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

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Abstract

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

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

A. Introduction

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

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

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

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

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

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

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

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

B. Material and Method

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

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

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

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

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

C. Result

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

Table 1. Summary of Responses Plants Due Fertilization Natural Guano

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

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

1. Plant Height

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

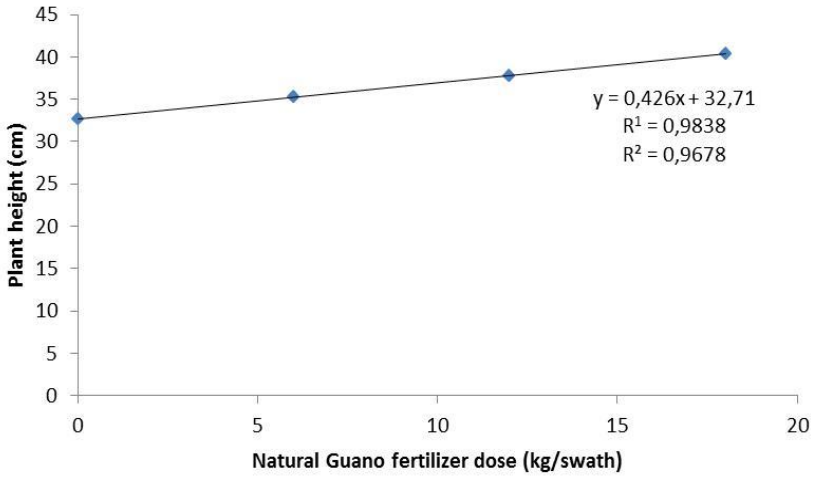

Figure 1. The relationship between the dose of natural fertilizer guano and the average height of the plants.

2. Number of Leaves

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

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

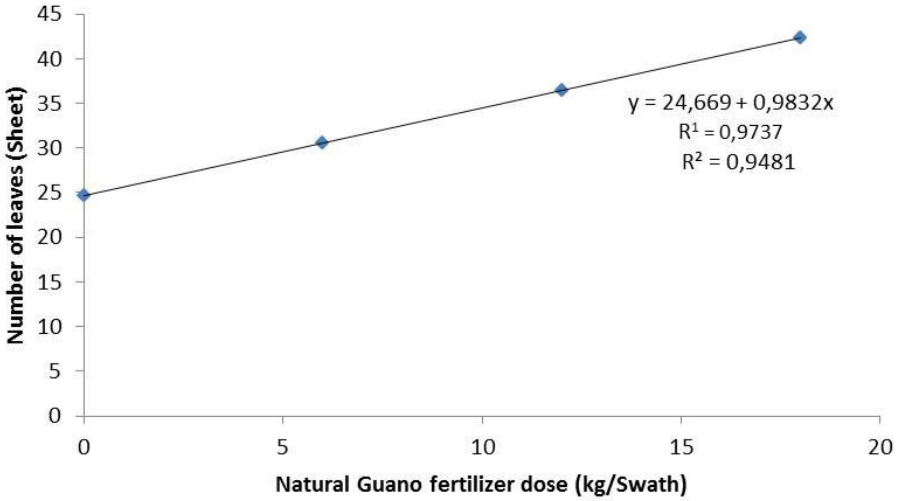

Figure 2. The relationship between the dose of natural fertilizer guano and the average number of leaves

3. Number of Tillers

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

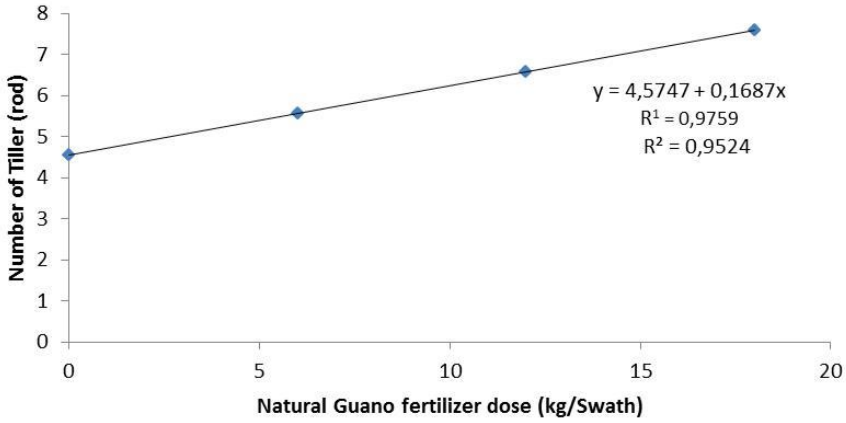

Figure 3. The relationship between the dose of natural fertilizer guano and the average number of tillers

4. Rod Diameter

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

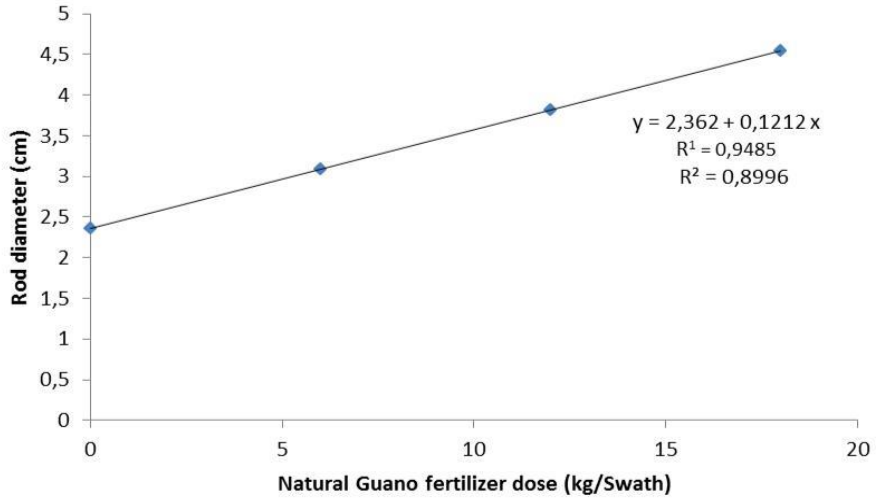

Figure 4. The relationship between the dose of natural fertilizer guano and the average diameter of the rod

5. Result Fresh Stover per Plot (kg)

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

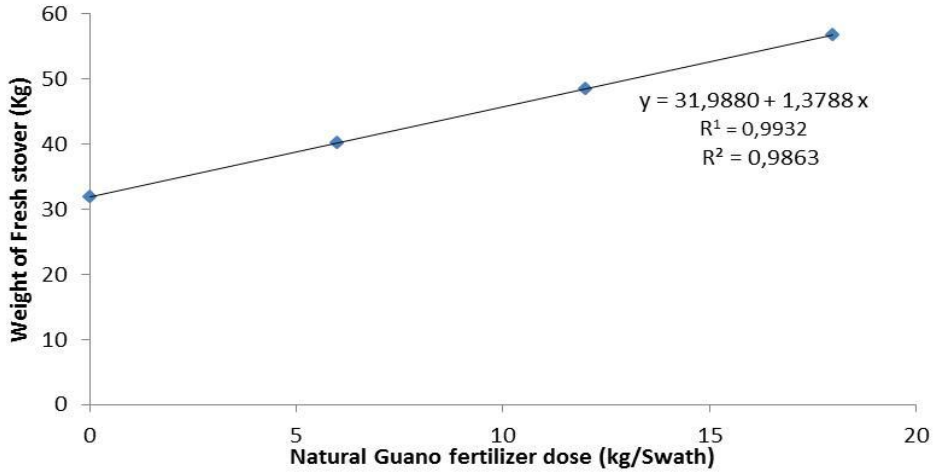

Figure 5. The relationship between the dose of natural guano fertilizer and yield (Weight of fresh Stover)

D. Discussion

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

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

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

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

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

E. Conclusion

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

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