the GMS (Patiram, 2007).

Soil organic matter (OM), soil carbon (C) and available phosphorus in soil were conducted before planting and after okra harvesting. Combustion method was used in order to determine the soil OM and soil C in this research. The soil sample that get from the study site which is in polybag and planting bed was placed in an oven and was left for 24 hours at 110 °C. The sample was cool down before put into crucible. Initial weight of crucible with lid was recorded. Five gram of soil sample that already cool was placed into the crucible, and then the weight of crucible with lid and soil sample were weighed and recorded. The sample was placed into a muffle furnace for about 8 hours at 550 °C. After 8 hours, the sample was cool down first. The weight of sample and crucible after ashing was recorded. The soil OM and soil C were calculated by using equation 3.6 and 3.7 respectively (Tan, 2003).

Soil OM =

$$\frac{Initial\ weight\ of\ soil\ sample\ (g)+Final\ weight\ of\ soil\ sample\ (g)}{weight\ of\ soil\ sample\ (g)} \times 100\% = \mathrm{x} \qquad (3.6)$$

$$\text{Soil C} = \mathrm{x} \times 0.58 \qquad (3.7)$$

Available P in soil was determined by using double acid method. A mixture of 0.05 M hydrocholoric acid (HCl) and 0.0025 M of sulphuric acid (H_2SO_4) was prepared. Five gram of soil sample that already dried was transferred into 250 ml conical flask. Twenty ml of double acid extractant was added and was shaken at 180 rpm about 10 minutes. The supernatant was filtered using filter paper no.2 into another beaker. Reagent A with a mixture of 12 g of ammonium moybdate, 0.2908 g of potassium antimonyl tartrate, 148 ml concentrated H_2SO_4 and distilled water was prepared. Reagent B which is mixture of 1.32 g of ascorbic acid was mixed with 250 ml reagent A was prepared fresh. Eight ml of Reagent B was added into a 50 ml volumetric flask followed by extractant solution and distilled water was made up to the volume. The blue colour was developed and dilution needs to undergo in order to get light blue colour. The blue colour was analysed using UV spectrophotometer at 882 nm wavelength. The total P in soil was calculated by using the following calculation (Rosa & Franz, 2005).

Total P in soil =

$$\text{UV-reading} \times \frac{volume\ of\ double\ acid\ extractant\ (20ml)}{weight\ of\ soil\ (5g)} \times \frac{volumetric\ flask\ (50\ ml)}{volume\ extractant\ add\ (ml)} \times dilution \text{ (if any)} \qquad (3.8)$$

3.9 Data Analysis

The data in this study were analysed by using Statistical Package for Social Science (SPSS) software version 20. The Analysis of Variance (ANOVA) and T-test were used to detect the treatment effects. If significant different was detected, post hoc test by Duncan test was used to determine and separate the treatment means at $p \leq 0.05$.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Soil Properties of Study Area

Table 4.1 shows soil properties of the study site.

Table 4.1 Soil properties of study area

Soil Properties	**Value**
Soil Texture	Sandy loam and loamy sand (Sand with 79%, silt with 11% and clay with 10%)
Soil Electrical Conductivity EC	206 mS/m to 168 mS/m
Soil Colour	Reddish brown and dark red

Soil texture of the study area was sandy loam and loamy sandy, where this type of soil texture can hold and built up organic matter compared with others soil texture. This is because, this type of soil texture only have least amount of clay content in soil (Bouycous, 1962). Soil texture play important role in making management decision on application of irrigation, fertilizers or pesticide implied directly or indirectly to the soil.

Soil texture can directly affect the soil EC. This is because, when the clay content is decrease, the soil EC also decreases. Soil EC play imported role on a precision farming (Bouycous, 1962).

4.2 Single Effect of Bokashi and MSG toward Okra Plants

4.2.1 Single Effect of Bokashi and MSG toward Okra Growth Performance

Table 4.2 shows the growth performance in term of number of leaves, height of plant, diameter of bulk and chlorophyll index toward different treatment rate of bokashi and MSG.

Table 4.2 Growth performance of okra toward different treatment rate of bokashi and MSG

Factor	**Treatment**	**Number of leaves**	**Height of plants (cm)**	**Diameter of bulk (cm)**	**Chlorophyll index**
Single effect of bokashi	Treatment 1 (0 g/polybag)	10.400 ± 4.107 ^{a}	74.283±42.9159 ^{a}	4.877 ± 1.8288 ^{a}	39.577±7.7639 ^{a}
	Treatment 2 (9.75 g/polybag)	12.400 ± 4.789 ^{b}	78.133±45.8682 ^{a}	5.617 ± 2.4505 ^{b}	45.560±8.6160 ^{b}
	Treatment 3 (19.5 g/polybag)	11.233 ± 4.352 ^{ab}	76.450±44.0657 ^{a}	5.437 ± 2.1647 ^{b}	42.403±5.4823 ^{a}
	Treatment 4 (39 g/polybag)	12.567 ± 5.776 ^{b}	84.433±49.8501 ^{b}	5.307 ± 1.6526 ^{b}	40.047±6.8111 ^{a}
	Treatment 5	11.233 ±	74.183±43.5081 ^{a}	4.903 ± 1.8376	41.563±7.9692 ^{a}

	(58.5 g/polybag)	4.431 ^{ab}		^{a}	
Single effect of MSG	Treatment 1 (0 g/1 L H_20)	9.03 ± 3.672 ^{a}	65.267 ± 37.3794 ^{a}	4.567 ± 1.7189 ^{a}	35.080 ± 10.8215 ^{a}
	Treatment 2 (3 g/1 L H_20)	13.57 ± 5.940 ^{c}	81.167 ± 47.0721 ^{d}	5.733 ± 2.1397 ^{c}	46.560 ± 14.3342 ^{b}
	Treatment 3 (6 g/1 L H_20)	12.60 ± 5.733 ^{c}	76.983 ± 43.9860 ^{c}	5.100 ± 1.8773 ^{b}	47.440 ± 16.7767 ^{b}
	Treatment 4 (9 g/1 L H_20)	10.20 ± 4.604 ^{b}	63.233 ± 35.8464 ^{a}	4.290 ± 1.6395 ^{a}	37.153 ± 13.5241 ^{a}
	Treatment 5 (12 g/1 L H_20)	9.90 ± 3.994 ^{ab}	68.417 ± 39.0961 ^{b}	4.560 ± 1.8613 ^{a}	38.843 ± 12.4144 ^{a}

Means followed by the different letter (s) between columns indicate significance differences between treatment by Duncan test at $p \leq 0.05$

The number of leaves for bokashi treatment shows significant differences between T1 and T2 and T1 and T4. From the results, rate of bokashi treatment on T2 and T4 increase the number of leaves with mean of 12 and 13 respectively. When rates of bokashi treatments increase, number of leaves also increase.

The number of leaves for MSG treatment shows significant differences between T1 and T2, T1 and T3 and T1 and 4. From the results, rate of MSG treatment on T2 and T3 have higher number of leaves with mean of 14 and 13 respectively. Numbers of leaves were increased from T1 until T3, unfortunately, when plant was applied with higher rate of MSG more than 6g, the number of plant become least.

The number of leaves play important role in chlorophyll content. This is because, one of the parts of leaves, there are green pigment that called as chlorophyll that play role in photosynthesis process throughout the plant (Gitelson, Gritz & Merzlyak, 2003).

The height of plants for bokashi treatment shows significant differences between T1 and T4 only and others showed no significance differences. From the results, rate of bokashi treatment on T4 increase the height of plant with mean of 84.43 cm. When rates of bokashi treatments increase, number of leaves also increase.

The height of plants for MSG treatment shows significant differences between T1 and T2, T1 and T3 and T1 and T5. From the results, rate of MSG treatment on T2 showed higher plant height with mean of 81.17 cm. Height of plants were increased from T1 until T3, unfortunately, when plant was applied with higher rate of MSG more than 6g, the height of plant was decrease.

Moles and et.al (2009) stated that plant height play important role as plant supporter. Thus, the okra plant will be more stable when has highest of plant height.

The diameter of bulk for bokashi treatment shows significant differences between T1 and T2, T1 and T3 and T1 and T4. From the results, rate of bokashi treatment on T2, T3 and T4 had increase the diameter of bulk with mean of 5.6 cm, 5.4 cm and 5.3 cm respectively. When rates of bokashi treatments increase, number of leaves also increase.

The diameter of bulk for MSG treatment shows significant differences between T1 and T2 and T1 and T3. From the results, rate of MSG treatment on T2 had increase the diameter of bulk with mean of 5.7 cm. Diameter of bulk were increased from T1 until T3, unfortunately, when plant was applied with higher rate of MSG more than 6g, the diameter of bulk become shorter.

The chlorophyll index for bokashi treatment shows significant differences between T1 and T2 only and others showed no significance differences. From the results, rate of bokashi treatment on T2 had increase the chlorophyll index with mean of 45.56. When rates of bokashi treatments increase, number of leaves also increase.

The chlorophyll index for MSG treatment shows significant differences between T1 and T2 and T1 and T3. From the results, rate of MSG treatment on T2 and T3 had increase the chlorophyll index with mean of 46.56 and 47.44 respectively. Chlorophyll index were increased from T1 until T3, unfortunately, when plant was applied with higher rate of MSG more than 6g, the chlorophyll index decrease.

The higher chlorophyll content on the leaves, photosynthesis process in okra plant also increases. This is because, chlorophyll content or green pigment play important role in photosynthesis process other than water and carbon dioxide. Generally, photosynthesis process is the process where light energy was transform into chemical energy which is changed water, carbon dioxide and mineral into oxygen. Oxygen that produced by plant would be used by life organisms such as animal and human. Thus, chlorophyll content and photosynthesis process is important on biodiversity (Gitelson, Gritz & Merzlyak, 2003).

From table 4.2, T2, T3 and T4 with rate of bokashi 9.75 g/polybags, 19.5 g/polybags and 39 g/polybags were the best treatment out of five treatments on the okra growth performance. This is because, T2, T3 and T4 have higher plant height, more numbers of leaves, higher chlorophyll index and longer diameter of bulk compared with others treatments.

From table 4.2, T2 and T3 with rate of MSG 3 g/1 L of distilled water (29.25 ml/polybag) and 6 g/1 L of distilled water (29.25 ml/polybag) were the best treatment out of five treatments on the okra growth performance. This is because when plant was applied with higher rate of MSG more than 6g, the plant will get worst result in term of plant height, number of leaves, diameter of bulk and chlorophyll content.

4.2.2 Single Effect of Bokashi and MSG toward Okra Yield

Table 4.3 shows the yield of okra plant in term of quantity and weight toward different treatment rate of bokashi and MSG.

Table 4.3 Yield production of okra toward different treatment rate of bokashi and MSG

Factor	Treatment	Quantity of yield	Weight of yield (g)
Single effect of bokashi	Treatment 1 (0 g/polybag)	2 ± 1 ^{ab}	47.83 ± 29.126 ^{a}
	Treatment 2 (9.75 g/polybag)	4 ± 2 ^{c}	97.08± 55.328 ^{b}
	Treatment 3 (19.5 g/polybag)	3 ± 1 ^{bc}	60.25 ± 30.251 ^{a}
	Treatment 4 (39 g/polybag)	2 ± 1 ^{ab}	65.17 ± 44.140 ^{ab}
	Treatment 5 (58.5 g/polybag)	1 ± 1 ^{a}	40.17 ± 38.729 ^{a}
Single	Treatment 1	2 ± 1 ^{ab}	60.50 ± 35.233 ^{a}

effect of	(0 g/1 L H_20)		
MSG	Treatment 2 (3 g/1 L H_20)	4 ± 2 [c]	106.50 ± 76.222 [b]
	Treatment 3 (6 g/1 L H_20)	3 ± 2[bc]	66.58 ± 37.965 [a]
	Treatment 4 (9 g/1 L H_20)	2 ± 1 [a]	41.25 ± 28.275 [a]
	Treatment 5 (12 g/1 L H_20)	1 ± 1 [a]	33.83 ± 21.896 [a]

Means followed by the different letter (s) between columns indicate significance differences between treatment by Duncan test at $p \leq 0.05$.

According to the table 4.3, on single effect of bokashi, T2 had the highest quantity of yield and weight of yield with mean of 4 and 97.08 g respectively compared with others, while the T5 have the lowest quantity of yield and weight of yield with mean of 1 and 40.17 g respectively. Thus, T2, T3 and T4 with rate of bokashi 9.75 g/polybags, 19.5 g/polybags and 39 g/polybags were the best treatment out of five treatments on the okra yield production because have potential to produce higher production of yield.

According to the table 4.3, on single effect of MSG, T2 have the highest quantity of yield and weight of yield with mean of 4 and 106.50 g respectively compared others, while the T5 have the lowest quantity of yield and weight of yield with mean of 1 and 33.83 g respectively. Thus, T2 with rate of MSG 29.25 ml/polybag (3 g/1 L of distilled water) was the best treatment out of five treatments on the okra growth performance because can produce more yield compare other treatments.

Chaturvedi (2006) mentioned that growth performance directly proportional toward yield production of okra plants. When okra plants have better growth performance, plant are in suitable condition to produce yield on time and in higher quantity.

4.2.3 Single Effect of Bokashi and MSG toward Soil Characteristics

Table 4.4 shows the soil characteristics in term of pH, temperature and soil moisture content toward different treatment rate of bokashi and MSG.

Table 4.4 PH, temperature and soil moisture content of soil toward different treatment rate of bokashi and MSG

Factor	Treatment	pH	Temperature	Soil moisture content (SMC) (%)
Single effect of bokashi	Treatment 1 (0 g/polybag)	3.7230 ± 0.47237^{a}	27.390 ± 2.1522^{a}	6.200 ± 19.6061 ^{a}
	Treatment 2 (9.75 g/polybag)	3.7560 ± 0.52581^{a}	27.010 ± 1.9365^{a}	1.420 ± 4.4904^{a}
	Treatment 3 (19.5 g/polybag)	3.8060 ± 0.47306^{a}	26.860 ± 1.8709^{a}	6.200 ± 19.6061 ^{a}
	Treatment 4 (39 g/polybag)	3.7210 ± 0.39128^{a}	27.100 ± 1.8324^{a}	1.420 ± 4.4904^{a}
	Treatment 5 (58.5 g/polybag)	3.8490 ± 0.45754^{a}	26.800 ± 1.8379^{a}	14.900 ± 26.0190 ^{a}
Single	Treatment 1	3.9340 ±	27.920 ±	6.200 ± 19.6061^{a}

effect of MSG	(0 g/1 L H_20)	0.54702^{a}	2.8936^{a}	
	Treatment 2 (3 g/1 L H_20)	3.7120 ± 0.52336^{a}	26.960 ± 1.8325^{a}	1.420 ± 4.4904^{a}
	Treatment 3 (6 g/1 L H_20)	3.7710 ± 0.51193^{a}	27.060 ± 2.3268^{a}	8.000 ± 19.7990^{a}
	Treatment 4 (9 g/1 L H_20)	3.8520 ± 0.55954^{a}	27.070 ± 2.0565^{a}	14.660 ± 25.3733^{a}
	Treatment 5 (12 g/1 L H_20)	4.0720 ± 0.51272^{a}	27.570 ± 2.1628^{a}	2.600 ± 8.2219^{a}

Means followed by the different letter (s) between columns indicate significance differences between treatment by Duncan test at $p \leq 0.05$

According to the table 4.4, there are no significance differences between treatment for pH, temperature and soil moisture content. Thus, pH, temperature and soil moisture content does not give effect throughout the experiment on okra plant. From the result, when pH increases, the temperature will decrease. Thus, when the soil less acidity and near to the neutral, the temperature will decrease and kept the soil in moist condition. Since, pH, temperature and smc are very important in growing plant.

Table 4.5 shows the soil characteristics in term of SOM, SC and available P in soil toward different treatment rate of bokashi and MSG. The data were measured before transplanting and after plant produce yield.

Table 4.5 Soil organic matter, soil carbon and available phosphorus (P) in soil toward different treatment rate of bokashi and MSG

Factor	Treatment	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5
Single effect of bokashi	SOM (soil organic matter)					
	Before transplant	3.61 ± 0.23^{b}	3.82 ± 0.66^{b}	4.30 ± 0.35^{b}	4.38 ± 0.99^{b}	4.94 ± 0.89^{b}
	After harvest	6.61 ± 0.32^{a}	7.57 ± 0.99^{a}	8.51 ± 0.47^{a}	7.84 ± 1.11^{a}	6.72 ± 0.27^{a}
	SC (soil carbon)					
	Before transplant	2.09 ± 0.13^{b}	2.22 ± 0.37^{b}	2.49 ± 0.21^{b}	2.55 ± 0.57^{b}	2.87 ± 0.52^{b}
	After harvest	3.84 ± 0.18^{a}	4.39 ± 0.58^{a}	4.93 ± 0.27^{a}	4.55 ± 0.64^{a}	3.90 ± 0.16^{a}
	Available P in soil (ppm)					
	Before transplant	277.33 ± 3.06^{a}	326.67 ± 6.43^{a}	192.0 ± 7.21^{a}	116.33 ± 7.10^{b}	194.67 ± 3.06^{a}
	After harvest	133.33 ± 4.16^{b}	43.33 ± 14.47^{b}	12.67 ± 6.43^{b}	126.67 ± 6.11^{a}	16.0 ± 4.00^{b}
Single effect of MSG	SOM (soil organic matter)					
	Before transplant	2.93 ± 0.14^{b}	16.67 ± 0.09^{b}	4.79 ± 0.09^{b}	3.34 ± 0.06^{b}	3.51 ± 0.05^{b}
	After harvest	6.83 ± 0.09^{a}	20.21 ± 1.03^{a}	8.11 ± 0.18^{a}	6.81 ± 0.10^{a}	7.65 ± 0.34^{a}
	SC (soil carbon)					
	Before transplant	1.70 ± 0.08^{b}	9.67 ± 0.05^{b}	2.77 ± 0.06^{b}	1.94 ± 0.03^{b}	2.03 ± 0.02^{b}

After harvest	3.96 ± 0.05^a	11.73 ± 0.60^a	4.70 ± 0.10^a	3.95 ± 0.06^a	4.44 ± 0.20^a
Available P in soil (ppm)					
Before transplant	275.33 ± 2.31^a	324.67 ± 6.43^a	294.67 ± 8.33^a	285.33 ± 7.57^a	90.67 ± 10.01^a
After harvest	56.67 ± 4.16^b	227.33 ± 6.43^b	266.00 ± 14.42^b	80.00 ± 17.32^b	22.0 ± 2.00^b

Means within column with different superscripts indicate significant difference by independent t-test

There were significance differences between SOM before transplanting and after harvest for all five treatments on both factors. Soil organic matter (SOM) was increase from before transplant and after harvest. This shows that the soil that used in this study can hold SOM and only release it when required by the plants. This could be due to the application of organic fertilizer which is bokashi and uses of organic material during the okra cultivation which resulted in the built up of SOM (Akbar et al., 2010)

There were significance differences between SC before transplanting and after harvest for all five treatments on both factors. Soil organic matter (SOM) was directly affect or was corresponding to the SC in the soil, thus when SOM increases, SC also increases (Rosa & Franz, 2005). Soil carbon (SC) was increase from before transplant and after harvest. This was probably due to the application of organic fertilizer which is bokashi and organic materials during the okra cultivation which resulted in the built up of SOM (Akbar et al., 2010)

There were significance differences between available P in soil before transplanting and after harvest for all five treatments on both factors. Available P in soil was decrease from before transplant to after yield collection. This was probably due to the condition where okra plants absorb and required P in soil during okra cultivation. Even though, okra plant was supplied with organic fertilizer and inorganic fertilizer which is NPK that suggested, it could not support the supply of nutrient to the soil. Thus, okra plant required phosphorus in soil for growth performance and root morphology. When phosphorus content in soil increase, the growth performance will be higher and root elongation will be more stress. Thus, application of fertilizer would release nutrients according to the quantity that is required by okra plant (Adriano, Gutiérrez, Dendooven & Salvador-Figueroa, 2012).

4.3 The Best Rate Treatment Application of Single Effect of Bokashi and MSG in Growing Okra

Based on the results of 4.2 that had been discussed, on the single effect of bokashi, T2, T3 and T4 with rate of bokashi of 9.75 g/polybags, 19.5 g/polybags and 39 g/polybags respectively were the best treatment out of five treatments. This is because, these treatments have better growth performance, yield production and soil characteristics of okra cultivation compared with other treatments.

Based on the results of 4.2 that had been discussed, on the single effect of MSG, T2 and T3 with rate of MSG 3 g/1 L of distilled water and 6 g/1 L of distilled water respectively were the best treatment out of five treatments. This is because, these treatments have better growth performance, yield production and soil characteristics of okra cultivation compared with other treatments.

4.4 Factorial Effect between Bokashi and MSG toward Okra Plants

4.4.1 Interaction Effect between Bokashi and MSG toward Okra Growth Performance

Table 4.6 shows the growth performance in term of number of leaves, height of plants, diameter of bulk and chlorophyll index toward different treatment rate of factorial experiment of MSG and bokashi.

Table 4.6 Growth performance of okra toward different treatment rate of factorial experiment between MSG and bokashi

Treatment	**Number of leaves**	**Height of plants (cm)**	**Diameter of bulk (cm)**	**Chlorophyll index**
Treatment 1 (0 g/planting bed&3 g/1 L H_20)	11 ± 6 [a]	38.57 ± 19.059 [a]	3.576 ± 1.5569 [a]	37.029 ± 7.8920 [a]
Treatment 2 (0 g/planting bed&6 g/1 L H_20)	11 ± 6 [a]	42.57 ± 21.910 [b]	3.790 ± 1.6610 [a]	38.595 ± 6.3985 [a]
Treatment 3 (360 g/planting bed&3 g/1 L H_20)	16 ± 7 [b]	53.90 ± 29.560 [d]	5.571 ± 2.9835 [d]	48.095 ± 10.8385 [c]
Treatment 4 (360 g/planting bed&6 g/1 L H_20)	14 ± 10 [b]	58.38 ± 34.464 [e]	4.990 ± 2.6220 [c]	43.200 ± 10.3569 [b]
Treatment 5 (720 g/planting bed&3 g/1 L H_20)	12 ± 6 [a]	49.67 ± 28.152 [c]	4.943 ± 2.7651 [c]	43.990 ± 10.1171 [b]
Treatment 6 (720 g/planting bed&6 g/1 L H_20)	12 ± 8[a]	51.29 ± 30.651 [c]	4.586 ± 2.7399 [b]	35.910 ± 7.6765 [a]

Means followed by the different letter (s) between columns indicate significance differences between treatment by Duncan test at $p \leq 0.05$.

Number of leaves shows significant differences between T1 and T3 and T1 and T4. From the results, treatment on T3 and T4 had higher number of leaves with mean of 16 and 14 respectively.

The number of leaves was play important role in chlorophyll content. This is because, one of the parts of leaves, there are green pigment that called as chlorophyll that play role in photosynthesis process throughout the plant (Gitelson, Gritz & Merzlyak, 2003).

Figure 4.1 shows the interaction effect between application of bokashi and uses of MSG toward okra number of leaves.

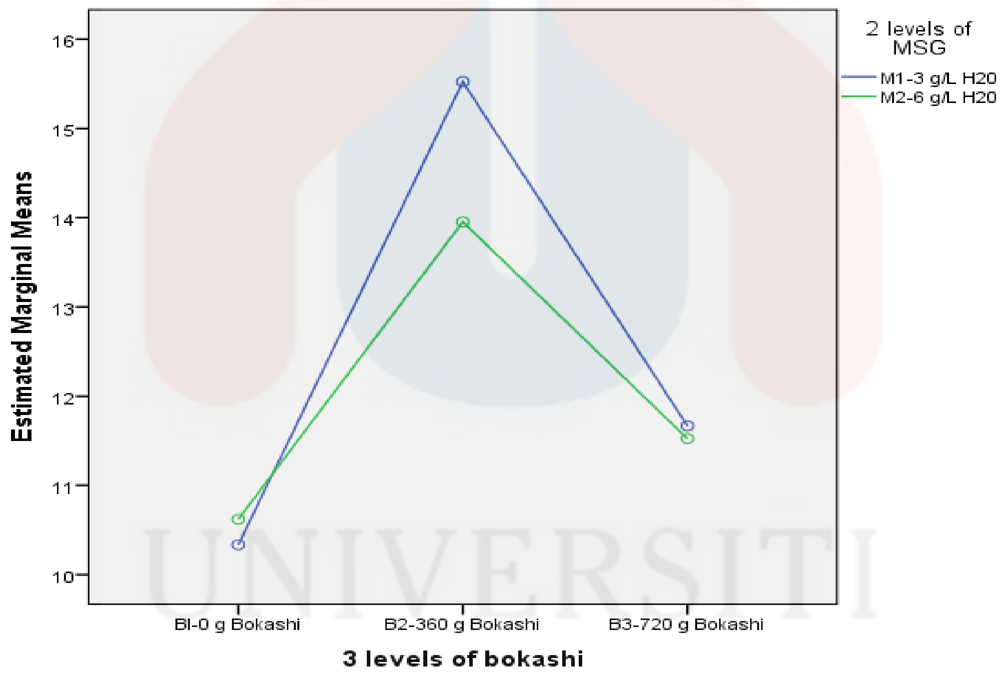

Figure 4.1 Interaction effects between application of bokashi and uses of MSG toward okra number of leaves

Based on figure 4.1, there were interaction between application of bokashi and uses of MSG on T1 (0 g/planting bed&3 g/1 L H_20), T2 (0 g/planting bed&6 g/1 L H_20), T5 (720 g/planting bed&3 g/1 L H_20) and T6 (720 g/planting bed&6 g/1 L H_20)

The height of plants for bokashi treatment shows significant differences between T1 and T4 only and others shown no significance differences. From the results, rate of bokashi treatment on T4 increase the height of plant with mean of 84.43 cm. When rates of bokashi treatments increase, number of leaves also increase.

The height of plants shows significant differences in all treatments except between T5 and T6. From the results, treatment on T4 had shown higher on height of plants with mean of 53.38 cm.

Moles and et.al (2009) stated that plant height play important role as plant supporter. Thus, the okra plant will be more stable when has highest of plant height.

Figure 4.2 show the interaction effect between application of bokashi and uses of MSG toward okra height of plants.

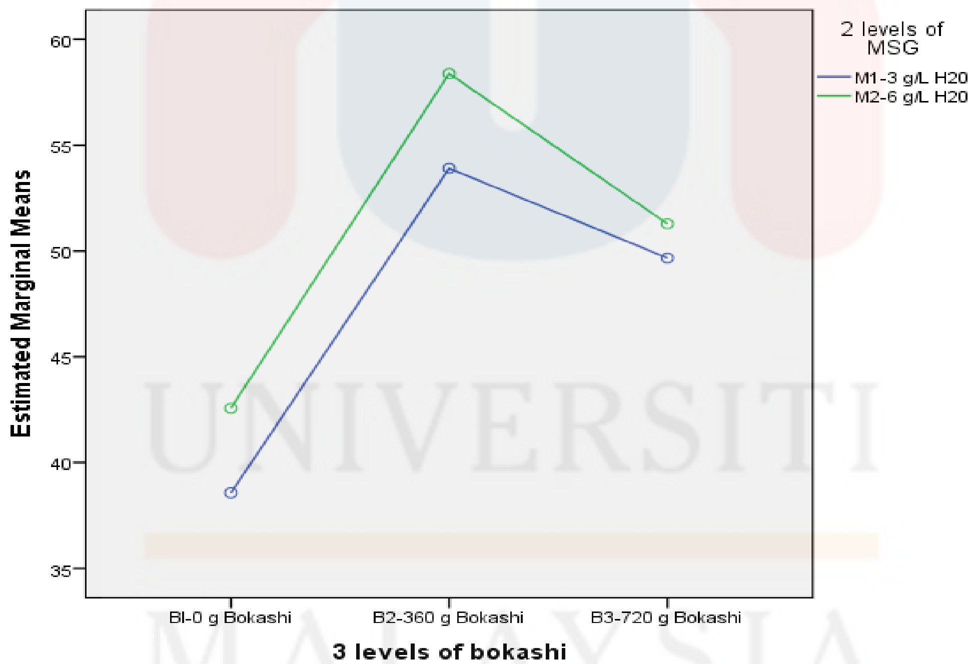

Figure 4.2 Interaction effects between application of bokashi and uses of MSG toward okra height of plants

Based on figure 4.2, there were no interaction between application of bokashi and uses of MSG on height of okra plants.

The diameter of bulk shows significant differences between T1 and T3, T1 and T4, T1 and T5 and T1 and T6. From the results, treatment on T3 had higher the diameter of bulk with mean of 5.57 cm.

Figure 4.3 show the interaction effect between application of bokashi and uses of MSG toward okra diameter of bulk.

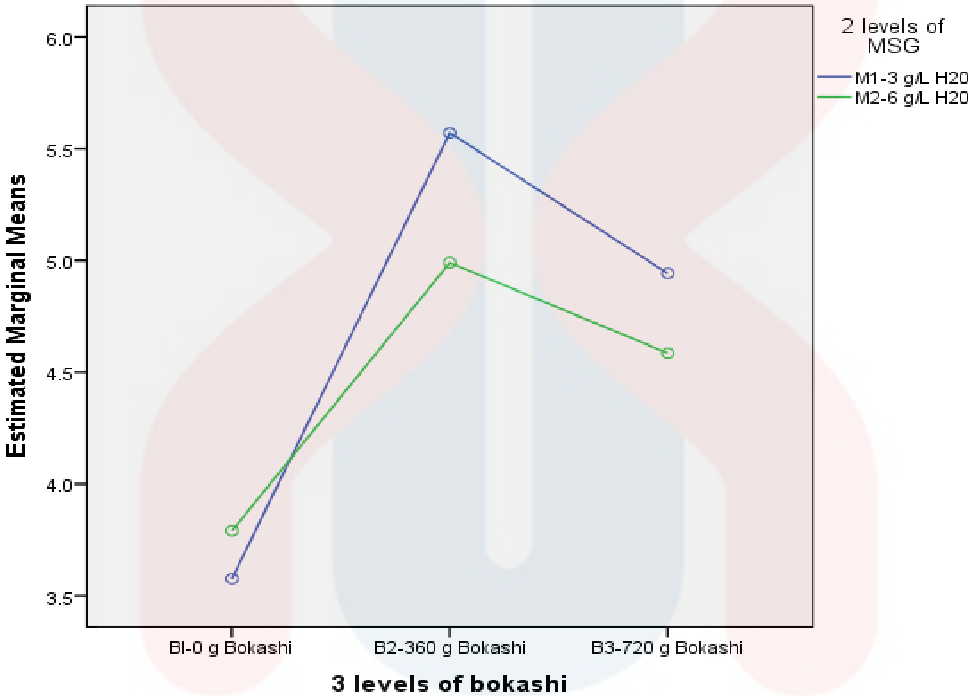

Figure 4.3 Interaction effects between application of bokashi and uses of MSG toward okra diameter of bulk

Based on figure 4.3, there were interaction between application of bokashi and uses of MSG on T1 (0 g/planting bed&3 g/1 L H_20) and T2 (0 g/planting bed&6 g/1 L H_20).

The chlorophyll index for MSG treatment shows significant significant differences between T1 and T3, T1 and T4 and T1 and T5. From the results, treatment on T3 had increase the chlorophyll index with mean of 48.10%.

The more chlorophyll content, promote and increase photosynthesis process in okra plant. Photosynthesis process is the process where light energy was transform into chemical energy which is changed water, carbon dioxide and mineral into oxygen. Oxygen that produced by plant would be used by life organisms such as animal and human. Thus, chlorophyll content and photosynthesis process is important on biodiversity (Gitelson, Gritz & Merzlyak, 2003).

Figure 4.4 show the interaction effect between application of bokashi and uses of MSG toward chlorophyll index.

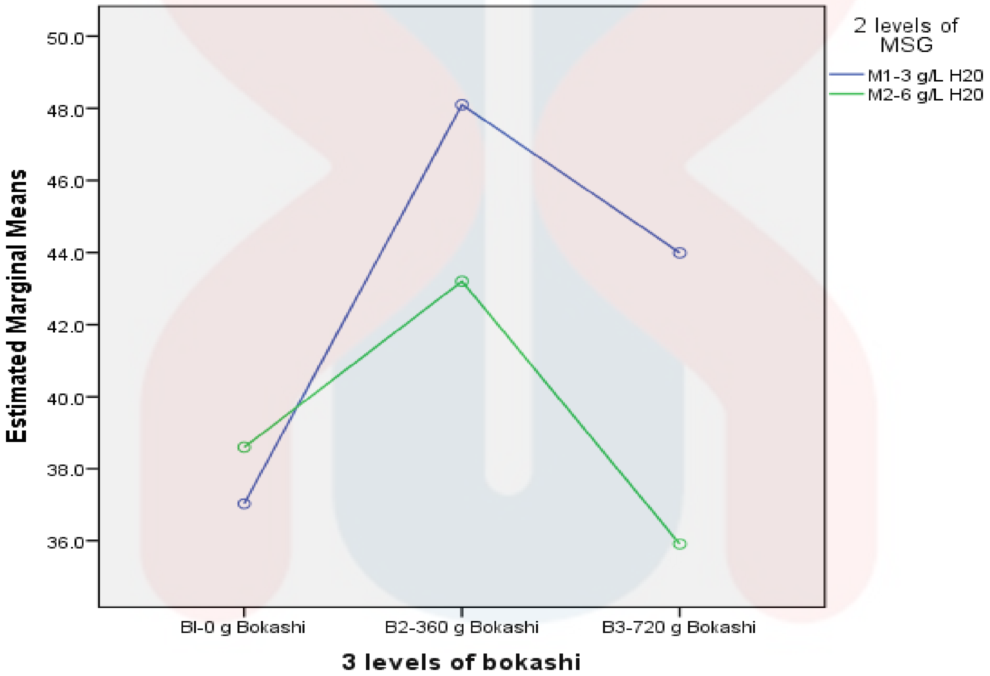

Figure 4.4 Interaction effects between application of bokashi and uses of MSG toward chlorophyll index

Based on figure 4.4, there were interaction between application of bokashi and uses of MSG on T1 (0 g/planting bed&3 g/1 L H_20) and T2 (0 g/planting bed&6 g/1 L H_20).

From table 4.6, T3 and T4 were the best treatment out of six treatments on the okra growth performance.

4.4.2 Factorial Effect between Bokashi and MSG toward Yield Production

Table 4.7 shows the yield production in term of quantity of yield and weight of yield toward different treatment rate of factorial effect of bokashi and MSG.

Table 4.7 Yield production of okra toward different treatment rate in factorial experiment between MSG and bokashi

Treatment	**Quantity of okra**	**Weight of okra (g)**
Treatment 1 (0 g/planting bed&3 g/1 L H_20)	3 ± 3^{a}	55.00 ± 55.00^{a}
Treatment 2 (0 g/planting bed&6 g/1 L H_20)	3 ± 2^{a}	60.33 ± 52.37^{a}
Treatment 3 (360 g/planting bed&3 g/1 L H_20)	11 ± 1^{c}	265.67 ± 25.775^{d}
Treatment 4 (360 g/planting bed&6 g/1 L H_20)	8 ± 2^{bc}	186.33 ± 35.25^{bc}
Treatment 5 (720 g/planting bed&3 g/1 L H_20)	10 ± 1^{c}	222.67 ± 15.18^{cd}
Treatment 6 (720 g/planting bed&6 g/1 L H_20)	5 ± 2^{ab}	122.00 ± 31.58^{ab}

Means followed by the different letter (s) between columns indicate significance differences between treatment by Duncan test at $p \leq 0.05$

According to the table 4.7, T3 had the highest quantity of yield and weight of yield with mean of 11 and 265.67 g respectively compared others, while the T1 have the lowest quantity of yield and weight of yield with mean of 3 and 55 g respectively. This may effect from the growth performance of okra, where, when growth performance better, plant are in suitable condition to produce yield on time and in higher quantity. (Chaturvedi, 2006).

4.4.3 Factorial Effect between Bokashi and MSG toward Soil Characteristics

Table 4.8 shows the soil characteristics in term of SOM, SC and available P in soil toward different treatment rate of factorial effect of bokashi and MSG. The data were measured before transplanting and after plant produce yield.

Table 4.8 Soil organic matter, soil carbon and available phosphorus (P) in soil toward different treatment rate of factorial effect of bokashi and MSG

Treatment	**Treatment 1**	**Treatment 2**	Treatment3	Treatment 4	Treatment 5	Treatment 6
SOM (soil organic matter)						
Before transplant	2.82 ± 0.06^{b}	2.29 ± 0.10^{b}	4.43 ± 0.04^{b}	3.17 ± 0.13^{b}	3.36 ± 0.07^{b}	3.36 ± 0.05^{b}
After harvest	4.58 ± 0.22^{a}	7.68 ± 0.02^{a}	8.28 ± 0.09^{a}	6.69 ± 0.09^{a}	6.84 ± 0.12^{a}	7.87 ± 0.11^{a}
SC (soil carbon)						
Before transplant	1.63 ± 0.03^{b}	1.33 ± 0.06^{b}	2.57 ± 0.02^{b}	1.84 ± 0.07^{b}	1.95 ± 0.04^{b}	1.95 ± 0.03
After harvest	2.65 ± 0.12^{a}	4.45 ± 0.02^{a}	4.80 ± 0.05^{a}	3.88 ± 0.06^{a}	3.97 ± 0.07^{a}	4.56 ± 0.06^{a}
Available P in soil (ppm)						
Before transplant	13.33 ± 8.33^{b}	146.67 ± 50.33^{a}	281.67 ± 15.31^{a}	13.33 ± 7.02^{b}	265.67 ± 5.86^{a}	40.67 ± 3.06^{a}
After harvest	15.33 ± 5.03^{a}	11.67 ± 3.79^{b}	172.00 ± 2.00^{b}	60.00 ± 2.00^{a}	$265.33.0\pm6.11^{b}$	$35.33.0\pm5.03^{b}$

Means within column with different superscripts indicate significant difference by independent t-test

There were significance differences between SOM before transplanting and after yield for all six treatments. Soil organic matter (SOM) was increase from before transplant and after collect yield. This shows that the soil that used in this study can hold SOM and only release it when required by the plants. This could be due to the application of organic fertilizer which is bokashi and uses of organic material during the okra cultivation which resulted in the built up of SOM (Akbar et al., 2010)

There were significance differences between SC before transplanting and after yield for all six treatments. Soil organic matter (SOM) was directly affect or was corresponding to the SC in the soil, thus when SOM increases, SC also increases (Rosa & Franz, 2005). Soil carbon (SC) was increase from before transplant and after collect yield. This was probably due to the application of organic fertilizer which is bokashi and organic materials during the okra cultivation which resulted in the built up of SOM (Akbar et al., 2010)

There were significance differences between available P in soil before transplanting and after yield for all six treatments. Available P in soil was decrease from before transplant to after collect yield. This was probably due to the condition where okra plants absorb and required P in soil during okra cultivation. Even though, okra plant was supplied with organic fertilizer and inorganic fertilizer which is NPK that suggested, it could not support the supply of nutrient to the soil. Thus, okra plant required available P in soil in order for growth performance and root morphology. The higher available P in soil that is supplied to the okra plant, better growth performance, but it will decrease the root elongation. Thus, application of fertilizer would release nutrients according to the quantity that is required by okra plant (Adriano, Gutiérrez, Dendooven & Salvador-Figueroa, 2012).

CHAPTER 5

CONCLUSION AND RECOMMENDATION

There were significance differences on the different treatment of the single effect of bokashi and MSG on growth performance, yield production and soil characteristics of okra. The best rate treatments applications of single bokashi were T2, T3 and T4 with rate of bokashi of 9.75 g/polybags, 19.5 g/polybags and 39 g/polybags respectively, while best rate treatment application of single MSG were T2 and T3 with rate of MSG 3 g/1 L of distilled water and 6 g/1 L of distilled water respectively. There are significance difference between the interaction effect of bokashi and MSG toward growth performance, yield production and soil characteristics of okra.

Apart from that, SOM and SC in soil were increased from transplant to the production of yield and were differences among the treatments. This may effects from texture of soil sample used is sandy loam and loamy sand that can built up and hold SOM and SC in soil and only supplied toward plant when plant required.

Growth performance of okra plant directly affects the yield of okra. When okra plants have better growth performance, okra plants will produce more yields. Available phosphorus in soil was decrease from before transplant to after yield collection because the total P in soil had been absorbed by okra in order for growth and root elongation.

As recommendation, this study can be further evaluated in the field for at least three cycles to confirm the findings by using randomized completely block design (RCBD) method.

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APPENDICES

Figure 1: Planting bed

Figure 2: Polybag

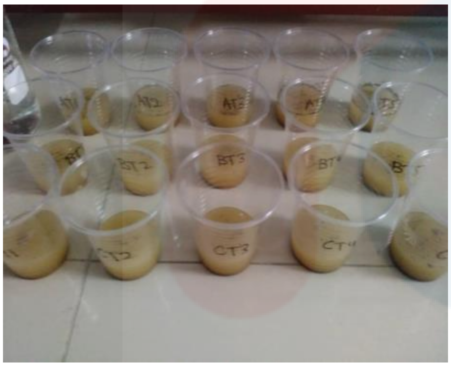

Figure 3: conduct EC meter experiments

Figure 4: conduct SOM experiment

Figure 5: Blue colour development in Total P in soil

RESULT (RAW DATA)

POLIBAG

BOKASHI

1) Growth performance

Week	Treatment	No. of leaves	Height of plant (cm)	Diameter of bulk (cm)	Chlorophyll index
Week 1	Treatment 1	4	11	1.5	29.5
	Treatment 1	5	9.5	1.2	21.1
	Treatment 1	6	12	1.5	20.5
	Treatment 2	4	13	1.8	31.8
	Treatment 2	6	11	1.3	32.5
	Treatment 2	5	11.5	1.5	36.1
	Treatment 3	5	12.5	1.5	31.7
	Treatment 3	4	10.5	1.3	31.1
	Treatment 3	5	11.5	1.5	27.6
	Treatment 4	4	11	1.5	31.1
	Treatment 4	6	11.5	1.5	35.9
	Treatment 4	5	12	1.5	33.0
	Treatment 5	5	11	1.3	22.6
	Treatment 5	4	11	1.3	29.9
	Treatment 5	4	10.5	1.5	29.0
Week 2	Treatment 1	6	20	2	32.6
	Treatment 1	6	18.5	2.5	33.6
	Treatment 1	7	25	3	30.6
	Treatment 2	6	24	2.5	59.3
	Treatment 2	7	21	3	57.8
	Treatment 2	6	26	3	46.4
	Treatment 3	7	25	3.5	40.7
	Treatment 3	6	20	2	45.7
	Treatment 3	6	23	3	43.8
	Treatment 4	7	25	3	39.9
	Treatment 4	8	25	4	29.0
	Treatment 4	7	24.5	3.5	42.8
	Treatment 5	7	23.5	3	32.9
	Treatment 5	8	20	3	57.9
	Treatment 5	6	25	3	54.3
Week 3	Treatment 1	9	30	3.0	37.7
	Treatment 1	9	29	3.0	35.9
	Treatment 1	10	38	5.0	34.5
	Treatment 2	9	34	3.0	59.0
	Treatment 2	11	32	4.0	56.9
	Treatment 2	10	34	3.5	49.0
	Treatment 3	10	39	4.5	44.5
	Treatment 3	9	33	3.5	41.4
	Treatment 3	9	32	4.0	43.3
	Treatment 4	10	37	4.0	37.9
	Treatment 4	8	36	5.0	35.3
	Treatment 4	8	35	5.0	45.8
	Treatment 5	9	36	3.5	41.1
	Treatment 5	11	30	3.0	41.8
	Treatment 5	10	38	3.0	39.9
Week 4	Treatment 1	9	45	4.5	33.6
	Treatment 1	10	41	4.0	32.6
	Treatment 1	8	47	5	45.9
	Treatment 2	12	42	4.5	32.3
	Treatment 2	13	42	5	44.5
	Treatment 2	9	44	4.5	36.7
	Treatment 3	8	45	5	36.2
	Treatment 3	9	40	4.0	42.0
	Treatment 3	10	46	5.0	43.3
	Treatment 4	8	48	5.0	34.6
	Treatment 4	10	48	5.0	28.7
	Treatment 4	8	46	5.5	40.1
	Treatment 5	8	46	4.0	56.5
	Treatment 5	9	37	4.5	43.1
	Treatment 5	6	49	5.0	29.6
Week 5	Treatment 1	10	70	5.0	39.5

	Treatment 1	11	65.5	5	42.1
	Treatment 1	16	70	6	40.6
	Treatment 2	14	68	6	38.4
	Treatment 2	13	71.5	5	36.4
	Treatment 2	17	71	5.5	41.9
	Treatment 3	14	78	5.5	39.7
	Treatment 3	12	65	5.5	40.0
	Treatment 3	10	78	6	41.3
	Treatment 4	12	78	5.8	37.7
	Treatment 4	12	75	5.8	35.3
	Treatment 4	19	75	6	39.7
	Treatment 5	15	74	5.0	39.5
	Treatment 5	10	57	5.0	40.2
	Treatment 5	10	73.5	5.5	42.6
Week 6	Treatment 1	12	105	5.5	45.6
	Treatment 1	15	95	6	42.6
	Treatment 1	17	107	6	44.1
	Treatment 2	14	103	7	45.3
	Treatment 2	15	105	6.5	45.0
	Treatment 2	18	100	6	38.2
	Treatment 3	17	103	5.8	43.2
	Treatment 3	11	90	6	45.6
	Treatment 3	16	108	7	35.9
	Treatment 4	13	110	6.0	36.2
	Treatment 4	17	108	6.0	37.1
	Treatment 4	23	115	6.2	44.6
	Treatment 5	16	109	5.5	40.1
	Treatment 5	11	70	5.5	45.2
	Treatment 5	13	106	6.0	39.0
Week 7	Treatment 1	14	106	5.5	48.6
	Treatment 1	15	98	6	45.6
	Treatment 1	17	112	6.3	47.1
	Treatment 2	16	113	8	55.3
	Treatment 2	19	110	6.5	55.0
	Treatment 2	20	108	6.3	48.2
	Treatment 3	19	109	6	49.2
	Treatment 3	13	100	6.5	47.6
	Treatment 3	15	110	7.2	45.9
	Treatment 4	15	120	6.0	46.2
	Treatment 4	17	114	6.2	47.1
	Treatment 4	25	132	6.3	34.6
	Treatment 5	16	111	5.5	43.1
	Treatment 5	13	80	5.8	49.2
	Treatment 5	14	114	6.2	45.0
Week 8	Treatment 1	19	114	5.5	47.6
	Treatment 1	12	102	6.8	48.6
	Treatment 1	15	120	6.5	40.1
	Treatment 2	20	123	8.5	56.3
	Treatment 2	20	118	6.5	57.0
	Treatment 2	17	119	6.5	50.2
	Treatment 3	20	120	6.3	49.9
	Treatment 3	15	108	7	47.9
	Treatment 3	17	120	8.0	47.0
	Treatment 4	18	131	6.3	49.2
	Treatment 4	18	120	6.5	57.1
	Treatment 4	22	138	6.5	44.6
	Treatment 5	20	120	6.0	45.1
	Treatment 5	15	99	6.0	50.2
	Treatment 5	18	119	6.5	45.9
Week 9	Treatment 1	10	120	6	40.6
	Treatment 1	7	110	6.8	47.6
	Treatment 1	10	128	7	45.1
	Treatment 2	11	137	9.0	46.3
	Treatment 2	12	125	7.8	47.0
	Treatment 2	15	120	7.8	46.2
	Treatment 3	10	127	7.0	47.9
	Treatment 3	16	110	7.5	46.9
	Treatment 3	15	135	8.5	46.0
	Treatment 4	10	143	6.5	48.2
	Treatment 4	12	128	6.8	50.1
	Treatment 4	20	144	6.8	34.6
	Treatment 5	12	132	7.0	40.1

	Treatment 5	16	106	6.5	45.2
	Treatment 5	20	123	7.0	40.9
Week 10	Treatment 1	6	126	6	39.2
	Treatment 1	5	114	7	47.3
	Treatment 1	12	140	7.2	47.3
	Treatment 2	15	145	9.5	37.8
	Treatment 2	8	137	10	39.4
	Treatment 2	10	136	8.5	40.6
	Treatment 3	8	131	7.5	42.8
	Treatment 3	11	114	8	38.5
	Treatment 3	10	150	9.0	45.5
	Treatment 4	7	152	7	39.5
	Treatment 4	11	133	7	47.9
	Treatment 4	17	158	7	37.6
	Treatment 5	12	147	7.5	32.6
	Treatment 5	10	115	7	40.2
	Treatment 5	9	133	7.5	44.2

POLIBAG

MSG

1) Growth performance

Week	Treatment	No. of leaves	Height of plant (cm)	Diameter of bulk (cm)	Chlorophyll index
Week 1	Treatment 1	5	11.5	1.2	19.2
	Treatment 1	4	9.5	1.2	20.2
	Treatment 1	4	11	1.2	15.9
	Treatment 2	5	12.5	1.5	29.3
	Treatment 2	6	13	1.5	30.8
	Treatment 2	4	13	1.5	18.7
	Treatment 3	4	12	1.5	26.7
	Treatment 3	5	12	1.5	22.9
	Treatment 3	6	13	1.5	20.9
	Treatment 4	4	10.5	1.3	11.1
	Treatment 4	3	11.5	1.5	10.9
	Treatment 4	3	10	1.3	14.9
	Treatment 5	4	11	1.2	13.9
	Treatment 5	4	11	1.2	14.2
	Treatment 5	4	11.5	1.3	20.3
Week 2	Treatment 1	6	18	2.5	18.4
	Treatment 1	5	17	2.5	22.0
	Treatment 1	5	20	2.5	24.8
	Treatment 2	7	22	4	29.9
	Treatment 2	7	21	3	32.0
	Treatment 2	7	23	4	30.3
	Treatment 3	7	22	3	22.9
	Treatment 3	8	22	3	20.8
	Treatment 3	9	20	3	30.9
	Treatment 4	5	17	2.5	16.7
	Treatment 4	6	18	2.5	17.9
	Treatment 4	6	19	2	20.2
	Treatment 5	6	20	2.5	22.2
	Treatment 5	5	19	2	28.9
	Treatment 5	6	17.5	2	11.4
Week 3	Treatment 1	8	28	3.5	28.9
	Treatment 1	8	30	3.5	27.7
	Treatment 1	9	26	3.0	20.9
	Treatment 2	10	36	4.0	39.3
	Treatment 2	9	32	4.0	38.7
	Treatment 2	8	37	4.0	40.0
	Treatment 3	9	36	4.0	40.9
	Treatment 3	8	35	3.5	65.7
	Treatment 3	8	34	4.0	49.0
	Treatment 4	9	33	3.0	36.8
	Treatment 4	9	29	3.0	30.9
	Treatment 4	7	32	3.0	32.5
	Treatment 5	8	30	2.5	50.8
	Treatment 5	9	28	3.5	32.8
	Treatment 5	7	29	3.0	39.9

Week 4	Treatment 1	9	39	3.5	37.5
	Treatment 1	6	36	4	26.7
	Treatment 1	8	40	4	39.3
	Treatment 2	7	42	5	43.6
	Treatment 2	12	43	5	42.6
	Treatment 2	11	48	5	40.4
	Treatment 3	10	44	4	35.1
	Treatment 3	9	43	4.5	77.7
	Treatment 3	10	46	5	35.2
	Treatment 4	7	40	4.5	50.7
	Treatment 4	6	33	3	47.0
	Treatment 4	8	41	3.5	58.3
	Treatment 5	8	43	4	60.2
	Treatment 5	8	42	3	38.2
	Treatment 5	7	36	4	40.2
Week 5	Treatment 1	9	58	4.5	41.2
	Treatment 1	8	60	5	50.5
	Treatment 1	10	71	5	41.6
	Treatment 2	12	84.5	5	40.7
	Treatment 2	16	86	6.5	40.8
	Treatment 2	15	80	7	39.5
	Treatment 3	10	77	6	38.3
	Treatment 3	15	66.5	5	41.5
	Treatment 3	11	74	7	44.3
	Treatment 4	11	63	5.5	44.8
	Treatment 4	9	50	4	41.7
	Treatment 4	11	60	5	40.2
	Treatment 5	11	66	5	36.5
	Treatment 5	8	64.5	5.8	39.6
	Treatment 5	9	69	5.5	39.9
Week 6	Treatment 1	8	93	6	47.1
	Treatment 1	10	86	5.5	53.3
	Treatment 1	8	79	5.5	42.3
	Treatment 2	14	103	6	46.4
	Treatment 2	17	104	8	39.2
	Treatment 2	18	108	7	46.0
	Treatment 3	20	108	7	45.5
	Treatment 3	15	100	6	41.8
	Treatment 3	10	106	5	49.7
	Treatment 4	15	80	5	44.7
	Treatment 4	15	79	4.5	50.3
	Treatment 4	11	86	6	44.6
	Treatment 5	13	92	5	41.3
	Treatment 5	13	99	6	43.6
	Treatment 5	11	88	6	44.7
Week 7	Treatment 1	12	89	6	37.1
	Treatment 1	11	90	5.8	33.3
	Treatment 1	10	100	5.8	32.3
	Treatment 2	19	110	6.2	56.4
	Treatment 2	19	114	8.2	69.2
	Treatment 2	16	116	7.3	56.0
	Treatment 3	10	110	7.3	55.5
	Treatment 3	16	113	6.2	51.8
	Treatment 3	14	110	5.1	69.7
	Treatment 4	14	85	5.1	44.0
	Treatment 4	10	83	4.7	53.3
	Treatment 4	14	93	6.2	40.6
	Treatment 5	12	98	5.2	49.3
	Treatment 5	14	100	6.2	43.9
	Treatment 5	11	93	6.2	47.7
Week 8	Treatment 1	13	95	6	47.1
	Treatment 1	12	98	5.8	43.3
	Treatment 1	15	104	5.8	42.3
	Treatment 2	20	119	6.2	66.4
	Treatment 2	20	122	8.2	59.2
	Treatment 2	18	120	7.3	66.0
	Treatment 3	25	112	7.3	45.5
	Treatment 3	18	115	6.2	71.8
	Treatment 3	17	113	5.1	79.7
	Treatment 4	16	90	5.1	34.0
	Treatment 4	12	92	4.7	23.3
	Treatment 4	16	98	6.2	50.6

	Treatment 5	15	102	5.2	49.3
	Treatment 5	16	109	6.2	53.9
	Treatment 5	15	100	6.2	27.7
Week 9	Treatment 1	16	100	6.2	37.1
	Treatment 1	15	102	6.0	33.3
	Treatment 1	18	106	6.0	32.3
	Treatment 2	25	126	6.5	67.4
	Treatment 2	25	128	8.5	69.2
	Treatment 2	22	129	7.5	76.0
	Treatment 3	26	119	7.5	55.5
	Treatment 3	20	120	6.5	61.8
	Treatment 3	22	119	5.5	69.7
	Treatment 4	19	99	5.5	33.0
	Treatment 4	18	99	5	33.3
	Treatment 4	18	103	6.5	40.6
	Treatment 5	16	106	5.5	39.3
	Treatment 5	17	112	6.5	43.9
	Treatment 5	16	102	6.5	45.7
Week 10	Treatment 1	6	115	6.5	49.6
	Treatment 1	5	116	6.5	51.2
	Treatment 1	8	110	6.5	36.0
	Treatment 2	10	146	7.5	45.0
	Treatment 2	14	148	8.6	44.8
	Treatment 2	14	149	8.0	53.0
	Treatment 3	13	139	7.9	44.8
	Treatment 3	11	130	7.0	52.7
	Treatment 3	12	139	6.9	54.9
	Treatment 4	7	110	6	47.9
	Treatment 4	9	110	5.6	52.7
	Treatment 4	8	123	7	47.1
	Treatment 5	7	110	6	46.9
	Treatment 5	8	122	6.8	46.6
	Treatment 5	9	122	6.8	52.5

BATAS

GROWTH PERFORMANCE

Week	Treatment	No. of leaves	Height of plant (cm)	Diameter of bulk (cm)	Chlorophyll index
Week 1	Treatment 1	4	15	1.3	29.5
	Treatment 1	2	15	1.2	21.1
	Treatment 1	4	20	1.3	33.0
	Treatment 2	5	22	1.5	32.5
	Treatment 2	4	17	1.5	30.1
	Treatment 2	4	20	1.5	32.3
	Treatment 3	4	19	1.5	31.8
	Treatment 3	4	19	1.5	35.8
	Treatment 3	4	16	1.5	29.0
	Treatment 4	4	18	1.5	36.1
	Treatment 4	3	22	1.3	27.6
	Treatment 4	3	24	1.3	22.6
	Treatment 5	4	19	1.5	31.3
	Treatment 5	4	19	1.5	27.4
	Treatment 5	4	18	1.5	31.7
	Treatment 6	3	15	1.3	20.5
	Treatment 6	4	16	1.5	31.1
	Treatment 6	4	19	1.5	25.2
Week 2	Treatment 1	6	18	1.6	45.2
	Treatment 1	4	18	1.7	35.3
	Treatment 1	5	22	1.6	53.9
	Treatment 2	4	23	1.6	34.2
	Treatment 2	5	19	1.7	43.5
	Treatment 2	5	21	1.8	57.8
	Treatment 3	7	23	2.0	54.3
	Treatment 3	8	24	2.2	59.3
	Treatment 3	8	24	2.3	39.8
	Treatment 4	7	22	2.1	46.4
	Treatment 4	6	24	1.9	33.8
	Treatment 4	7	26	2.0	39.0
	Treatment 5	6	20	1.9	38.1

	Treatment 5	5	21	1.8	47.7
	Treatment 5	5	19	1.7	40.2
	Treatment 6	4	17	1.5	34.2
	Treatment 6	5	18	1.7	36.6
	Treatment 6	5	20	1.7	34.6
Week 3	Treatment 1	6	24	2.5	37.9
	Treatment 1	9	23	3	37.7
	Treatment 1	11	28	4	37.0
	Treatment 2	7	25	2.5	39.6
	Treatment 2	7	26	3.0	35.3
	Treatment 2	18	29	4	41.4
	Treatment 3	12	26	3.5	39.6
	Treatment 3	18	29	4.5	40.1
	Treatment 3	11	23	4.5	39.0
	Treatment 4	20	27	4.5	37.8
	Treatment 4	5	27	3.5	39.1
	Treatment 4	7	29	3.0	36.1
	Treatment 5	9	25	3.5	39.9
	Treatment 5	7	24	3	41.1
	Treatment 5	15	30	3.5	40.2
	Treatment 6	5	20	3.0	38.8
	Treatment 6	8	25	2.5	37.0
	Treatment 6	5	22	2.5	32.5
Week 4	Treatment 1	8	34	4	46.9
	Treatment 1	10	33	3.9	40.5
	Treatment 1	12	38	4.1	38.1
	Treatment 2	8	35	4.5	40.8
	Treatment 2	8	29	3.8	40.7
	Treatment 2	20	30	4	40.5
	Treatment 3	19	56	5.5	55.9
	Treatment 3	19	59	5.5	58.1
	Treatment 3	20	63	5.5	48.7
	Treatment 4	10	47	5	42.3
	Treatment 4	6	47	5	40.5
	Treatment 4	8	50	5	41.8
	Treatment 5	10	45	4.5	45.8
	Treatment 5	8	44	4.3	43.8
	Treatment 5	13	40	4.5	41.6
	Treatment 6	10	50	4.0	41.0
	Treatment 6	9	55	3.5	43.4
	Treatment 6	8	52	3.9	38.0
Week 5	Treatment 1	10	45	4.3	33.9
	Treatment 1	10	50	4.8	36.0
	Treatment 1	10	58	5.0	29.6
	Treatment 2	15	60	5.0	28.9
	Treatment 2	12	65	5.1	35.8
	Treatment 2	10	60	4.8	36.9
	Treatment 3	18	73	7	49.7
	Treatment 3	17	75	8	40.2
	Treatment 3	18	84	8.0	42.3
	Treatment 4	16	88	7.0	41.9
	Treatment 4	15	90	7.0	42.4
	Treatment 4	20	93	7.5	42.4
	Treatment 5	17	78	7.0	42.8
	Treatment 5	14	75	7.2	33.7
	Treatment 5	10	70	7.5	37.5
	Treatment 6	13	75	7.5	34.8
	Treatment 6	12	78	7	29.9
	Treatment 6	17	80	6.3	24.7
Week 6	Treatment 1	14	50	4.8	43.9
	Treatment 1	13	55	5.0	26.0
	Treatment 1	15	62	5.2	39.6
	Treatment 2	10	65	5.2	30.9
	Treatment 2	11	60	5.6	40.8
	Treatment 2	14	68	5.1	40.9
	Treatment 3	20	78	8	59.7
	Treatment 3	20	80	9	50.2
	Treatment 3	20	90	8.5	48.3
	Treatment 4	20	95	7.5	51.9
	Treatment 4	19	93	7.4	52.4
	Treatment 4	26	100	8	48.4
	Treatment 5	20	83	7.5	52.8

	Treatment 5	16	80	7.9	53.7
	Treatment 5	14	76	8	47.5
	Treatment 6	17	80	8	44.8
	Treatment 6	16	82	7.5	33.9
	Treatment 6	20	85	7.1	34.7
Week 7	Treatment 1	20	60	5.0	48.9
	Treatment 1	21	69	5.3	29.0
	Treatment 1	23	73	5.5	34.6
	Treatment 2	19	78	5.5	40.9
	Treatment 2	17	69	6.0	43.8
	Treatment 2	20	73	5.9	42.9
	Treatment 3	24	83	9	69.7
	Treatment 3	27	89	10	60.2
	Treatment 3	28	99	9.5	58.3
	Treatment 4	28	99	8.0	61.9
	Treatment 4	30	100	7.8	62.4
	Treatment 4	33	105	8.5	60.4
	Treatment 5	26	90	8.0	62.8
	Treatment 5	20	87	8.5	63.7
	Treatment 5	18	80	9.0	60.5
	Treatment 6	22	85	8.4	54.8
	Treatment 6	26	90	8.0	38.9
	Treatment 6	29	93	7.9	44.7

Polybag

2) Yield production

Week	Treatment	Bokashi		MSG	
		No. of yield	Weight of yield (g)	No. of yield	Weight of yield (g)
Week 7	Treatment 1	0	0	1	40
	Treatment 1	0	0	2	60
	Treatment 1	2	55	0	0
	Treatment 2	2	30	0	0
	Treatment 2	3	90	1	15
	Treatment 2	2	70	1	45
	Treatment 3	1	20	0	0
	Treatment 3	1	15	1	25
	Treatment 3	1	35	1	20
	Treatment 4	1	35	2	35
	Treatment 4	1	40	0	0
	Treatment 4	1	20	0	0
	Treatment 5	0	0	1	25
	Treatment 5	0	0	1	15
	Treatment 5	0	0	0	0
Week 8	Treatment 1	3	85	3	110
	Treatment 1	3	80	3	100
	Treatment 1	3	90	3	120
	Treatment 2	6	230	5	180
	Treatment 2	5	160	5	120
	Treatment 2	3	95	6	230
	Treatment 3	4	110	2	50
	Treatment 3	3	90	3	120
	Treatment 3	3	95	2	50
	Treatment 4	3	110	2	80
	Treatment 4	4	105	1	15
	Treatment 4	5	160	2	90
	Treatment 5	4	120	0	0
	Treatment 5	0	0	2	80
	Treatment 5	3	90	1	40
Week 9	Treatment 1	3	40	3	68
	Treatment 1	2	47	3	48
	Treatment 1	3	52	3	55
	Treatment 2	5	70	6	133
	Treatment 2	6	140	7	155
	Treatment 2	6	100	7	210
	Treatment 3	4	79	5	95
	Treatment 3	4	69	4	96
	Treatment 3	4	70	5	108
	Treatment 4	3	68	3	67

	Treatment 4	2	47	2	40
	Treatment 4	3	72	2	43
	Treatment 5	2	54	2	45
	Treatment 5	2	40	2	39
	Treatment 5	2	38	2	42
Week 10	Treatment 1	3	55	1	20
	Treatment 1	1	30	2	55
	Treatment 1	1	40	1	50
	Treatment 2	3	60	3	55
	Treatment 2	2	65	4	75
	Treatment 2	2	55	3	60
	Treatment 3	3	55	4	80
	Treatment 3	2	40	4	90
	Treatment 3	2	45	3	65
	Treatment 4	1	45	2	40
	Treatment 4	0	0	1	35
	Treatment 4	2	80	1	50
	Treatment 5	2	70	1	40
	Treatment 5	1	40	3	45
	Treatment 5	1	30	1	35

BATAS (YIELD PRODUCTION)

Week	Treatment	Quantity of yield	Weight of yield (g)
Week 7	Treatment 1	5	110
	Treatment 1	3	55
	Treatment 1	0	0
	Treatment 2	4	87
	Treatment 2	0	0
	Treatment 2	4	94
	Treatment 3	11	270
	Treatment 3	10	238
	Treatment 3	12	289
	Treatment 4	10	225
	Treatment 4	8	178
	Treatment 4	7	156
	Treatment 5	11	239
	Treatment 5	10	220
	Treatment 5	9	209
	Treatment 6	5	109
	Treatment 6	7	158
	Treatment 6	4	99

3) SOIL CHARACTERISTICS AND SOIL ANALYSIS

A) soil Ph, soil temperature and soil moisture content

WEEK	TREATMENT	BOKASHI			MSG		
		pH	Temp	SMC (%)	pH	Temp	SMC (%)
WEEK 1	Treatment 1	4.69	27.7	62.0	4.79	29.6	00.0
	Treatment 2	4.70	27.8	00.0	4.80	28.5	00.0
	Treatment 3	4.79	28.2	62.0	4.80	29.4	62.0
	Treatment 4	4.68	27.6	00.0	4.77	28.7	62.0
	Treatment 5	4.74	28.0	62.0	4.79	29.1	00.0
WEEK 2	Treatment 1	3.34	31.8	00.0	4.10	33.2	00.0
	Treatment 2	3.12	31.5	00.0	3.73	30.6	00.0
	Treatment 3	3.50	30.7	00.0	4.20	31.5	18.0
	Treatment 4	3.36	31.4	00.0	4.30	31.6	62.0
	Treatment 5	3.38	30.8	62.0	4.20	32.2	00.0
WEEK 3	Treatment 1	3.60	28.3	00.0	4.44	32.6	00.0
	Treatment 2	4.35	28.6	00.0	4.33	29.1	14.2
	Treatment 3	3.93	29.0	00.0	3.90	30.0	00.0
	Treatment 4	3.85	28.4	00.0	4.26	29.1	00.0
	Treatment 5	3.97	28.5	00.0	4.11	29.6	00.0
WEEK 4	Treatment 1	3.20	30.1	00.0	4.45	27.6	00.0

	Treatment 2	3.36	26.5	00.0	3.51	26.4	00.0
	Treatment 3	3.60	27.1	00.0	4.14	26.0	00.0
	Treatment 4	3.67	27.8	00.0	3.75	25.9	00.0
	Treatment 5	3.47	26.4	00.0	4.09	25.9	0.00
WEEK 5	Treatment 1	3.38	25.2	00.0	3.96	25.3	62.0
	Treatment 2	3.26	25.3	00.0	3.18	25.3	00.0
	Treatment 3	3.50	25.2	00.0	3.53	25.2	00.0
	Treatment 4	3.46	25.2	00.0	3.42	25.2	00.0
	Treatment 5	3.37	25.2	00.0	3.51	25.3	26.0
WEEK 6	Treatment 1	4.00	26.5	00.0	3.79	26.0	00.0
	Treatment 2	4.04	26.8	00.0	3.90	26.0	00.0
	Treatment 3	4.22	25.8	00.0	3.53	26.2	00.0
	Treatment 4	3.79	26.2	00.0	4.49	25.9	11.3
	Treatment 5	4.04	25.9	25.0	3.89	26.0	00.0
WEEK 7	Treatment 1	3.73	26.2	00.0	3.17	26.0	00.0
	Treatment 2	3.76	26.2	00.0	3.49	26.6	00.0
	Treatment 3	3.60	26.1	00.0	3.36	26.1	00.0
	Treatment 4	3.49	26.3	00.0	3.48	25.9	00.0
	Treatment 5	3.74	26.2	00.0	3.48	25.9	00.0
WEEK 8	Treatment 1	4.26	26.9	00.0	3.70	26.9	00.0
	Treatment 2	4.09	27.0	00.0	3.70	26.5	00.0
	Treatment 3	4.20	25.9	00.0	3.83	25.2	00.0
	Treatment 4	3.89	26.5	00.0	3.49	26.0	11.3
	Treatment 5	4.40	24.9	00.0	3.39	26.9	00.0
WEEK 9	Treatment 1	3.70	25.2	00.0	3.07	26.0	00.0
	Treatment 2	3.59	25.2	00.0	3.09	25.6	00.0
	Treatment 3	3.49	25.1	00.0	3.06	25.1	00.0
	Treatment 4	3.33	25.3	00.0	3.08	25.7	00.0
	Treatment 5	3.49	25.2	00.0	4.48	27.9	00.0
WEEK 10	Treatment 1	3.33	26.0	00.0	3.87	26.0	00.0
	Treatment 2	3.29	25.2	00.0	3.39	25.0	00.0
	Treatment 3	3.23	25.5	00.0	3.36	25.9	00.0
	Treatment 4	3.69	26.3	00.0	3.48	26.7	00.0
	Treatment 5	3.89	26.9	00.0	4.78	26.9	00.0

b) soil organic matter and soil carbon

polybag (bokashi)

Treatment	Soil organic matter		Soil carbon	
	Before	After	Before	After
Treatment 1	3.74	6.43	2.17	3.73
	3.35	6.98	1.94	4.05
	3.54	7.02	2.05	4.07
Treatment 2	4.58	8.72	2.66	5.06
	4.38	8.99	2.54	5.21
	4.60	8.06	2.67	4.67
Treatment 3	3.92	8.48	2.27	4.92
	3.79	8.50	2.21	4.93
	3.83	8.47	2.22	4.91
Treatment 4	5.53	6.56	3.21	3.81
	5.29	6.49	3.07	3.76
	5.60	6.66	3.25	3.86
Treatment 5	3.93	7.01	2.28	4.07
	4.05	6.99	2.35	4.05
	3.77	7.12	2.19	4.13

polybag (MSG)

Treatment	Soil organic matter		Soil carbon	
	Before (g)	After (g)	Before (g)	After (g)
Treatment 1	2.98	6.80	1.73	3.94
	2.77	6.77	1.61	3.93
	3.03	6.93	1.76	4.02
Treatment 2	16.63	20.72	9.65	12.02
	16.78	20.89	9.73	12.12
	16.61	19.03	9.63	11.04
Treatment 3	4.78	8.02	2.77	4.65

	4.88	8.31	2.83	4.82
	4.70	7.99	2.72	4.63
Treatment 4	3.29	6.85	1.91	3.97
	3.40	6.89	1.97	4.00
	3.33	6.70	1.93	3.89
Treatment 5	3.47	7.31	2.01	4.24
	3.56	7.99	2.06	4.63
	3.49	7.65	2.02	4.44

BATAS

Treatment	Soil organic matter		Soil carbon	
	Before	After	Before	After
Treatment 1	2.78	4.61	1.61	2.67
	2.88	4.78	1.67	2.77
	2.79	4.35	1.62	2.52
Treatment 2	2.20	7.67	1.28	4.45
	2.39	7.70	1.39	4.47
	2.27	7.66	1.32	4.44
Treatment 3	4.40	8.28	2.55	4.80
	4.43	8.37	2.57	4.85
	4.47	8.19	2.59	4.75
Treatment 4	3.19	6.71	1.85	3.89
	3.28	6.77	1.90	3.93
	3.03	6.59	1.76	3.82
Treatment 5	3.39	6.92	1.97	4.01
	3.41	6.89	1.98	4.00
	3.28	6.70	1.90	3.89
Treatment 6	3.31	7.81	1.92	4.53
	3.37	7.99	1.95	4.63
	3.40	7.80	1.97	4.52

c) Total P in soil (wavelength-882 nm)

Treatment	BOKASHI (ppm)		MSG (ppm)		BATAS (ppm)	
	Before	After	Before	After	Before	After
Treatment 1	274	132	274	52	4	10
	278	130	278	60	20	16
	280	138	274	58	16	20
Treatment 2	322	34	322	232	140	9
	324	60	332	230	200	10
	334	36	320	220	100	16
Treatment 3	190	8	288	278	276	174
	186	10	292	250	299	170
	200	20	304	270	270	172
Treatment 4	110	128	280	70	6	58
	124	120	294	70	20	60
	115	132	282	100	14	62
Treatment 5	192	12	92	24	268	264
	194	20	80	20	270	260
	198	16	100	22	259	272
Treatment 6					38	36
					40	40
					44	30

SOLUTION ON HOW TO GET VALUE OF FERTILIZER APPLIED

Bokashi in polybag, as suggested

1 ha = 10 000 m^2

1 ha with 15 cm depth of soil = 2 000 000 kg of soil

3000 kg of bokashi will covered 2 000 000 kg of soil

Thus, $\frac{3000\ kg\ of\ bokashi}{x\ kg\ of\ bokasi} = \frac{2\ 000\ 000\ kg\ of\ soil}{13\ kg\ of\ top\ soil}$

X kg of bokashi = 0.0195 kg @ 19.5 g

Bokashi in planting bed, as suggested

1 ha = 10 000 m^2

1 ha with 15 cm depth of soil = 2 000 000 kg of soil

3000 kg of bokashi will covered 2 000 000 kg of soil

Thus, $\frac{3000\ kg\ of\ bokashi}{x\ kg\ of\ bokasi} = \frac{10\ 000\ \ m^2}{1.2\ m^2}$

X kg of bokashi = 0.36 kg @ 360 g

MSG in planting bed

$$\frac{4500\ ml\ of\ MSG}{x\ ml} = \frac{10\ 000\ \ m^2}{1.2\ m^2}$$

x = 540 ml

MSG in polybag

$$\frac{4500\ ml\ of\ MSG}{x\ ml} = \frac{2\ 000\ 000\ kg}{13\ kg}$$

x = 30 ml

DATA SPSS

Bokashi (growth performance)

Descriptives

numberofleavesbokashi

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Treatment 1	30	10.40	4.107	.750	8.87	11.93	4	19
Treatment 2	30	12.40	4.789	.874	10.61	14.19	4	20
Treatment 3	30	11.23	4.352	.795	9.61	12.86	4	20
Treatment 4	30	12.57	5.776	1.054	10.41	14.72	4	25
Treatment 5	30	11.23	4.431	.809	9.58	12.89	4	20
Total	150	11.57	4.734	.387	10.80	12.33	4	25

Tests of Between-Subjects Effects

Dependent Variable: numberofleavesbokashi

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2537.033[a]	13	195.156	33.102	.000
Intercept	20068.167	1	20068.167	3403.929	.000
Week	2438.700	9	270.967	45.961	.000
Treatment	98.333	4	24.583	4.170	.003
Error	801.800	136	5.896		
Total	23407.000	150			
Corrected Total	3338.833	149			

a. R Squared = .760 (Adjusted R Squared = .737)

numberofleavesbokashi

Duncan

Treatment	N	Subset	
		1	2
Treatment 1	30	10.40	
Treatment 3	30	11.23	11.23
Treatment 5	30	11.23	11.23
Treatment 2	30		12.40
Treatment 4	30		12.57
Sig.		.214	.053

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 5.896.

a. Uses Harmonic Mean Sample Size = 30.000.

b. Alpha = .05.

Descriptives

Heightofplantbokashi

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Treatment 1	30	74.283	42.9159	7.8353	58.258	90.308	9.5	140.0
Treatment 2	30	78.133	45.8682	8.3744	61.006	95.261	11.0	145.0
Treatment 3	30	76.450	44.0657	8.0453	59.996	92.904	10.5	150.0
Treatment 4	30	84.433	49.8501	9.1013	65.819	103.048	11.0	158.0
Treatment 5	30	74.183	43.5081	7.9435	57.937	90.430	10.5	147.0
Total	150	77.497	44.8581	3.6626	70.259	84.734	9.5	158.0

Tests of Between-Subjects Effects

Dependent Variable: heightofplantbokashi

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	291769.438[a]	13	22443.803	378.901	.000
Intercept	900860.002	1	900860.002	15208.522	.000
Week	289641.782	9	32182.420	543.311	.000
Treatment	2127.657	4	531.914	8.980	.000
Error	8055.810	136	59.234		
Total	1200685.250	150			
Corrected Total	299825.248	149			

a. R Squared = .973 (Adjusted R Squared = .971)

heightofplantbokashi

Duncan

Treatment	N	Subset	
		1	2
Treatment 5	30	74.183	
Treatment 1	30	74.283	
Treatment 3	30	76.450	
Treatment 2	30	78.133	

Treatment 4	30		84.433
Sig.		.071	1.000

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 59.234.

a. Uses Harmonic Mean Sample Size = 30.000.

b. Alpha = .05.

Descriptives

Diameterofbulkbokashi

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Treatment 1	30	4.877	1.8288	.3339	4.194	5.560	1.2	7.2
Treatment 2	30	5.617	2.4505	.4474	4.702	6.532	1.3	10.0
Treatment 3	30	5.437	2.1647	.3952	4.628	6.245	1.3	9.0
Treatment 4	30	5.307	1.6526	.3017	4.690	5.924	1.5	7.0
Treatment 5	30	4.903	1.8376	.3355	4.217	5.590	1.3	7.5
Total	150	5.228	2.0017	.1634	4.905	5.551	1.2	10.0

Tests of Between-Subjects Effects

Dependent Variable: diameterofbulkbokashi

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	549.974[a]	13	42.306	122.239	.000
Intercept	4099.798	1	4099.798	11846.038	.000
Week	537.085	9	59.676	172.429	.000
Treatment	12.889	4	3.222	9.310	.000
Error	47.068	136	.346		
Total	4696.840	150			
Corrected Total	597.042	149			

a. R Squared = .921 (Adjusted R Squared = .914)

diameterofbulkbokashi

Duncan

Treatment	N	Subset	
		1	2

Treatment 1	30	4.877	
Treatment 5	30	4.903	
Treatment 4	30		5.307
Treatment 3	30		5.437
Treatment 2	30		5.617
Sig.		.861	.055

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = .346.
a. Uses Harmonic Mean Sample Size = 30.000.
b. Alpha = .05.

Descriptives

Chlorophyllindexbokashi

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Treatment 1	30	39.577	7.7639	1.4175	36.678	42.476	20.5	48.6
Treatment 2	30	45.560	8.6160	1.5731	42.343	48.777	31.8	59.3
Treatment 3	30	42.403	5.4823	1.0009	40.356	44.450	27.6	49.9
Treatment 4	30	40.047	6.8111	1.2435	37.503	42.590	28.7	57.1
Treatment 5	30	41.563	7.9692	1.4550	38.588	44.539	22.6	57.9
Total	150	41.830	7.6134	.6216	40.602	43.058	20.5	59.3

Tests of Between-Subjects Effects

Dependent Variable: chlorophyllindexbokashi

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4567.438[a]	13	351.341	11.742	.000
Intercept	262462.335	1	262462.335	8771.842	.000
Week	3890.323	9	432.258	14.447	.000
Treatment	677.115	4	169.279	5.658	.000
Error	4069.257	136	29.921		
Total	271099.030	150			
Corrected Total	8636.695	149			

a. R Squared = .529 (Adjusted R Squared = .484)

chlorophyllindexbokashi

Duncan

Treatment	N	Subset

		1	2
Treatment 1	30	39.577	
Treatment 4	30	40.047	
Treatment 5	30	41.563	
Treatment 3	30	42.403	
Treatment 2	30		45.560
Sig.		.069	1.000

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 29.921.

a. Uses Harmonic Mean Sample Size = 30.000.

b. Alpha = .05.

MSG (growth performance)

Descriptives

Numberofleavesmsg

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Treatment 1	30	9.03	3.672	.670	7.66	10.40	4	18
Treatment 2	30	13.57	5.940	1.085	11.35	15.78	4	25
Treatment 3	30	12.60	5.733	1.047	10.46	14.74	4	26
Treatment 4	30	10.20	4.604	.841	8.48	11.92	3	19
Treatment 5	30	9.90	3.994	.729	8.41	11.39	4	17
Total	150	11.06	5.110	.417	10.24	11.88	3	26

Tests of Between-Subjects Effects

Dependent Variable: numberofleavesmsg

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3394.820[a]	13	261.140	71.655	.000
Intercept	18348.540	1	18348.540	5034.706	.000
Week	2949.393	9	327.710	89.921	.000
Treatment	445.427	4	111.357	30.555	.000
Error	495.640	136	3.644		
Total	22239.000	150			
Corrected Total	3890.460	149			

a. R Squared = .873 (Adjusted R Squared = .860)

numberofleavesmsg

Duncan

Treatment	N	Subset		
		1	2	3
Treatment 1	30	9.03		
Treatment 5	30	9.90	9.90	
Treatment 4	30		10.20	
Treatment 3	30			12.60
Treatment 2	30			13.57
Sig.		.081	.544	.052

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 3.644.

a. Uses Harmonic Mean Sample Size = 30.000.

b. Alpha = .05.

Descriptives

Heightofplantmsg

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Treatment 1	30	65.267	37.3794	6.8245	51.309	79.224	9.5	116.0
Treatment 2	30	81.167	47.0721	8.5941	63.590	98.744	12.5	149.0
Treatment 3	30	76.983	43.9860	8.0307	60.559	93.408	12.0	139.0
Treatment 4	30	63.233	35.8464	6.5446	49.848	76.619	10.0	123.0
Treatment 5	30	68.417	39.0961	7.1379	53.818	83.015	11.0	122.0
Total	150	71.013	40.9326	3.3421	64.409	77.617	9.5	149.0

Tests of Between-Subjects Effects

Dependent Variable: heightofplantmsg

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	245222.063[a]	13	18863.236	579.829	.000
Intercept	756434.027	1	756434.027	23251.694	.000
Week	238051.273	9	26450.141	813.039	.000
Treatment	7170.790	4	1792.698	55.105	.000
Error	4424.410	136	32.532		
Total	1006080.500	150			
Corrected Total	249646.473	149			

a. R Squared = .982 (Adjusted R Squared = .981)

heightofplantmsg

Duncan

Treatment	N	Subset			
		1	2	3	4
Treatment 4	30	63.233			
Treatment 1	30	65.267			
Treatment 5	30		68.417		
Treatment 3	30			76.983	
Treatment 2	30				81.167
Sig.		.170	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 32.532.

a. Uses Harmonic Mean Sample Size = 30.000.

b. Alpha = .05.

Descriptives

Diameterofbulkmsg

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Treatment 1	30	4.567	1.7189	.3138	3.925	5.209	1.2	6.5
Treatment 2	30	5.733	2.1397	.3906	4.934	6.532	1.5	8.6
Treatment 3	30	5.100	1.8773	.3427	4.399	5.801	1.5	7.9
Treatment 4	30	4.290	1.6395	.2993	3.678	4.902	1.3	7.0
Treatment 5	30	4.560	1.8613	.3398	3.865	5.255	1.2	6.8
Total	150	4.850	1.9014	.1553	4.543	5.157	1.2	8.6

Tests of Between-Subjects Effects

Dependent Variable: diameterofbulkmsg

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	494.771[a]	13	38.059	117.841	.000
Intercept	3528.375	1	3528.375	10924.756	.000
Week	455.148	9	50.572	156.584	.000
Treatment	39.623	4	9.906	30.670	.000
Error	43.924	136	.323		
Total	4067.070	150			

Corrected Total	538.695	149			

a. R Squared = .918 (Adjusted R Squared = .911)

diameterofbulkmsg

Duncan

Treatment	N	Subset		
		1	2	3
Treatment 4	30	4.290		
Treatment 5	30	4.560		
Treatment 1	30	4.567		
Treatment 3	30		5.100	
Treatment 2	30			5.733
Sig.		.076	1.000	1.000

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = .323.

a. Uses Harmonic Mean Sample Size = 30.000.

b. Alpha = .05.

Descriptives

Chlorophyllindexmsg

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Treatment 1	30	35.080	10.8215	1.9757	31.039	39.121	15.9	53.3
Treatment 2	30	46.560	14.3342	2.6171	41.208	51.912	18.7	76.0
Treatment 3	30	47.440	16.7767	3.0630	41.175	53.705	20.8	79.7
Treatment 4	30	37.153	13.5241	2.4691	32.103	42.203	10.9	58.3
Treatment 5	30	38.843	12.4144	2.2665	34.208	43.479	11.4	60.2
Total	150	41.015	14.4466	1.1796	38.685	43.346	10.9	79.7

Tests of Between-Subjects Effects

Dependent Variable: chlorophyllindexmsg

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	20451.140[a]	13	1573.165	20.097	.000
Intercept	252338.635	1	252338.635	3223.656	.000
Week	16644.725	9	1849.414	23.626	.000
Treatment	3806.414	4	951.604	12.157	.000

Error	10645.695	136	78.277		
Total	283435.470	150			
Corrected Total	31096.835	149			

a. R Squared = .658 (Adjusted R Squared = .625)

chlorophyllindexmsg

Duncan

Treatment	N	Subset	
		1	2
Treatment 1	30	35.080	
Treatment 4	30	37.153	
Treatment 5	30	38.843	
Treatment 2	30		46.560
Treatment 3	30		47.440
Sig.		.122	.701

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 78.277.

a. Uses Harmonic Mean Sample Size = 30.000.

b. Alpha = .05.

Bokashi (yield production)

Descriptives

Numberofyield

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
treatment 1	12	2.00	1.206	.348	1.23	2.77	0	3
treatment 2	12	3.75	1.712	.494	2.66	4.84	2	6
treatment 3	12	2.67	1.231	.355	1.88	3.45	1	4
treatment 4	12	2.17	1.467	.423	1.23	3.10	0	5
treatment 5	12	1.42	1.311	.379	.58	2.25	0	4
Total	60	2.40	1.564	.202	2.00	2.80	0	6

ANOVA

numberofyield

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	36.900	4	9.225	4.720	.002
Within Groups	107.500	55	1.955		

Total	144.400	59			

numberofyield

Duncan

Bokashi	N	Subset for alpha = 0.05		
		1	2	3
treatment 5	12	1.42		
treatment 1	12	2.00	2.00	
treatment 4	12	2.17	2.17	
treatment 3	12		2.67	2.67
treatment 2	12			3.75
Sig.		.221	.277	.063

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 12.000.

Descriptives

Weightofyield

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
treatment 1	12	47.83	29.126	8.408	29.33	66.34	0	90
treatment 2	12	97.08	55.328	15.972	61.93	132.24	30	230
treatment 3	12	60.25	30.251	8.733	41.03	79.47	15	110
treatment 4	12	65.17	44.140	12.742	37.12	93.21	0	160
treatment 5	12	40.17	38.729	11.180	15.56	64.77	0	120
Total	60	62.10	43.968	5.676	50.74	73.46	0	230

ANOVA

weightofyield

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	23055.233	4	5763.808	3.484	.013
Within Groups	91002.167	55	1654.585		
Total	114057.400	59			

weightofyield

Duncan

Bokashi	N	Subset for alpha = 0.05

		1	2
treatment 5	12	40.17	
treatment 1	12	47.83	
treatment 3	12	60.25	
treatment 4	12	65.17	65.17
treatment 2	12		97.08
Sig.		.176	.060

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 12.000.

MSG (yield production)

Descriptives

Numberofyieldmsg

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
treatment 1	12	2.08	1.084	.313	1.39	2.77	0	3
treatment 2	12	4.00	2.412	.696	2.47	5.53	0	7
treatment 3	12	2.83	1.642	.474	1.79	3.88	0	5
treatment 4	12	1.50	.905	.261	.93	2.07	0	3
treatment 5	12	1.33	.888	.256	.77	1.90	0	3
Total	60	2.35	1.755	.227	1.90	2.80	0	7

ANOVA

numberofyieldmsg

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	57.400	4	14.350	6.352	.000
Within Groups	124.250	55	2.259		
Total	181.650	59			

numberofyieldmsg

Duncan

Treatment	N	Subset for alpha = 0.05		
		1	2	3
treatment 5	12	1.33		
treatment 4	12	1.50		
treatment 1	12	2.08	2.08	
treatment 3	12		2.83	2.83

treatment 2	12			4.00
Sig.		.255	.227	.063

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 12.000.

Descriptives

Weightofyieldmsg

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
treatment 1	12	60.50	35.233	10.171	38.11	82.89	0	120
treatment 2	12	106.50	76.222	22.003	58.07	154.93	0	230
treatment 3	12	66.58	37.965	10.960	42.46	90.71	0	120
treatment 4	12	41.25	28.275	8.162	23.28	59.22	0	90
treatment 5	12	33.83	21.896	6.321	19.92	47.75	0	80
Total	60	61.73	49.781	6.427	48.87	74.59	0	230

ANOVA

weightofyieldmsg

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	38724.900	4	9681.225	4.954	.002
Within Groups	107484.833	55	1954.270		
Total	146209.733	59			

weightofyieldmsg

Duncan

Treatment	N	Subset for alpha = 0.05	
		1	2
treatment 5	12	33.83	
treatment 4	12	41.25	
treatment 1	12	60.50	
treatment 3	12	66.58	
treatment 2	12		106.50
Sig.		.103	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 12.000.

Interaction between MSG and bokashi (growth performance)

Tests of Between-Subjects Effects

Dependent Variable: numberofleavesbatas

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	437.111[a]	5	87.422	1.668	.148
Intercept	18969.175	1	18969.175	361.908	.000
Bokashi_Rate	410.111	2	205.056	3.912	.023
MSG_Rate	7.143	1	7.143	.136	.713
Bokashi_Rate * MSG_Rate	19.857	2	9.929	.189	.828
Error	6289.714	120	52.414		
Total	25696.000	126			
Corrected Total	6726.825	125			

a. R Squared = .065 (Adjusted R Squared = .026)

numberofleavesbatas

Duncan

3 levels of bokashi	N	Subset	
		1	2
BI-0 g Bokashi	42	10.48	
B3-720 g Bokashi	42	11.60	
B2-360 g Bokashi	42		14.74
Sig.		.480	1.000

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 52.414.

a. Uses Harmonic Mean Sample Size = 42.000.

b. Alpha = 0.05.

Tests of Between-Subjects Effects

Dependent Variable: numberofleavesbatas

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6071.492[a]	41	148.085	18.981	.000
Intercept	18969.175	1	18969.175	2431.451	.000
Week	5095.603	6	849.267	108.858	.000
Treatment	437.111	5	87.422	11.206	.000

week * treatment	538.778	30	17.959	2.302	.002
Error	655.333	84	7.802		
Total	25696.000	126			
Corrected Total	6726.825	125			

a. R Squared = .903 (Adjusted R Squared = .855)

numberofleavesbatas

Duncan

Treatment	N	Subset	
		1	2
treatment 1	21	10.33	
treatment 2	21	10.62	
treatment 6	21	11.52	
treatment 5	21	11.67	
treatment 4	21		13.95
treatment 3	21		15.52
Sig.		.163	.072

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 7.802.

a. Uses Harmonic Mean Sample Size = 21.000.

b. Alpha = .05.

Tests of Between-Subjects Effects

Dependent Variable: heightofplantbatas

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5623.492[a]	5	1124.698	1.455	.210
Intercept	303310.508	1	303310.508	392.474	.000
Bokashi_Rate	5217.587	2	2608.794	3.376	.037
MSG_Rate	356.698	1	356.698	.462	.498
Bokashi_Rate * MSG_Rate	49.206	2	24.603	.032	.969
Error	92738.000	120	772.817		
Total	401672.000	126			
Corrected Total	98361.492	125			

a. R Squared = .057 (Adjusted R Squared = .018)

Tests of Between-Subjects Effects

Dependent Variable: heightofplantbatas

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	97248.825[a]	41	2371.923	179.067	.000
Intercept	303310.508	1	303310.508	22898.217	.000
Week	87125.048	6	14520.841	1096.241	.000
Treatment	5623.492	5	1124.698	84.908	.000
week * treatment	4500.286	30	150.010	11.325	.000
Error	1112.667	84	13.246		
Total	401672.000	126			
Corrected Total	98361.492	125			

a. R Squared = .989 (Adjusted R Squared = .983)

heightofplantbatas

Duncan

Treatment	N	Subset				
		1	2	3	4	5
treatment 1	21	38.57				
treatment 2	21		42.57			
treatment 5	21			49.67		
treatment 6	21			51.29		
treatment 3	21				53.90	
treatment 4	21					58.38
Sig.		1.000	1.000	.153	1.000	1.000

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 13.246.

a. Uses Harmonic Mean Sample Size = 21.000.

b. Alpha = .05.

Tests of Between-Subjects Effects

Dependent Variable: diameterofbulkbatas

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	61.194[a]	5	12.239	2.033	.079
Intercept	2638.631	1	2638.631	438.411	.000
Bokashi_Rate	55.829	2	27.915	4.638	.011
MSG_Rate	1.834	1	1.834	.305	.582
Bokashi_Rate * MSG_Rate	3.532	2	1.766	.293	.746
Error	722.234	120	6.019		
Total	3422.060	126			

Corrected Total	783.429	125			

a. R Squared = .078 (Adjusted R Squared = .040)

Tests of Between-Subjects Effects

Dependent Variable: diameterofbulkbatas

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	773.149[a]	41	18.857	154.087	.000
Intercept	2638.631	1	2638.631	21560.802	.000
Week	665.511	6	110.918	906.338	.000
Treatment	61.194	5	12.239	100.006	.000
week * treatment	46.443	30	1.548	12.650	.000
Error	10.280	84	.122		
Total	3422.060	126			
Corrected Total	783.429	125			

a. R Squared = .987 (Adjusted R Squared = .980)

diameterofbulkbatas

Duncan

Treatment	N	Subset			
		1	2	3	4
treatment 1	21	3.576			
treatment 2	21	3.790			
treatment 6	21		4.586		
treatment 5	21			4.943	
treatment 4	21			4.990	
treatment 3	21				5.571
Sig.		.050	1.000	.660	1.000

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = .122.

a. Uses Harmonic Mean Sample Size = 21.000.

b. Alpha = .05.

Tests of Between-Subjects Effects

Dependent Variable: chlorophyllindexbatas

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2341.114[a]	5	468.223	5.742	.000
Intercept	213218.748	1	213218.748	2614.866	.000

Bokashi_Rate	1378.058	2	689.029	8.450	.000
MSG_Rate	455.620	1	455.620	5.588	.020
Bokashi_Rate * MSG_Rate	507.435	2	253.718	3.112	.048
Error	9784.918	120	81.541		
Total	225344.780	126			
Corrected Total	12126.032	125			

a. R Squared = .193 (Adjusted R Squared = .159)

Tests of Between-Subjects Effects

Dependent Variable: chlorophyllindexbatas

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	9856.539[a]	41	240.403	8.898	.000
Intercept	213218.748	1	213218.748	7891.794	.000
Week	5530.475	6	921.746	34.116	.000
Treatment	2341.114	5	468.223	17.330	.000
week * treatment	1984.949	30	66.165	2.449	.001
Error	2269.493	84	27.018		
Total	225344.780	126			
Corrected Total	12126.032	125			

a. R Squared = .813 (Adjusted R Squared = .721)

chlorophyllindexbatas

Duncan

Treatment	N	Subset		
		1	2	3
treatment 6	21	35.910		
treatment 1	21	37.029		
treatment 2	21	38.595		
treatment 4	21		43.200	
treatment 5	21		43.990	
treatment 3	21			48.095
Sig.		.117	.623	1.000

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 27.018.

a. Uses Harmonic Mean Sample Size = 21.000.

b. Alpha = .05.

Tests of Between-Subjects Effects

Dependent Variable: quantityofyieldbatas

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	199.333[a]	5	39.867	13.047	.000
Intercept	800.000	1	800.000	261.818	.000
Week	.000	0	.	.	.
Treatment	199.333	5	39.867	13.047	.000
week * treatment	.000	0	.	.	.
Error	36.667	12	3.056		
Total	1036.000	18			
Corrected Total	236.000	17			

a. R Squared = .845 (Adjusted R Squared = .780)

quantityofyieldbatas

Duncan

Treatment	N	Subset		
		1	2	3
T2	3	2.67		
T1	3	2.67		
T6	3	5.33	5.33	
T4	3		8.33	8.33
T5	3			10.00
T3	3			11.00
Sig.		.100	.057	.100

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 3.056.

a. Uses Harmonic Mean Sample Size = 3.000.

b. Alpha = 0.05.

Tests of Between-Subjects Effects

Dependent Variable: weightofyieldbatas

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	113413.333[a]	5	22682.667	15.289	.000
Intercept	415872.000	1	415872.000	280.321	.000
Week	.000	0	.	.	.
Treatment	113413.333	5	22682.667	15.289	.000

week * treatment	.000	0	.	.	.	.
Error	17802.667	12	1483.556			
Total	547088.000	18				
Corrected Total	131216.000	17				

a. R Squared = .864 (Adjusted R Squared = .808)

weightofyieldbatas

Duncan

Treatment	N	Subset			
		1	2	3	4
T1	3	55.00			
T2	3	60.33			
T6	3	122.00	122.00		
T4	3		186.33	186.33	
T5	3			222.67	222.67
T3	3				265.67
Sig.		.065	.063	.270	.197

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 1483.556.

a. Uses Harmonic Mean Sample Size = 3.000.

b. Alpha = 0.05.

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
phbokashi	treatment 1	10	3.7230	.47237	.14938	3.3851	4.0609	3.20	4.69
	treatment 2	10	3.7560	.52581	.16627	3.3799	4.1321	3.12	4.70
	treatment 3	10	3.8060	.47306	.14959	3.4676	4.1444	3.23	4.79
	treatment 4	10	3.7210	.39128	.12373	3.4411	4.0009	3.33	4.68
	treatment 5	10	3.8490	.45754	.14469	3.5217	4.1763	3.37	4.74
	Total	50	3.7710	.44940	.06355	3.6433	3.8987	3.12	4.79
temperaturebokashi	treatment 1	10	27.390	2.1522	.6806	25.850	28.930	25.2	31.8
	treatment 2	10	27.010	1.9365	.6124	25.625	28.395	25.2	31.5
	treatment 3	10	26.860	1.8709	.5916	25.522	28.198	25.1	30.7
	treatment 4	10	27.100	1.8324	.5795	25.789	28.411	25.2	31.4
	treatment 5	10	26.800	1.8379	.5812	25.485	28.115	24.9	30.8
	Total	50	27.032	1.8611	.2632	26.503	27.561	24.9	31.8
SMCbokashi	treatment 1	10	6.200	19.6061	6.2000	-7.825	20.225	.0	62.0
	treatment 2	10	.000	.0000	.0000	.000	.000	.0	.0
	treatment 3	10	6.200	19.6061	6.2000	-7.825	20.225	.0	62.0
	treatment 4	10	.000	.0000	.0000	.000	.000	.0	.0
	treatment 5	10	14.900	26.0190	8.2279	-3.713	33.513	.0	62.0
	Total	50	5.460	17.2085	2.4336	.569	10.351	.0	62.0
phmsg	treatment 1	10	3.9340	.54702	.17298	3.5427	4.3253	3.07	4.79
	treatment 2	10	3.7120	.52336	.16550	3.3376	4.0864	3.09	4.80
	treatment 3	10	3.7710	.51193	.16189	3.4048	4.1372	3.06	4.80
	treatment 4	10	3.8520	.55954	.17694	3.4517	4.2523	3.08	4.77
	treatment 5	10	4.0720	.51272	.16214	3.7052	4.4388	3.39	4.79
	Total	50	3.8682	.52490	.07423	3.7190	4.0174	3.06	4.80
temperaturemsg	treatment 1	10	27.920	2.8936	.9150	25.850	29.990	25.3	33.2
	treatment 2	10	26.960	1.8325	.5795	25.649	28.271	25.0	30.6
	treatment 3	10	27.060	2.3268	.7358	25.396	28.724	25.1	31.5
	treatment 4	10	27.070	2.0565	.6503	25.599	28.541	25.2	31.6
	treatment 5	10	27.570	2.1628	.6840	26.023	29.117	25.3	32.2
	Total	50	27.316	2.2191	.3138	26.685	27.947	25.0	33.2
SMCmsg	treatment 1	10	6.200	19.6061	6.2000	-7.825	20.225	.0	62.0
	treatment 2	10	1.420	4.4904	1.4200	-1.792	4.632	.0	14.2
	treatment 3	10	8.000	19.7990	6.2610	-6.163	22.163	.0	62.0
	treatment 4	10	14.660	25.3733	8.0237	-3.491	32.811	.0	62.0
	treatment 5	10	2.600	8.2219	2.6000	-3.282	8.482	.0	26.0
	Total	50	6.576	17.3033	2.4471	1.658	11.494	.0	62.0

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
numberofleavesbatas	treatment 1	21	10.33	5.817	1.269	7.69	12.98	2	23
	treatment 2	21	10.62	5.661	1.235	8.04	13.20	4	20
	treatment 3	21	15.52	7.420	1.619	12.15	18.90	4	28
	treatment 4	21	13.95	9.605	2.096	9.58	18.32	3	33
	treatment 5	21	11.67	6.327	1.381	8.79	14.55	4	26
	treatment 6	21	11.52	7.827	1.708	7.96	15.09	3	29
	Total	126	12.27	7.336	.654	10.98	13.56	2	33
heightofplantbatas	treatment 1	21	38.57	19.059	4.159	29.90	47.25	15	73
	treatment 2	21	42.57	21.910	4.781	32.60	52.54	17	78
	treatment 3	21	53.90	29.560	6.451	40.45	67.36	16	99
	treatment 4	21	58.38	34.464	7.521	42.69	74.07	18	105
	treatment 5	21	49.67	28.152	6.143	36.85	62.48	18	90
	treatment 6	21	51.29	30.651	6.689	37.33	65.24	15	93
	Total	126	49.06	28.052	2.499	44.12	54.01	15	105
diameterofbulkbatas	treatment 1	21	3.576	1.5569	.3397	2.868	4.285	1.2	5.5
	treatment 2	21	3.790	1.6610	.3625	3.034	4.547	1.5	6.0
	treatment 3	21	5.571	2.9835	.6510	4.213	6.929	1.5	10.0
	treatment 4	21	4.990	2.6220	.5722	3.797	6.184	1.3	8.5
	treatment 5	21	4.943	2.7651	.6034	3.684	6.201	1.5	9.0
	treatment 6	21	4.586	2.7399	.5979	3.339	5.833	1.3	8.4
	Total	126	4.576	2.5035	.2230	4.135	5.018	1.2	10.0
chlorophyllindexbatas	treatment 1	21	37.029	7.8920	1.7222	33.436	40.621	21.1	53.9
	treatment 2	21	38.595	6.3985	1.3963	35.683	41.508	28.9	57.8
	treatment 3	21	48.095	10.8385	2.3651	43.162	53.029	29.0	69.7
	treatment 4	21	43.200	10.3569	2.2601	38.486	47.914	22.6	62.4
	treatment 5	21	43.990	10.1171	2.2077	39.385	48.596	27.4	63.7
	treatment 6	21	35.910	7.6765	1.6751	32.415	39.404	20.5	54.8
	Total	126	41.137	9.8493	.8774	39.400	42.873	20.5	69.7

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
SOMbeforebokasi	treatment 1	3	3.6100	.22517	.13000	3.0507	4.1693	3.35	3.74
	treatment 2	3	3.8233	.66214	.38229	2.1785	5.4682	3.35	4.58
	treatment 3	3	4.3000	.34699	.20033	3.4380	5.1620	3.92	4.60
	treatment 4	3	4.3833	.99324	.57345	1.9160	6.8507	3.79	5.53
	treatment 5	3	4.9400	.88831	.51287	2.7333	7.1467	3.93	5.60
	Total	15	4.2113	.75649	.19533	3.7924	4.6303	3.35	5.60
SOMafterbokashi	treatment 1	3	6.6133	.31754	.18333	5.8245	7.4022	6.43	6.98
	treatment 2	3	7.5733	.99324	.57345	5.1060	10.0407	6.98	8.72
	treatment 3	3	8.5100	.46573	.26889	7.3531	9.6669	8.06	8.99
	treatment 4	3	7.8433	1.11150	.64173	5.0822	10.6045	6.56	8.50
	treatment 5	3	6.7200	.26514	.15308	6.0614	7.3786	6.49	7.01
	Total	15	7.4520	.95615	.24688	6.9225	7.9815	6.43	8.99
SCbeforebokasi	treatment 1	3	2.0933	.13279	.07667	1.7635	2.4232	1.94	2.17
	treatment 2	3	2.2167	.38786	.22393	1.2532	3.1802	1.94	2.66
	treatment 3	3	2.4933	.20404	.11780	1.9865	3.0002	2.27	2.67
	treatment 4	3	2.5467	.57449	.33168	1.1196	3.9738	2.21	3.21
	treatment 5	3	2.8667	.51598	.29790	1.5849	4.1484	2.28	3.25
	Total	15	2.4433	.44003	.11361	2.1997	2.6870	1.94	3.25
SCafterbokasi	treatment 1	3	3.8367	.18475	.10667	3.3777	4.2956	3.73	4.05
	treatment 2	3	4.3933	.57744	.33338	2.9589	5.8278	4.05	5.06
	treatment 3	3	4.9333	.27025	.15603	4.2620	5.6047	4.67	5.21
	treatment 4	3	4.5500	.64094	.37005	2.9578	6.1422	3.81	4.93
	treatment 5	3	3.8967	.15822	.09135	3.5036	4.2897	3.76	4.07
	Total	15	4.3220	.55386	.14301	4.0153	4.6287	3.73	5.21
SOMbeforemsg	treatment 1	3	2.9267	.13796	.07965	2.5840	3.2694	2.77	3.03
	treatment 2	3	16.6733	.09292	.05364	16.4425	16.9041	16.61	16.78
	treatment 3	3	4.7867	.09018	.05207	4.5626	5.0107	4.70	4.88
	treatment 4	3	3.3400	.05568	.03215	3.2017	3.4783	3.29	3.40
	treatment 5	3	3.5067	.04726	.02728	3.3893	3.6241	3.47	3.56
	Total	15	6.2467	5.43507	1.40333	3.2368	9.2565	2.77	16.78
SOMaftermsg	treatment 1	3	6.8333	.08505	.04910	6.6221	7.0446	6.77	6.93
	treatment 2	3	20.2133	1.02832	.59370	17.6589	22.7678	19.03	20.89
	treatment 3	3	8.1067	.17673	.10203	7.6676	8.5457	7.99	8.31
	treatment 4	3	6.8133	.10017	.05783	6.5645	7.0622	6.70	6.89
	treatment 5	3	7.6500	.34000	.19630	6.8054	8.4946	7.31	7.99

	Total	15	9.9233	5.36630	1.38557	6.9516	12.8951	6.70	20.89
SCbeforemsg	treatment 1	3	1.7000	.07937	.04583	1.5028	1.8972	1.61	1.76
	treatment 2	3	9.6700	.05292	.03055	9.5386	9.8014	9.63	9.73
	treatment 3	3	2.7733	.05508	.03180	2.6365	2.9101	2.72	2.83
	treatment 4	3	1.9367	.03055	.01764	1.8608	2.0126	1.91	1.97
	treatment 5	3	2.0300	.02646	.01528	1.9643	2.0957	2.01	2.06
	Total	15	3.6220	3.15243	.81396	1.8762	5.3678	1.61	9.73
SCaftermsg	treatment 1	3	3.9633	.04933	.02848	3.8408	4.0859	3.93	4.02
	treatment 2	3	11.7267	.59677	.34454	10.2442	13.2091	11.04	12.12
	treatment 3	3	4.7000	.10440	.06028	4.4406	4.9594	4.63	4.82
	treatment 4	3	3.9533	.05686	.03283	3.8121	4.0946	3.89	4.00
	treatment 5	3	4.4367	.19502	.11260	3.9522	4.9211	4.24	4.63
	Total	15	5.7560	3.11362	.80393	4.0317	7.4803	3.89	12.12
totalPbeforebokasi	treatment 1	3	277.33	3.055	1.764	269.74	284.92	274	280
	treatment 2	3	326.67	6.429	3.712	310.70	342.64	322	334
	treatment 3	3	192.00	7.211	4.163	174.09	209.91	186	200
	treatment 4	3	116.33	7.095	4.096	98.71	133.96	110	124
	treatment 5	3	194.67	3.055	1.764	187.08	202.26	192	198
	Total	15	221.40	75.973	19.616	179.33	263.47	110	334
totalPafterbokashi	treatment 1	3	133.33	4.163	2.404	122.99	143.68	130	138
	treatment 2	3	43.33	14.468	8.353	7.39	79.27	34	60
	treatment 3	3	12.67	6.429	3.712	-3.30	28.64	8	20
	treatment 4	3	126.67	6.110	3.528	111.49	141.84	120	132
	treatment 5	3	16.00	4.000	2.309	6.06	25.94	12	20
	Total	15	66.40	55.329	14.286	35.76	97.04	8	138
totalPbeforemsg	treatment 1	3	275.33	2.309	1.333	269.60	281.07	274	278
	treatment 2	3	324.67	6.429	3.712	308.70	340.64	320	332
	treatment 3	3	294.67	8.327	4.807	273.98	315.35	288	304
	treatment 4	3	285.33	7.572	4.372	266.52	304.14	280	294
	treatment 5	3	90.67	10.066	5.812	65.66	115.67	80	100
	Total	15	254.13	86.535	22.343	206.21	302.05	80	332
totalPaftermsg	treatment 1	3	56.67	4.163	2.404	46.32	67.01	52	60
	treatment 2	3	227.33	6.429	3.712	211.36	243.30	220	232
	treatment 3	3	266.00	14.422	8.327	230.17	301.83	250	278
	treatment 4	3	80.00	17.321	10.000	36.97	123.03	70	100
	treatment 5	3	22.00	2.000	1.155	17.03	26.97	20	24
	Total	15	130.40	101.304	26.156	74.30	186.50	20	278

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
quantityofyieldbatas	T1	3	2.67	2.517	1.453	-3.58	8.92	0	5
	T2	3	2.67	2.309	1.333	-3.07	8.40	0	4
	T3	3	11.00	1.000	.577	8.52	13.48	10	12
	T4	3	8.33	1.528	.882	4.54	12.13	7	10
	T5	3	10.00	1.000	.577	7.52	12.48	9	11
	T6	3	5.33	1.528	.882	1.54	9.13	4	7
	Total	18	6.67	3.726	.878	4.81	8.52	0	12
weightofyieldbatas	T1	3	55.00	55.000	31.754	-81.63	191.63	0	110
	T2	3	60.33	52.367	30.234	-69.75	190.42	0	94
	T3	3	265.67	25.775	14.881	201.64	329.69	238	289
	T4	3	186.33	35.247	20.350	98.78	273.89	156	225
	T5	3	222.67	15.177	8.762	184.97	260.37	209	239
	T6	3	122.00	31.575	18.230	43.56	200.44	99	158
	Total	18	152.00	87.855	20.708	108.31	195.69	0	289

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
SOMbeforebatas	T1	3	2.8167	.05508	.03180	2.6799	2.9535	2.78	2.88
	T2	3	2.2867	.09609	.05548	2.0480	2.5254	2.20	2.39
	T3	3	4.4333	.03512	.02028	4.3461	4.5206	4.40	4.47
	T4	3	3.1667	.12662	.07311	2.8521	3.4812	3.03	3.28
	T5	3	3.3600	.07000	.04041	3.1861	3.5339	3.28	3.41
	T6	3	3.3600	.04583	.02646	3.2462	3.4738	3.31	3.40
	Total	18	3.2372	.67352	.15875	2.9023	3.5722	2.20	4.47
SOMafterbatas	T1	3	4.5800	.21656	.12503	4.0420	5.1180	4.35	4.78
	T2	3	7.6767	.02082	.01202	7.6250	7.7284	7.66	7.70
	T3	3	8.2800	.09000	.05196	8.0564	8.5036	8.19	8.37
	T4	3	6.6900	.09165	.05292	6.4623	6.9177	6.59	6.77
	T5	3	6.8367	.11930	.06888	6.5403	7.1330	6.70	6.92

	T6	3	7.8667	.10693	.06173	7.6010	8.1323	7.80	7.99
	Total	18	6.9883	1.25220	.29515	6.3656	7.6110	4.35	8.37
SCbeforebatas	T1	3	1.6333	.03215	.01856	1.5535	1.7132	1.61	1.67
	T2	3	1.3300	.05568	.03215	1.1917	1.4683	1.28	1.39
	T3	3	2.5700	.02000	.01155	2.5203	2.6197	2.55	2.59
	T4	3	1.8367	.07095	.04096	1.6604	2.0129	1.76	1.90
	T5	3	1.9500	.04359	.02517	1.8417	2.0583	1.90	1.98
	T6	3	1.9467	.02517	.01453	1.8842	2.0092	1.92	1.97
	Total	18	1.8778	.38928	.09175	1.6842	2.0714	1.28	2.59
SCafterbatas	T1	3	2.6533	.12583	.07265	2.3408	2.9659	2.52	2.77
	T2	3	4.4533	.01528	.00882	4.4154	4.4913	4.44	4.47
	T3	3	4.8000	.05000	.02887	4.6758	4.9242	4.75	4.85
	T4	3	3.8800	.05568	.03215	3.7417	4.0183	3.82	3.93
	T5	3	3.9667	.06658	.03844	3.8013	4.1321	3.89	4.01
	T6	3	4.5600	.06083	.03512	4.4089	4.7111	4.52	4.63
	Total	18	4.0522	.72659	.17126	3.6909	4.4135	2.52	4.85
TotalPbefrorebatas	T1	3	13.33	8.327	4.807	-7.35	34.02	4	20
	T2	3	146.67	50.332	29.059	21.63	271.70	100	200
	T3	3	281.67	15.308	8.838	243.64	319.69	270	299
	T4	3	13.33	7.024	4.055	-4.11	30.78	6	20
	T5	3	265.67	5.859	3.383	251.11	280.22	259	270
	T6	3	40.67	3.055	1.764	33.08	48.26	38	44
	Total	18	126.89	117.911	27.792	68.25	185.52	4	299
TotalPafterbatas	T1	3	15.33	5.033	2.906	2.83	27.84	10	20
	T2	3	11.67	3.786	2.186	2.26	21.07	9	16
	T3	3	172.00	2.000	1.155	167.03	176.97	170	174
	T4	3	60.00	2.000	1.155	55.03	64.97	58	62
	T5	3	265.33	6.110	3.528	250.16	280.51	260	272
	T6	3	35.33	5.033	2.906	22.83	47.84	30	40
	Total	18	93.28	96.779	22.811	45.15	141.40	9	272