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EFFECT OF RICE HUSK ASH AND NPK PHONSKA FERTILIZER ON GROWTH AND YIELD OF MUNG BEAN (*PHASEOLUS RADIATUS*)

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ABSTRACT

Increased yield of mung beans can be done in various ways, including by providing organic and inorganic fertilizers, namely the provision of rice husk ash combined with NPK fertilizer. The study was conducted in the experimental garden of the Faculty of Agriculture of UISU, Johor Building, Medan, North Sumatra with a height of ± 25 m above sea level with flat topography. This study aims to determine the effect of giving rice husk ash and NPK Phonska fertilizer on the growth and yield of mung beans. This research used a factorial randomized block desig with three replications with variables of plant height, number of branches, pods number, flowering age, and root dry weight. The results showed that the application of rice husk ash and NPK Phonska fertilizer independently was able to increase the growth of green beans with a dose of 75 g/polybag and NPK Phonska fertilizer 40 g/polybag. While rice husk ash and NPK Phonska fertilizer combination has not been able to increase growth and yield of mung beans. Based on the regression equation, the optimum dose of rice husk ash and NPK Phonska fertilizer to increase plant height and number of branches of mung beans are 69.33 g/polybag, 39.67 g/polybag, 38.75 g/polybag, and 32.00 g/polybag, respectively.

KEYWORDS: Mung bean, rice husk, NPK Phonska.

INTRODUCTION

Mung beans (*Phaseolus radiatus*) have long been known and planted by Indonesian farming communities. The origin of the green bean plant originated from the Indian region which was brought into Indonesian territory at the beginning of the 17th century, by Chinese traders. The center for the distribution of mung beans was initially centered on Java and Bali, but in the 1920s it began to develop in Sulawesi, Kalimantan and Eastern Indonesia.[1]

At the farm level, the average productivity is only 0.9 t/ha. With proper cultivation techniques the results can reach 2 t/ha. Currently available choices of superior varieties of mung beans that vary in both the size of the seeds (large or small) and dull or shiny green seed coat. Selection of varieties should be adjusted to market demand. For infertile land, plants are fertilized with 45 kg Urea/ha + 45-90 kg SP36/ha + 50 kg KCl/ha given when planting in a run on the side of the planting hole along the row of plants. Organic material in the form of manure as much as 15-20 t/ha and kitchen ash is very good for fertilizer and is provided as a cover for planting holes.[2]

The development of mung bean productivity during the last 10 years fluctuates and tends to increase by 1.80%, while the harvested area and production fluctuates and tends to decrease by 3.94% and 2.21%, respectively. The highest production in 2003 was 344,558 ha and 335,224 tons respectively, while the highest productivity in 2013 was 11.62 Ku/ha, the national average productivity was still below the yield potential.[2]

Rice husk is leather wrapped around a grain of rice, where the rice husk will separate and become a waste or waste. If the rice husk is burned it will produce rice husk ash. The most common value of silica content (SiO_2) in rice husk ash is 94%-96% and its value is closer to or below 90% likely due to the sample of husk contaminated by other substances with low silicon content. Rice husk is a ligno-cellulose material like other biomass but contains high silica. The chemical content of rice husk consists of 50% cellulose, 25%-30% lignin, and 15%-20% silica.[3] Rice husk ash is an organic material that can add macro and micro nutrients needed for plant metabolic processes. Giving rice husk ash as a source of nutrients, especially as potassium fertilizer and silicon, is an alternative for farmers to reduce the dose of the use of NPK inorganic fertilizers and more oriented to environmentally sound agriculture. Husk ash has the function of binding heavy metals.[4]

NPK Phonska fertilizer or also known as NPK compound fertilizer is fertilizer consisting of more than one main nutrient. These nutrients can be NP, NK, and NPK. This fertilizer is made from urea, ammonium, ZA, DAP, MAP, TSP, KCL, ZK, phosphate, zeolite, dolomite, kieserit, TE and other additional substances. Phonska fertilizer has a rich content of substances allowing integrated fertilization of plants. Phonska fertilizer as mentioned earlier is compound fertilizer, which consists of various natural nutrient enhancing agents. The composition of Phonska fertilizer consists of 15% N, 15% P_2O_5, 15% K_2O, 10% S, and 2% water content. The recommended dosage of NPK fertilizer for mung bean plants is 350 kg/ha.[2]

Based on that study aimed to determine the effect of rice husk ash and Phonska NPK fertilizer on growth and yield of green beans.

MATERIALS AND METHODS

The study was conducted in the Experimental Garden Faculty of Agriculture, Universitas Islam Sumatera Utara, Gedung Johor, Medan, North Sumatra with a height of ± 25 m above sea level with Ultisol top soil type. This research was conducted from April-July 2019.

The study used a randomized block design consisting of two factors and three replications. The first factor is the dose rice husk ash (A), which consists of 4 levels, namely: 0 g/polybag (A0), 25 g/polybag (A1), 50 g/polybag (A2), and 75 g/polybag (A3). The second factor is the dose of NPK fertilizer Phonska (N) consists of 4 levels, namely: 0 g/polybag (N0), 20 g/polybag (N1), 40 g/polybag (N2), and 60 g/polybag (N3).

The observed variables were plant height, number of branches, pods number, flowering age, and root dry weight.

RESULTS AND DISCUSSION

Statistical analysis showed that rice husk ash independently significantly affected plant height, number of branches, and dry weight of mung bean roots. NPK Phonska fertilizer independently also significantly affects plant height and number of branches of mung beans. However, the combination of rice husk ash and NPK Phonska fertilizer had no significant effect on all observed variables (Table 1). This is due to rice husk ash contains elements needed by mung bean in its growth, such as SiO_2, K_2O, Na_2O, CaO, MgO, Fe_2O3, AL_2O_3, SO_3, and Cl. This is in accordance with research Prasetyoko[5] states that the application of rice husk ash is very significant effect on the vegetative phase of the mung bean. Increasing the concentration of rice husk ash from 25 g, 50 g and 75 g gives the best growth results in plant height.

This is presumably because the husk's ash function is to release acid bonds so that nutrients are available to plants. The results of the analysis show that husk ash has a high content of silica compounds. Silica is included in the building blocks of nutrients in addition to the elements of chlorine and sodium which are included in the elements that are not too important, but it stimulates plant growth and can also be an important element for certain plants.[6]

Table 1: Average plant height, number of branches, pods number, flowering age, and root dry weight of mung beans in the treatment of rice husk and NPK Phonska fertilizer doses.

Treatments	Plant height (cm)	Number of branches	Pods number	Flowering age (day)	Root dry weight (g)
Rice husk					
0 g/polybag	17.33c	4.13b	7.58	30.88	0.58c
25 g/polybag	18.38b	4.13b	8.54	30.50	0.65b
50 g/polybag	18.47b	4.83a	8.54	30.42	0.66b
75 g/polybag	18.69a	4.13b	8.42	30.29	0.70a
NPK Phonska					
0 g/polybag	17.79c	3.88c	8.13	30.62	0.67
20 g/polybag	18.18b	4.50a	8.29	31.00	0.64
40 g/polybag	18.76a	4.63a	8.75	30.37	0.68
60 g/polybag	18.12b	4.20b	7.92	30.08	0.61

Note: Different letters in the same column and row show significantly different based on Duncan's multiple range test at the 5%.

The effect of silica on the growth of mung bean is by giving silica can increase the mechanical strength of the tissue, besides silica also strengthens the cell wall of the epidermis so that it can suppress transpiration activities. Harsono[7] states that crop yields will increase with the strengthening of stems and roots and photosynthesis is more effective because the position of the leaves (canopy) is upright so the leaves can absorb more sunlight. The effect of giving rice husk ash to the vegetative growth of mung bean is also suspected by the influence of other elements, silica contained in the husk ash can increase the availability of elements such as elements K, P, Ca and N. The P element is needed for plant formation and growth roots, where fertile plant roots can strengthen the establishment of plants and can increase the absorption of nutrients needed by plants. While the element K is useful for the formation of leaf green matter, regulates the balance of N and P. fertilizer. Increased Ca after the application of husk ash also contributes to plant growth, because Ca plays a role in plant growth towards the top and bud formation and is needed in cell elongation, protein synthesis and cell division.

Plants such as mung beans, vegetative growth in the form of plant height and number of branches, require the element N which functions as the formation of shoots, the development of stems, and leaves of plants, greener plant colors and protein formation.[8] This is in line with Lingga's[9] opinion that in rice husk ash additional fertilizer N is needed so that the availability of N elements is sufficient for plants. Where is based on the results of descriptive analysis that treatment 75 g/polybag rice husk ash is the highest treatment in increasing the height of mung bean plants.

Giving rice husk ash to the growth of mung beans with various concentrations gives the best growth value compared to without giving rice husk ash (control), because physically rice husk ash has a light texture that can help improve the physical properties of clay-textured soil and lack of organic elements. Besides rice husk ash can improve soil porosity so that the soil has better aeration and greatly helps the growth and development of plant roots, especially for plants that have shallow and soft roots such as green bean plants.[2]

The results of analysis of variance showed that the dose of rice husk ash did not significantly affect the number of pods and flowering age. This is presumably because rice husk ash has not been able to provide sufficient nutrients for plant generative growth, but there is still an increase in yield at each increase in the treatment dose of rice husk ash. This is in line with Darmawan's research which states that the application of rice husk ash to the growth of sweet corns can accelerate the age of the harvest because the P element plays a role in the process of accelerating flowering and seed cooking. In addition, the element P functions to stimulate the growth of new roots of young plant seeds and play a role in the process of photosynthesis and plant growth. This proves that the concentration of 75 g/polybag rice husk ash is an appropriate concentration and a dose that is balanced and in accordance with needs green bean plants, so the growth of green beans based on the observed parameters significantly affects plant growth. Rice husk ash when applied with the right dosage can accelerate the growth of peanut plants and good quality of production. Its giving into the soil can improve the physical properties of the soil and indirectly can also improve the chemical properties of the soil, namely the availability of nutrients for plants.

Based on the regression analysis shows that the form of the relationship between the dose of rice husk ash with the plant height of mung bean is quadratic in the form of the equation $y = -0.0003x^2 + 0.0416x + 17.385$ ($R^2 = 0.946$) (Figure 1). This means that increasing the dose of rice husk ash until the optimum dose will increase the plant height of mung beans. But if the dose of rice husk ash continues to be added to exceed the optimum dose, the plant height of mung bean will decrease. The coefficient of determination (R^2) 0.946 means that 94.60% of rice husk ash influences the mung bean plant height.

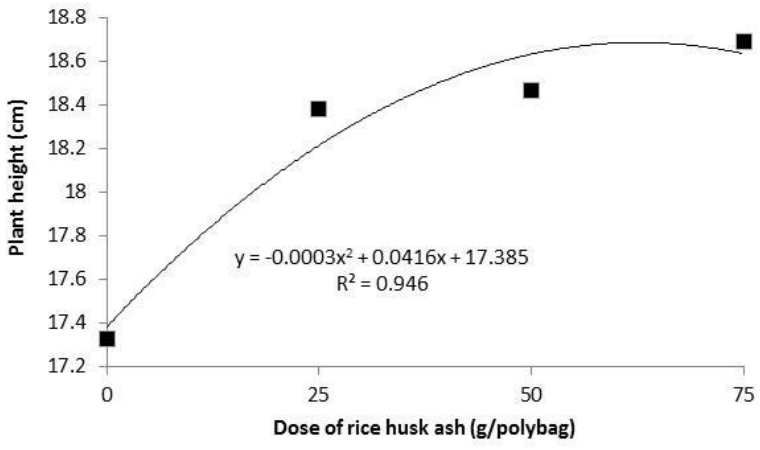

Figure 1: The form of the relationship between the doses of rice husk ash with plant height of mung beans.

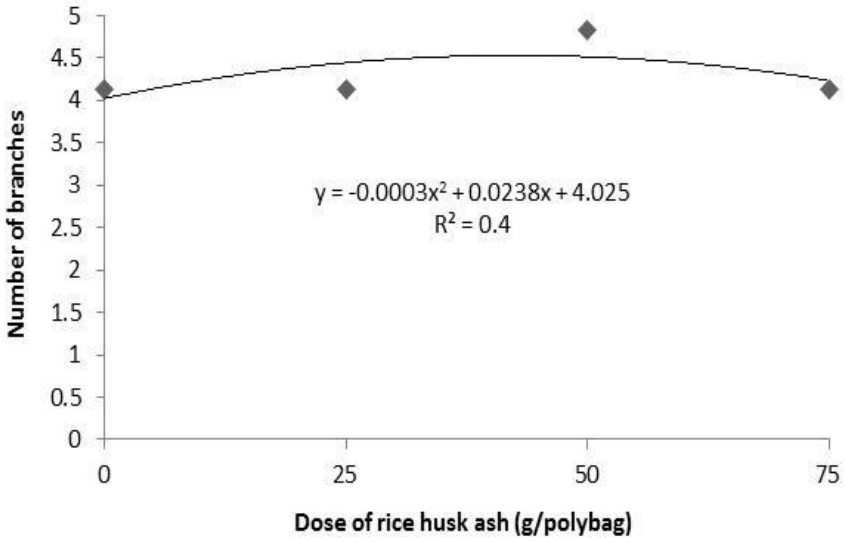

Figure 2: The form of the relationship between the doses of rice husk ash with number of branches of mung beans.

Based on the regression analysis shows that the form of the relationship between the dose of rice husk ash with the number of branches of mung beans is quadratic with the equation $y = -0.0003x^2 + 0.0238x + 4.025$ ($R^2 = 0.4$) (Figure 2). This means that the greater the dose of rice husk ash that is given up to the optimum dose will increase the number of branches of mung beans, but if the dose of rice husk ash is increased beyond the optimum dose it will reduce the number of branches of mung beans. The coefficient of determination (R^2) 0.4 means that only 40% of the rice husk ash affects the number of branches of the green bean plant, while another 60% is influenced by other factors.

Based on the regression analysis shows that the form of the relationship between the dose of rice husk ash with the root dry weight of mung beans is quadratic with the equation $y = 0.0015x + 0.592$ ($R^2 = 0.9157$) (Figure 3). This means that increasing the dose of rice husk ash will increase the root dry weight of mung beans. The coefficient of determination (R^2) 0.9157 means that 91.57% of rice husk ash influences the mung bean root dry weight.

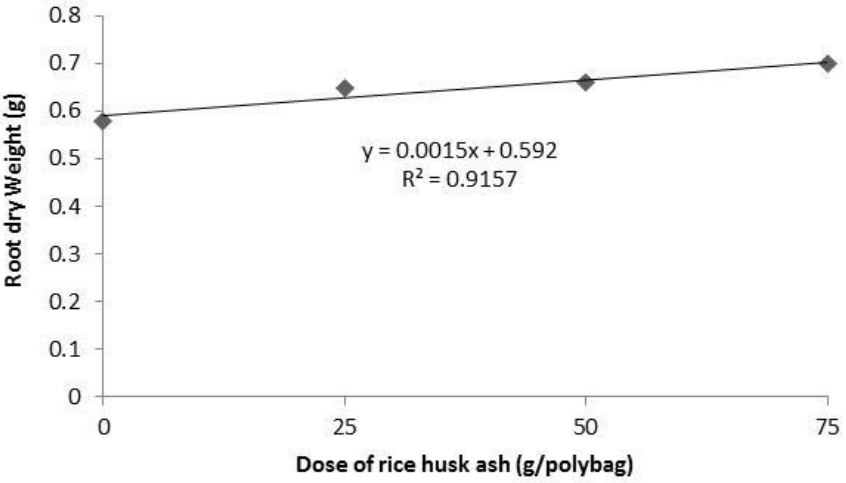

Figure 3: The form of the relationship between the doses of rice husk ash with root dry weight of mung beans.

Table 1 also shows that based on statistical analysis of NPK Phonska fertilizer application has a single significant effect on plant height and number of branches, but does not significantly affect the number of pods, flowering age and root dry weight of mung bean plants. NPK Phonska fertilizer contains nutrients needed by plants for plant growth and production. Nutrient content contained in NPK Phonska fertilizer used can only be used for vegetative growth of plants namely plant height and number of branches. Where N nutrient availability increases, so N uptake will increase causing plant height to increase.

It is known that P is absorbed by plants in the form of $H_2PO_4^-$ and $HPO_4^=$. In general, the function of P in plants can be stated as follows: stimulates root growth, especially seed roots or young plants. Accelerate and strengthen the growth of young plants into mature plants and increase the percentage of flowers into fruit or seeds. Helps assimilation and breathing while accelerating the flowering and cooking of fruit, seeds or grain. As a raw material for the formation of a number of certain proteins.[10]

The nutrient element P has a role in replenishing and developing crop yields. Phosphates are found in relatively higher amounts in fruit and plant seeds. But inorganic P is relatively small in number and most is in the form of phytate. The lack of P element generally causes the volume of plant tissue to be smaller and the color of the leaves to become dark.[11] P can also be said to stimulate the growth and development of plant roots. This situation is related to the function of P in cell metabolism. Nutrients that will be absorbed by the roots are determined by all factors that affect the availability of nutrients until the nutrients are on the root surface so that it affects the growth and development and yield of plants.[12]

P is a macro nutrient that is absolutely needed by plants. Phosphorus is needed for cell division, root formation, strengthening of stems, plays a role in carbohydrate metabolism, energy transfer, and the formation of flowers, fruits and seeds. P nutrient deficiency in plants will affect plant growth and development.[13] Anion P is so dissolved that it becomes a target of fixation so that it is not easily carried by mass flow or diffuse consequence. This anion is slightly leached which results in low effectiveness of fertilization if it is only stocked on the ground. The high fixation in old soils causes only 10%-20% of the remaining P fertilizer to be given to the soil which can be utilized by plants the following season. The element P makes up 0.2% of the plant part as a component of several enzymes and proteins play a role in providing chemical energy involved in the production of light, heat and motion, as an enzyme activator plays a role in the primodia phase and the formation of reproductive parts of plants to determine the initial phase of maturation, plays an important role in the formation of sufficient seeds and fruit P supply will stimulate the development of the root system.[14]

NPK fertilizer is recommended for use during planting or before planting. This is because this fertilizer is a fertilizer that is needed at the beginning of the growing stage. The gift is better if placed on infertile soil. The advantage of applying fertilizer as early as possible in plant growth will encourage the growth of initial roots which will give plants a better nutrient absorption.[9] P is an important component of Adenosine Triphosphate (ATP) which plays a role in the formation of nucleic acids (DNA and RNA) and stimulates cell division and helps the process of assimilation and respiration in the early growth of plant seeds.

The application of NPK Phonska fertilizer on mung beans is very good for accelerating growth and yield. Even though the application of this fertilizer has not significantly affected the number of pods, flowering age and dry root weight of plants. However, from observations there has been an increase in each increase in the treatment dose.

Based on the regression analysis shows that the form of the relationship between the dose of NPK Phonska fertilizer with the plant height of mung beans is quadratic with the equation $y = -0.0006x^2 + 0.0465x + 17.72$ ($R^2 = 0.7962$) (Figure 4). This means that increasing the dose of NPK Phonska until the optimum dose will increase the plant height of mung beans. But if the dose of NPK Phonska continues to be added to exceed the optimum dose, the plant height of mung bean will decrease. The coefficient of determination (R^2) 0.7962 means that 79.62% of NPK Phonska influences the mung bean plant height.

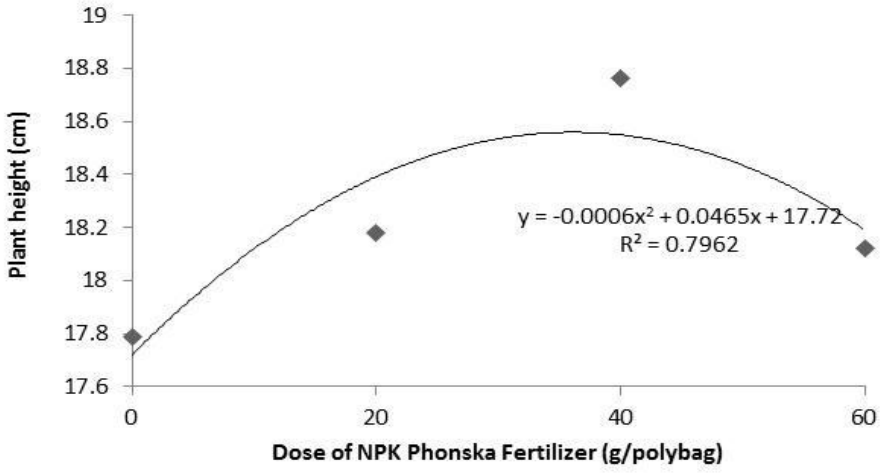

Figure 4: The form of the relationship between the doses of NPK Phoska fertilizer with plant heightt of mung beans.

Based on the regression analysis shows that the form of the relationship between the dose of NPK Phonska fertilizer with the number of branches of mung beans is quadratic with the equation $y = -0.0007x^2 + 0.0448x + 3.8765$ ($R^2 = 0.9993$) (Figure 5). This means that increasing the dose of NPK Phonska until the optimum dose will increase the number of branches of mung beans. But if the dose of NPK Phonska continues to be added to exceed the optimum dose, the number of branches of mung bean will decrease. The coefficient of determination (R^2) 0.9993 means that 99.93% of NPK Phonska influences the number of branches of mung bean.

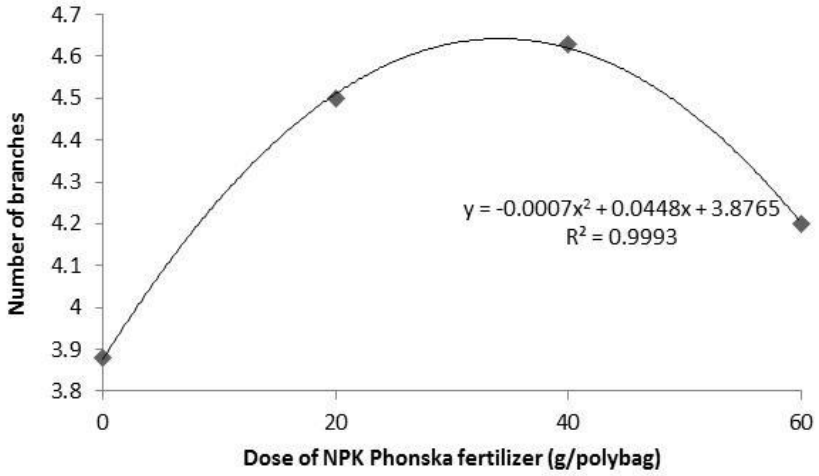

Figure 5: The relationship between the number of bulbs per plant and weights of bulbs per plant.

CONCLUSION

The application of rice husk ash and NPK Phonska fertilizer independently was able to increase the growth of green beans with a dose of 75 g/polybag and NPK Phonska fertilizer 40 g/polybag. While rice husk ash and NPK Phonska fertilizer combination has not been able to increase growth and yield of mung beans.

Based on the regression equation, the optimum dose of rice husk ash and NPK Phonska fertilizer to increase plant height and number of branches of mung beans are 69.33 g/polybag, 39.67 g/polybag, 38.75 g/polybag, and 32.00 g/polybag, respectively.

REFERENCES

1. Rukmana, R. 2002. Budidaya kacang-kacangan. Kansinus. Yogyakarta.
2. Anonimus. 2018. Pertumbuhan produksi kacang hijau nasional masih mini 1. (Serial online) https://industri.kontan.co.id/news/pertumbuhan-produksi-kacang-hijau-nasional-masih-mini-1. Diakses pada tanggal 14 Desember 2018 pukul 22.40 WIB. Medan.
3. Setiadi. 2008. Abu Sekam Padi. Virtual Fine Art Gallery. Jakarta.
4. Wara. 2013. Pemanfaatan Sekam Padi Dalam Sebagai Media Tanam dan Pupuk. (Serialonline)https://warasfarm.wordpress.com/2013/07/31/pemanfaatan-sekam padi-dalam-sebagai-media-tanam-dan-pupuk/. Diakases pada tanggal 14 Desember 2018 pukul 23.20 WIB. Medan.
5. Prasetyoko. 2007. Abu Sekam Padi Sebagai Sumber Silika Pada Sintesis Zeolit Tanpa Menggunakan Templat Organik. Akta Kimindo. Vol 3(1), hal 33-36.
6. Dharmaswara. 2012. Pengaruh Pemupukan Abu Sekam Padi terhadap pertumbuhan dan produksi kacang hijau. Skripsi. Institut Pertanian Bogor. Bogor.
7. Harsono. 2002. Dasar-dasar Ilmu Tanah. Raja Grafindo Persada, Jakarta.
8. Novizan. 2004. Petunjuk Pemupukan yang Efektif. Agro Media Utama. Jakarta.
9. Lingga. 2007. Petunjuk Penggunaan Pupuk, Penebar Swadaya. Jakarta.
10. Ahadiyat. 2012. Karakteristik Hasil Biji Kacang Hijau pada Kondisi Pemupukan P dan Intensitas Penyiangan Berbeda. Jurnal Agrivigor 11(2). Program Studi Agroteknologi. Fakultas Pertanian. Universitas Jendral Sudirman.
11. Jumin, H.S, 2008. Dasar-dasar Agronomi. Raja Grafido Persada. Jakarta.
12. Sutedjo, M.M. 2002. Pupuk dan Cara Pemupukan. Rineka Cipta. Jakarta.
13. Anjarsari. 2007. NPK Phonska. Serial Online (http://www.petrokimiagresik.com/Pupuk/Phonska.NPK). Diakses pada tanggal 3 Februari 2019. Pukul 20:00 WIB. Medan.
14. Hanafiah. 2005. Teknik Budidaya Tanaman. DPSMK. Depdiknas.