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Responses of Corn (*Zea mays* L.) to Zeolite and Urea Fertilizer in Karo Highlands

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Abstract

The research aims to determine the effects of Zeolites and Urea fertilizer on the production of maize. It was expected that the results of this study could reduce the use of urea fertilizer in producing corn, so that in the buildup to being more efficient and effective, it could also maintain productive soil conditions. The study was conducted from June-December 2017 in Gurusinga Village, Berastagi District, Karo Regency, North Sumatra, Indonesia, in the elevation of 1,250 meters above sea level, flat topography, andosol soil type (pH of 5.7). The experimental design was a factorial randomized block design. The first factor was the dose of Zeolite (Z) consisting of Z0 = 0 g / plot (control), Z1 = 105 g / plot, Z2 = 210 g / plot, Z3 = 315 g / plot, Z4 = 420 g / plot. The second factor was Urea fertilizer (U) consisting of U0 = 0 g / plant (control), U1 = 2.1 g / plant, U2 = 4.2 g / plant, U3 = 6.3 g / plant, U4 = 8, 4 g / plant with 3 replications. The results showed that the Zeolite and Urea fertilizer had a significant effect on the growth of corn plants ($p < 0.05$) on plant height (cm), stem diameter (mm), and leaf wide (cm2), while the number of leaves (strands) had no significant effect ($p > 0.05$). Zeolite and Urea fertilizer have a significant effect on the diameter of corncobs, length of corncobs, weight (gross and clean) per (sample and plot) and weight of 100 pieces ($p < 0.05$), while the number of rows/cob has no significant effect ($p > 0.05$).

Keywords: corn, zeolite, urea fertilizer, Karo Highlands

1. Introduction

Food crops have a crucial role as meeting domestic food, feed, and industrial needs, which tend to increase each year in line with population growth and the development of the food and feed industry so that in terms of National Food Security, the function becomes very important and strategic. Indonesia's population in 2010-2035 is projected to 252.164.800 people, and the total of corn required for direct consumption is 416,071 tons per year (Bappenas 2014). Corn commodity has a very strategic utility, both in the food security system and its role as the driving wheel of the national economy. Corn is used as an ingredient in the food, feed, fuel and polymer (FAO, 2017).

Ibrahim et al. (2012) stated that corn is a fascinating crop model, especially in the fields of biology and agriculture. Since the initiation of the 20th century, the plant has been the object of intensive genetic research and helped form the revolutionary hybrid cultivar technology. In terms of physiology, corn was classified as a C4 plant hence it is very efficient in utilizing sunlight. In agronomic studies, the dramatic and characteristic response of maize to the deficiency or poisoning of important nutrients makes it a preferred fertilizer physiological experiment plant.

The corn (*Zea mays* L.) is used as food by humans or animals. In Indonesia, it was listed as the second staple food after rice. In the world, corn recorded as the third staple food after wheat and rice (Sembiring *et* al., 2016). The value of the corn is commonly in three, foodstuff, animal feed, and industrial raw materials.

In Indonesia, corn is the second important commodity after rice. With the fast-growing livestock industry, however, it is a major component (60%) of the feed ration. It was estimated that more than 55% of domestic corn needs were used for feed, for food consumption about 30%, and the rests were for other purposes such as industries and seeds. The role of corn, therefore, has actually altered; it is more as an industrial raw material than as food (Kasryno, *et* al., 2016).

The lack of nutrients and water, poor structure, and aeration in the soil were problems of production of maize. The use of balanced fertilizers was also not fully implemented by farmers. It is still become an obstacle to the development of corn (Prima *et* al., 2015). Despite the land problem, an increase in agricultural production is still faced with low nitrogen fertilizer efficiency. Only about 40% of urea given to the soil can be utilized by the plants (Widyanto *et* al., 2013).

Karo District is one of the corn production areas in North Sumatera. Most if the soil in the region was saturated and has poor nutrients, and then farmers were extremely dependent on inorganic fertilizers. The used of urea fertilizer was around 1 ton/ha could be producing corn of 10-12 tons/ha. The acidity of the land is also unbalanced. It was necessary to add by dolomite before planting. It was functioned to neutralize the pH of the soil. Corn plants were needed inorganic fertilizers around 450 kg/ha Urea, TSP, and KCL fertilizers were 100 kg/ha, respectively. These fertilizers were quite rare in markets, and their price was high, particularly the non-subsidized one (Sembiring *et* al., 2016).

The natural zeolite is a mineral formed of volcanic materials in millions of years. In the country, it was spreading along volcanic arcs from Sumatra Island, Java, Nusa Tenggara, and Maluku. It was estimated that more than 50 areas had natural zeolite deposits, with volumes about 400 to 500 million tons. They are generally in the form of clinoptilolite and mordenite (Marfuatun, 2011). It has physical properties with nanometer-sized pores storing water, and chemical properties due to the negative charge on the pore walls occupied by cations and can exchange cations that exist outside the zeolite structure (Winarni *et* al., 2007).

The micro and macro elements of zeolites were increasing the nutrient of plants. It was also reducing heavy metal poisoning and solubility levels of Fe (iron) and Al (aluminum) ions as well as to release nutrients needed regularly and gradually. It was also reducing the loss of fertilizer due to the use of zeolite water in agricultural land. The recommendation of mixtures of zeolite and urea was 1: 1. Using 30% of zeolite and 70% of Urea was widely used by the fertilizer industry. The combinations were thrifty the zeolite with fairly good production (Suwardi. 2009).

The current business of growing corn is the inadequate use of inorganic fertilizers; without it, the productions are fall or even fail. The increasing use of urea was damage to the soil. The study effects of zeolites on reducing urea, therefore, needed to find out.

1.1 Research Issues

Can zeolites function as soil amendments, improve land, and expurgated the usage of urea fertilizer, and upsurge yields and the income of corn farmers in the Karo Highlands?

1.2 Research Hypothesis

The influence of zeolite as soil ameliorant can expurgate the use of urea fertilizer and the effects of interaction between zeolite and urea to growth and yield of maize in Karo highlands.

The purpose of this study was to find out the optimum dosage of zeolite, the minimum dosage of urea fertilizer, and the effect of interaction between zeolite and urea fertilizer for the efficient use of zeolites on the growth and yield of maize in the Karo highlands.

The benefit of this research was using zeolites to reduce the urea fertilizer in producing maize in the Karo highlands. The findings of the study would become a reference for further research on corn and zeolite. It is also used as materials for community services and as information for farmers in their cultivation practices.

2. Literature Review

Corn (Zea Mays L) is one of the important carbohydrate producing plants in the world besides wheat and rice. Grains of corn is the staple food for people of Central and South America, as for some regions in Indonesia and Africa. Currently, corn is also an important component of animal feed, a source of food oil and cornstarch base ingredients. Various products are using corn as raw materials for various industrial products (Ranum *et* al. 2014). The corn is growing well in almost any type of soil. It needs loose soil and rich in humus. However, it is not growing properly on solid soil and withstands water because the roots are hard to grow (Magdoff and Van Es, 2009).

The technical cultures and optimum fertilizer are upsurge productions in almost all types of soil with a pH of 6-7. The corn is not grown appropriately in overly acidic or basic soils (pH below 4.5 and over 8.5). However, it special fertilizer is required in such an environment. The critical soil pH for maize was 5.5 (Goulding, 2016).

Meanwhile, the zeolites are a group of hydrated aluminous silicate compounds with the main elements of alkali and alkaline of earth cations and had properties as absorbers, separators, and catalysts. In agriculture, zeolites are used as absorbers, ion exchangers, and soil cleaners, which are leads to fertilizer efficiency and improved production (Al-Jabri, 2010).

The zeolite is being mixed with inorganic fertilizers or organic fertilizers. Using zeolite simultaneously with the right dosage could be maintaining soil moisture for long enough, and when the soil temperature is relatively stable post watering. Meanwhile, compared to the application of fertilizer without mixing with zeolite, the temperature of the soil around the roots upsurges dramatically, which causes the C-organic content to rapidly oxidize, and its availability in the soil could not be maintained longer (Sembiring *et* al., 2017). It could preserve fertilizers. This proficiency is creating a low cost of fertilizers. However, it is essential to be renowned that it is a companion ingredient for Urea, SP-36, and KCI fertilizers, not to substitute them. Zeolite is also used to reduce the level of pollution of heavy metals such as Pb, Cd, Zn, Cu2 +, Mn2 +, Ni2 + in the environment. Modifications of zeolites as adsorbent anions such as NO3-, Cl-, and SO4- have been developed through the process of zeolite-H calculations at 5500C (Sembiring et al; 2017).

The main chemical of zeolite content are Si02 = 62.75%; Al 203 = 12.71%; K20 = 1.28%; CaO = 3.39%; Na2O = 1.29%; MnO = 5.58%; Fe203 = 2.01%; MgO = 0.85%; Clinoptilotite = 30%; Mordernite = 49%. Its CEC value is 80-120 me / 100 gr, and it is abundant for assessing soil fertility. The value of KPK would control the ability of materials to stock fertilizer given previously and it is absorbed by plants (Arryanto *et* al; 2012).

The functions of zeolites for agricultural are aggregate levels of dissolved oxygen in irrigated water in paddy fields, upholding soil pH balancing, being able to bind heavy metals that are poisonous to plants such as Pb and Cd, binding to cations elements in the fertilizers such as NH4 + from urea, K + from KC1, so that fertilizer absorption becomes efficient and environmentally friendly because it neutralizes the elements that pollute the environment, improves soil structure (physical properties) due to Ca and Na content and increasing soil CEC (chemical properties) and increasing crop yields (Sembiring *et* al; 2017).

The corn needs all nutrients, nitrogen (N), phosphorus (P), and potassium (K). The three major elements (three main elements) are usually specified in the form of fertilizers. The plants' intakes of these nutrients are varying depending on the level of soil fertility, environmental conditions, and the state of the plant itself (Sutedjo, 2002).

The productivity of maize depends on the availability of nutrients, especially nitrogen (N). Adding fertilizer of N (inorganic and organic) to grow and produce maize is commonly practiced in Indonesia. It contributes to a 30-50% upsurge of maize yield (Erisman et al. 2008; Syafruddin, 2015). The maize absorbs N nutrients in the upper crop Stover of 5.5-7 kg and seeds of 12.1-14.5 kg to produce one-ton corn (Syafruddin *et* al. 2006; Syafruddin, 2015). The N nutrients in corn lost through evaporation are 11–48%, DE nitrification 0.8–1.2%, and N2O emissions of 0.9–1.7% of the N-urea dose given to plants (Cai et al. 2002; Syafruddin, 2015). Approximately 15% N of corn is washed in the form of NO3 - (Zhou and Butterbach-Bahl, 2013). N2O and NH3 gas emissions and NO3 leaching - influenced by the dose of N fertilizer. N2O evaporation and NO3 leaching - increase exponentially, while NH3 increases linearly with increasing N quantities (Wang *et* al; 2014a, Syafruddin, 2015).

Lack of nitrogen would be reducing yield. Corn using around 25 percent of all N needed during the flowering stage. When the corn cobs are formed, 2/3 of all N needs have been sucked. Urea (CO (NH2) 2) fertilizer contains 46% nitrogen (N). This fertilizer is very hygroscopic by the high N content. Urea is very soluble in water and reacts quickly, is also volatile in the form of ammonia (Novizan, 2007)

Fertilization is one of the most important factors of production in addition to land, labor, and capital, balanced fertilization has a role in increasing the yield of corn plants, and fertilizer recommendations are made rationally and balanced based on nutrient requirements in the soil and plant needs for nutrients to increase effectiveness and efficiency fertilizer use and production without causing environmental damage due to excessive fertilization (Tuherkih and Sipahutar, 2008).

Nitrogen is an essential macronutrient whose availability could have a real effect when using inceptisol soils. The nutrient is car-related and results in an easy loss, especially if with improper use, even as a result of almost all the crops both in paddy fields and dry land are in dire need of N nutrient elements (Kasno, 2010). Nitrogen (N) is important to grow corn. During the process of growing and ripening, the seeds are continuously absorbed the nitrogen. It is continuously needed in all stages of growth until the production of seeds. Using the right dose of fertilizer during maize growth cloud be increasing corn yield (Saragih, *et* al. 2013). The nutrient of N is car-related and results in an easy loss, especially by improper use. It is vital, either to paddy fields or dryland plants (Kasno, 2010). Nitrogen is a component that is associated with a high photosynthetic activity, strong vegetative growth, and dark green color on the leaves (Ademiluyi, 2015).

Besides, young plants also need a higher percentage of phosphate (P). When the plant is deficient of P, it would be observed previously in the knee-high stage. The distribution of phosphate through fertilization, therefore, would be able to stun the situation even though this plant will only take nutrients from the plant to an advanced level. The recommended amount of phosphate fertilizer is around 75 kg - 100 kg TSP / ha (SP-36 200 kg / ha) applied to basic fertilizer (the day before the plant or at the same time planting, all at once. A large amount of potassium will be taken by the plant since the plant is as high as knee until the flowering is finished; a dosage of K fertilizer of 75-100 kg KCl per hectare will be given at the time of planting as base fertilizer in potassium-rich soil, fertilization with potassium can be removed. Fertilizer will be given in the hole made with tugal on the left / right of the seed hole / plant with a distance of 7 cm and as deep as 10 cm (Rasyid, B., 2012).

3. Materials and Research Methods

- This research was carried out in the Farmer Garden of Gurusinga Village, Berastagi District Karo Regency - North Sumatra. The height of the place is ± 1,250 meters above sea level with flat topography and andosol soil type with a pH of 5.7 from July 2017 to December 2017.
- The ingredients used are Pioner 33 hybrid seeds, zeolites, Urea inorganic fertilizers, TSP 100 kg / ha, KCl. 100 kg / ha, water.
- Tools used are hoes, rakes, fat, gauges, schlieper, scales, hand sprayers, plywood, plastic ropes, bamboo, saws, machetes, scissors, and stationery.

3.1. *Research Methods*

The study was conducted using factorial randomized block design with 2 treatment factors, as follows:

1. Zeolites, with 5 levels: Z_0 = 0 kg / plot (control), Z_1 = 105 g / plot, Z_2 = 210 g / plot, Z_3 = 315 g / plot, Z_4 = 420 g / plot.
2. Urea fertilizer 5 levels: U_0 = 0 g / plant (control), U_1 = 2.1 g / plant, U_2 = 4.2 g / plant, U_3 = 6.3 g / plant, U_4 = 8.4 g / plant.

The number of treatment is 5 x 5=25 combinations, a number of replications/blocks 3, 75 experimental plots, 16 plants/plots, 5 sample plants/plots, spacing is 70 cm x 30 cm, plot size 350 cm x 150 cm, the distance between plots is 50 cm, the distance between replicates/blocks is 100 cm, land area is 618.75 meters^2 and 1875 the number of plants to be used.

4. Research Results and Discussion

4.1 Results

4.1.1 Plant Height

The effect of zeolite Urea fertilizer on corn plant height was observed from 2 weeks to 8 weeks after planting (wap) at 1 week intervals with the average observations presented in Table 1.

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Table 1. Average Plant Height from Influence of Zeolite and Urea in Corn Plants, 2 to 8 wap

Treatment	2 wap	3 wap	4 wap	5 wap	6 wap	7 wap	8 wap
Z_o	11.6a	35.9a	60.5a	96.0a	129.5b	157.6b	185.8c
Z_1	11.6a	36.5a	61.5a	98.7a	137.2ab	166.4ab	195.7bc
Z_2	11.8a	36.6a	61.9a	100.8a	139.8ab	169.1ab	198.3abc
Z_3	11.9a	37.2a	62.5a	102.9a	143.3a	172.4a	201.4ab
Z_4	11.8a	37.3a	63.5a	103.6a	143.6a	174.0a	204.3a
U_o	11.8a	36.1a	59.9a	94.9a	130.0b	158.4b	186.9b
U_1	11.8a	36.5a	61.2a	99.6a	137.2ab	166.4b	195.7ab
U_2	12.1a	36.9a	62.3a	100.4a	138.6ab	167.6ab	196.5abc
U_3	11.6a	37.3a	63.0a	102.2a	141.3ab	170.9ab	200.4ab
U_4	11.4a	36.8a	63.5a	104.9a	146.3a	176.2a	206.0a

Note: Letter notation in the same average column shows no significant difference at the 5% level in the DMRT Test

The average height of zeolite plants aged 2 to 8 weeks from the results of statistical analysis had no significant effect ($p > 0.05$) at 2 to 5 weeks after planting, after 6 weeks of age, the difference was significant ($p < 0.05$). Significant differences will be seen in plants at the age of 8 weeks after planting (male flower discharge). At 8 weeks after planting, it was seen that using a zeolite dose of 420 g / plot (Z_4), the highest plant height would reach an average of 204.3 cm. The fewer zeolite doses are given, the plant height will decrease. Giving Zeolite as much as 315 g / plot (Z_3) will be given to plants whose plant height decreases to an average of 201.4 cm, then to use a dose of 210 g / plot (Z_2) for plants that have an average height of 198.3 cm. The results of the three experiments showed an insignificant height difference ($p > 0.05$).

Without the use of zeolite (Z_o), the lowest plant height is an average of 185.8 cm, with the lowest zeolite administration of 105 g / plot (Z_1), with a plant height slightly higher than Z_o with a plant height at Z_1 is an average 195.7 cm, where Z_o and Z_1 had no significant relief ($p > 0.05$) but were significantly different in Zo with respect to Z_2, Z_3 and Z_4 ($p < 0.05$).

From the results of this study, the effect of zeolite doses on plant height growth in 8 trials was to use a dose of 210 g / plot (Z_2). Based on statistical analysis, the higher the dose of Zeolite given the more noticeable differences, the response curve to plant height with linear equations $\hat{Y} = 0.040\ Z + 188.5 r = 0.91$ seen in Figure 1.

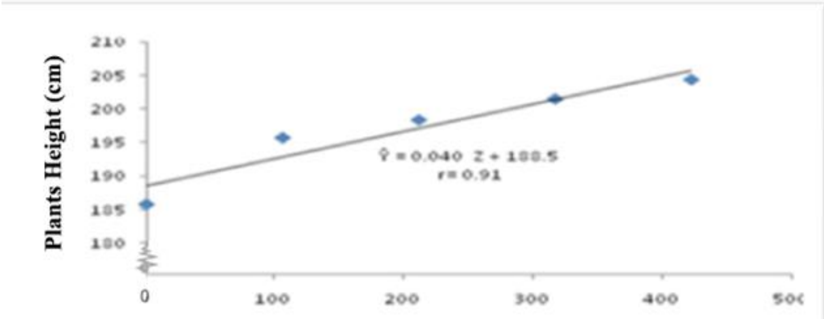

Figure 1. The effect of Zeolit dose towards plants height increased 8 weeks

Average plant height with urea administration, observations were made starting at 2 weeks to 8 weeks after planting. Since the plants were 2 weeks old to 5 weeks, based on the results of statistical analysis, the effect was not significantly different ($p > 0.05$), the effect of giving Urea with an increase in plant height increased since the plant was 6 weeks old and began to notice significant differences (p) and the effect is getting real until the plants are 8 weeks old with the use of Urea dosage of 8.4 g / plant (U_4) and with the highest average plant height of 205.97 cm, with no significantly lower dose such as giving Urea 6.3 g / plant (U_3) average plant height of 200.4 cm, administration of 4.2 g / plant (U_2) average height of 196.5 cm, all three will show no significant difference ($p > 0.05$).

The control treatment (Uo) of the lowest plant height with an average of 186.9 cm and (U_1) dose of Urea 2.1 g / plant with a plant height of 195.7 cm, where Uo and U_1 were not significantly different ($p > 0.05$) but Uo was significantly different ($p < 0.05$) against U_2, U_3 and against U_4.

The use of Urea dose at 4.2 g / plant (U_2) for the current corn plant height at 8 mst can be used as a recommended dosage and this will be supported by statistical analysis that the higher the dose of Urea used will respond to higher plant heights such as seen in Figure 2.

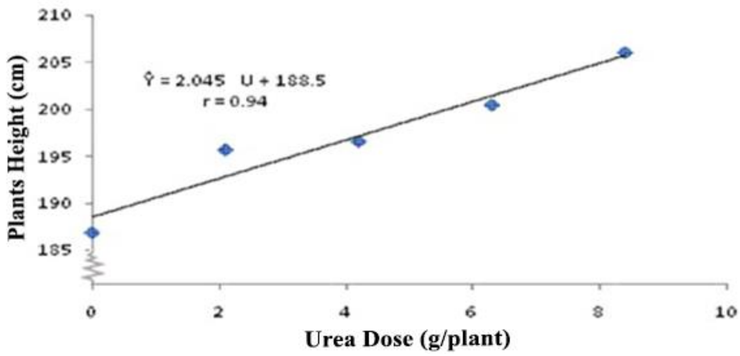

Figure 2. The effect of using urea dose towards plants height increased 8 weeks

The combination treatment with the interaction between the use of zeolite and urea had a different effect that was not significant at $p > 0.05$. In this case, it will show the giving of the two factors tested to be mutually beneficial in plant height growth.

4.1.2 Rod Diameter

Data on the results of observations of stem diameter are carried out starting from 2 to 8 weeks after planting (mst) with measurement intervals once a week with the average results presented in Table 2.

Based on statistical analysis since the plants were 2 weeks to 5 weeks, that gave no significant effect ($p > 0.05$) on the administration of various doses of zeolite, but after the age of 6 mst the effect of zeolites would provide a significant difference ($p < 0.05$) to 8 mst . Observations on plants aged 8 mst have seen the effect of the increasing use of Zeolite doses and the use of doses of 420 g / plot (Z_4) with the highest stem diameter of an average of 3.34 cm. Data on the use of Zeolite doses shows that the smaller the dose is given, the lower the stem diameter of corn plants. It was also seen that the use of Zeolite 315 g / plot (Z_3) on the stem diameter of 3.32 cm and the use of a dose of 210 g / plot (Z_2) on the average stem diameter of 3.26 cm would indicate that where the three treatments Z_4, Z_3 and Z_2 would provide no significant effect ($p > 0.05$).

Table 2. Average Stem Diameter Influence of Zeolite Addition to Corn Plants at 2 to 8 wap

Treatment	2 wap	3 wap	4 wap	5 wap	6 wap	7 wap	8 wap
Z_o	1.87a	2.45a	2.66a	2.84c	3.03b	3.03c	3.21b
Z_1	1.99a	2.57a	2.73a	2.90bc	3.15ab	3.06c	3.21b
Z_2	1.83a	2.41a	2.59a	2.95abc	2.98ab	3.10bc	3.26ab
Z_3	1.83a	2.41a	2.57a	2.98ab	2.99a	3.14ab	3.31ab
Z_4	1.86a	2.44a	2.61a	3.04a	3.02a	3.21a	3.37a
U_o	1.91a	2.49a	2.67a	2.83b	3.07b	3.10c	3.18b
U_1	1.90a	2.47a	2.62a	2.91ab	3.03b	3.07bc	3.23b
U_2	1.92a	2.50a	2.69a	2.97ab	3.08ab	3.14abc	3.31ab
U_3	1.84a	2.42a	2.62a	2.98ab	3.01ab	3.15ab	3.32ab
U_4	1.81a	2.39a	2.55a	3.01a	2.97a	3.17a	3.34a

Note: Letter notation in the same average column shows no significant difference at the 5% level (lowercase) on the DMRT Test

The treatment without zeolite (Z_o) at the lowest stem diameter with an average of 3.21 cm was not significantly different from the Z_1 treatment at the same average stem diameter.

The effect of urea administration on stem diameter for plants aged 2 to 8 mst will show the results of statistical analysis that the effect is not significantly different ($p > 0.05$) for plants 2 to 5 weeks old, but plants 6 weeks old are seen to have a significant effect ($p < 0.05$). Giving a dose of urea will be more evident in the observation of plants aged 8 mst. In 8-week-old plants, a dose of urea 8.4 g / plant (U_4) will be seen, with the highest stem diameter of an average of 3.34 cm and not significantly different from all uses of the urea dose (U_3, U_2). Without the use of urea (Uo) the lowest stem diameter is an average of 3.18 cm, and the use of a low urea dose with 2.1 g / plant (U_1) will have an average stem diameter of 3.23 cm. The treatment of U_o was not significantly different from the treatment of low-dose Urea (U_1, U_2 and U_3).

The treatment carried out in combination with the interaction between the use of zeolite and urea will have a significantly different effect on p> 0.05. This shows that the giving of the two factors tested will be mutually beneficial to the diameter of the stem.

4.1.3 Number of Leaves

Data on the number of leaves of corn plants due to the influence of zeolite and urea administration with observations since the plants were 2 to 8 weeks at 14-day intervals with average results in Table 3.

Table 3. Average Number of Leaves from Effect of Addition of Zeolites on Corn Plants 2 to 8 weeks

Treatment	2 wap	3 wap	4 wap	5 wap	6 wap	7wap	8wap
Z_o	2.04a	4.54a	7.04a	8.82a	10.61a	2.21a	3.81a
Z_1	2.14a	4.58a	7.28a	9.01a	10.74a	2.34a	3.94a
Z_2	2.09a	4.48a	7.28a	9.00a	10.73a	2.15a	3.56a
Z_3	1.97a	4.34a	6.71a	8.43a	10.16a	1.76a	3.36a
Z_4	2.01a	4.42a	6.83a	8.56a	10.28a	1.80a	3.31a
U_o	1.99a	4.37a	6.76a	8.52a	10.28a	1.88a	3.48a
U_1	2.06a	4.52a	7.12a	8.90a	10.68a	2.11a	3.54a
U_2	2.08a	4.51a	7.08a	8.81a	10.53a	2.04a	3.54a
U_3	2.09a	4.39a	7.09a	8.82a	10.54a	2.14a	3.74a
U_4	2.03a	4.56a	7.09a	8.78a	10.48a	2.08a	3.68a

Note: Letter notation in the same average column shows no significant difference at the 5% level (lowercase) on the DMRT Test.

Data on the number of leaves on the effect of zeolites on plants aged 2 to 8 days from the results of statistical analysis showed no significant effect ($p > 0.05$). The number of leaves since the plants were two weeks after planting (MST) averaged between 1.97 and 2.14 strands due to the influence of zeolites. The number of leaves will increase when the plant is 8 weeks old, between 13.31 to 13.94 strands.

The number of leaves produced when giving urea to plants aged 2 to 8 weeks showed the results of statistical analysis were not significantly different ($p > 0.05$). The number of leaves in plants that are 2 mst ranges from an average of 1.99 strands to 2.09 strands, and the number of leaves will increase with increasing plant age. When the plant is 8 weeks old, the number of leaves ranges from an average of 13.48 strands to 13.74 strands.

4.1.4 Leaf Area

Leaf area data for plants by giving zeolites and urea in plants aged two weeks to 8 weeks after planting (MST) at 7-day intervals (in table 4). The average leaf area when giving zeolite will be different for plants aged 2 weeks to 8 weeks. And since the plants are 2 weeks to 5 weeks old will produce statistical analysis results that are not significantly different ($p > 0.05$), and have a significant difference after the plants are 6 weeks old ($p < 0.05$) until the plants are 8 weeks old. Plants 8 weeks old will use a dose of 420 g zeolite / plot (Z_4) for a maximum area of 2717.31 cm2. In administering zeolites, it is important to note that the smaller the dose, the lower the leaf area of the plant. It is seen that the effect of administering Zeolite 315 g / plot (Z_3) on leaf area 2672.76 m2, giving Zeolite at a dose of 210 g / plot (Z_2) on an average area of 2644.68 cm2 and low dose Z_1 which has an average of 2551.59 cm2, which the four doses of zeolite will give no significant effect ($p > 0.05$).

Without zeolite (Z_o) the minimum area is an average of 2384.10 cm2, with the provision of low Zeolite 105 kg / plot (Z_1), the leaf area will look slightly wider when compared to Z_o with an average Z_1 that is not significantly different ($p > 0.05$) but it will be significantly different between Z_o and Z_2, Z_3 and Z_4.

The results of this study indicate that the effect of zeolite on the leaf area has a recommended dosage of 150 g / plot (Z_1). The results of statistical analysis show that the higher the dose of Zeolite given will give a wider response to leaves with linear equations $\hat{Y} = 0.75\ Z + 2436$ with $r = 0.89$, as shown in Figure 3.

Table 4. Average Leaf Area Effect of Addition of Zeolites in Corn Plants 2 to 8 wap

Treatment	2 wap	3 wap	4 wap	5 wap	6 wap	7 wap	8 wap
Zo	58.4a	223.4a	391.2a	1168.4a	1945.6c	2164.8b	2384.1b
Z1	58.7a	226.1a	393.5a	1222.6a	2051.8bc	2301.7ab	2551.6ab
Z2	59.7a	228.2a	399.9a	1260.1a	2120.4abc	2382.5a	2644.7a
Z3	59.6a	230.2a	399.4a	1264.9a	2130.3ab	2401.5a	2672.8a
Z4	59.1a	232.0a	395.3a	1260.5a	2125.6a	2421.5a	2717.3a
Uo	59.0a	227.1a	395.2a	1190.2a	1985.2a	2205.9b	2426.5b
U1	59.6a	226.5a	399.5a	1238.7a	2077.9a	2337.7ab	2597.4ab
U2	60.3a	232.0a	404.1a	1236.4a	2068.7a	2326.8ab	2585.0a
U3	59.0a	229.0a	395.0a	1255.6a	2116.2a	2383.9a	2651.5a
U4	57.6a	225.3a	385.3a	1255.5a	2125.6a	2417.8a	2710.1a

Note: Letter notation in the same average column shows no significant difference at the 5% level (lowercase) on the DMRT Test

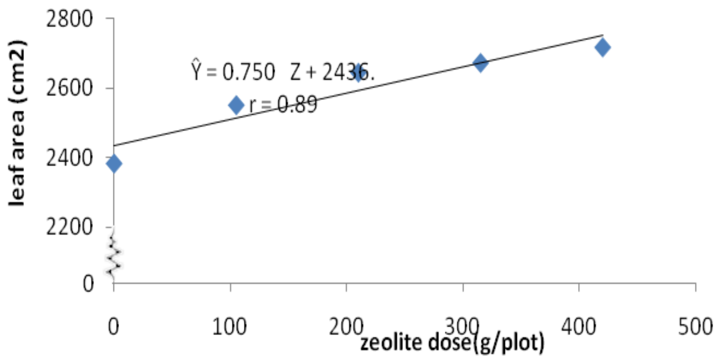

Figure 3. Effect of Zeolite doses on leaf area at 8 mst

Data on the average leaf area on the effect of giving several doses of Urea since the plants are 2 to 8 weeks old. Plants that are 2 to 6 weeks old show the results of statistical analysis on the effect that is not significantly different ($p > 0.05$), after 7 weeks of age the plant will have a significantly different effect ($p < 0.05$). Data from the results of statistical analysis show that with higher age plants there will be increasingly significant differences. This can be seen in plants that are 8 weeks old. The results of observations on plants aged 8 mst, it appears that the influence of the use of Urea doses of 8.4 g / plant (U_4) with leaf area that has a maximum average area of 2710.05 cm2. Thus, this shows that the plant was not significantly different in the use of Urea doses for lower doses of U3. It can be seen that the use of Urea 6.3 g / plant (U_3) in plants with an average leaf area of 2651.52 cm2, then the use of a dose of 4.2 g / plant (U_2) on plants with an average leaf area of 2584.99 cm2 and the use of a dose of 2.1 g / plants (U_1) on plants with an average area of 2597.40 cm2, where all four showed no significant difference ($p > 0.05$).

Without the use of Urea (U_o), the smallest leaf area is an average of 2426.47 cm2, and the dose of Urea is low with 2.1 g / plant (U_1) with a higher leaf area compared to U_o, where U_o and U_1 are not significantly different ($p > 0.05$) whereas Uo was significantly different ($p < 0.05$) with respect to U_2, U_3 and U_4.

The effect of the use of urea dose on leaf area increase in plants aged 8 mst using 2.1 g / plant (U_1) as the recommended dose, and shows the results of statistical analysis that the higher the dose of urea given, the response to leaf area will be more extensive; with the linear equation $\hat{Y} = 29.58 + 2469.0\ U$ with $r = 0.86$, seen in Figure 4.

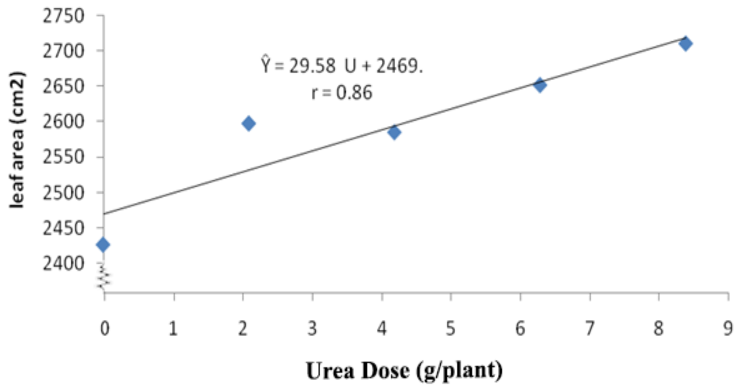

Figure 4. Effect of urea dose on leaf area at 8 wap

The interaction between the use of zeolite and urea doses had a significantly different effect at $p > 0.05$ on the leaf area parameters. This case shows the provision of the two factors tested mutually beneficial in the increase in the leaf area of the plant.

4.1.5 Diameter, Length and Number of Lines / Cobs

The average measurement results for the diameter of the cobs of corn. The length of corncobs and the number of rows / corncobs had a significantly different effect on zeolite administration and urea dose ($p < 0.05$) at harvest presented in Table 5.

Table 5. Average COB Diameter, COB Length, and Number of Rows / Samples of the Effect of Adding Zeolites and Urea to Corn Plants

Treatment	D. Corn cobs(cm)	Long Corncob(cm)	Number of lines/ corncobs (lines)
Z_o	4.28 b	18.15 c	14.29 a
Z_1	4.35 b	18.26 c	14.44 a
Z_2	4.44 ab	18.67 bc	14.65 a
Z_3	4.51 ab	19.11 ab	15.27 a
Z_4	4.61 a	19.90 a	15.24 a
U_o	4.25 c	17.92 c	14.38 a
U_1	4.37 bc	18.39 bc	14.29 a
U_2	4.43 abc	18.83 ab	14.83 a
U_3	4.53 ab	19.10 ab	15.13 a
U_4	4.61 a	19.85 a	15.24 a

Note: Letter notation in the same average column shows no significant difference at the 5% level (lowercase) on the DMRT Test

The giving of zeolites (Table 5) on the real effect ($p < 0.05$) on the diameter of corncobs and the length of corncobs, but not significantly different ($p > 0.05$) on the number of rows / corncobs. The average diameter of corncobs with the use of several doses of the largest zeolite received treatment using zeolite doses 420 g / plot (Z_4) an average of 4.61 cm, followed by treatment giving a dose of 315 g / plot (Z_3) an average of 4.5 cm and treatment use dose of 210 g / plot (Z_2) with an average diameter of 4.44 cm, the three treatments were not significantly different ($p > 0.05$). Compared to treatment without Zeolite (Z_o) with the smallest diameter of cob with an average of 4.28 cm followed and greater with treatment using a dose of 105 g / plot (Z_1), the average diameter of a cob of 4.35 cm. From the treatment, Zo has no significant difference on Z_1, Z_2 and Z_3. When compared with the treatment of the use of dose for the diameter of corn cobs which get the optimum diameter by using Zeolite in the treatment Z_2 (210 g / plot), this can be caused by no significant difference ($p > 0.05$) towards the use of higher doses (Z_3 and Z_4).

In terms of Zeolite administration, it shows that the higher the zeolite administration, the larger the diameter of the cob and based on statistical analysis, this has a correlation with the linear equation $\hat{Y} = 0.0004\ Z + 4{,}273$ and $r = 0.99$ as shown in Figure 5.

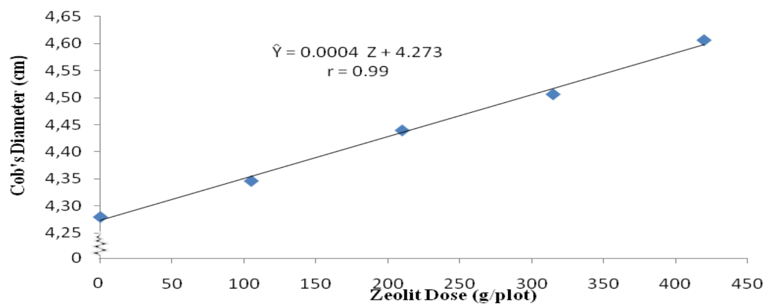

Figure 5. The effect of using Zeolit doses on cob's diameter

Giving urea fertilizer with a different dose of influence was not significant ($p > 0.05$) on the diameter of the cob, giving a dose of 8.4 g / plant (U_4) with the highest average diameter of 4.61 cm, followed by the use of urea 6.3 g / plant (U_3) diameter 4.53 cm and 4.2 g / plant (U_2) dose on average 4.43 cm cob, all three were not much different ($p > 0.05$). Without urea or control (U_o) lower, the average 4.25 cm was not much different from U_1 and U_2. The greatest result of analysis of ear diameter can use 4.2 g urea fertilizer / plant (U_2). Giving the higher dose of urea (U) gives a change in the larger and higher diameter of ear cobs, the higher $\hat{Y} = 0.041\ U + 4.26$ and $r = 0.99$ figure 6.

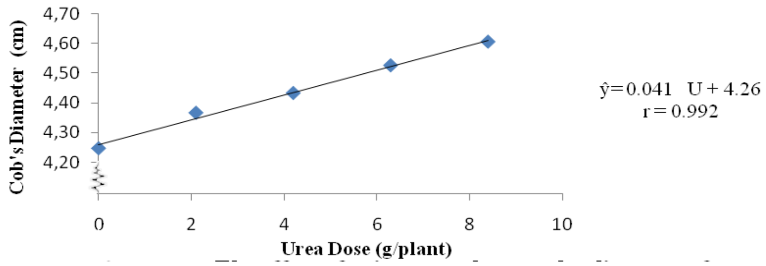

Figure 6. The effect of using urea dose on the diameter of corn cobs

The length of the cobs (Figure 5) measurements at harvest showed a real dose of zeolite ($p < 0.05$) to the length of the cobs, the average administration of high zeolites was Z4 (420 g / plot) the length of the longest cobs of 19.90 cm did not differ from Zeolite 315 g / plot (Z_3) on average 19.11 cm, but Z_4 was much different ($p < 0.05$) with respect to Z_2, Z1 and Z_o. Without Zeolite (Z_o) the lowest shortest length of cob is 18.15 cm, not much different from Z_1 and Z_2 and much different from Z_3 and Z_4. The results of the analysis of zeolite 315 g / plot (Z_3) resulted in optimal cob not much different to Z_4. The higher Zeolite administration, the higher the cobs length, and the higher the linear statistic with $\hat{Y} = 0.004\ Z + 17.94$ with r-0.93 and shown in Figure 7.

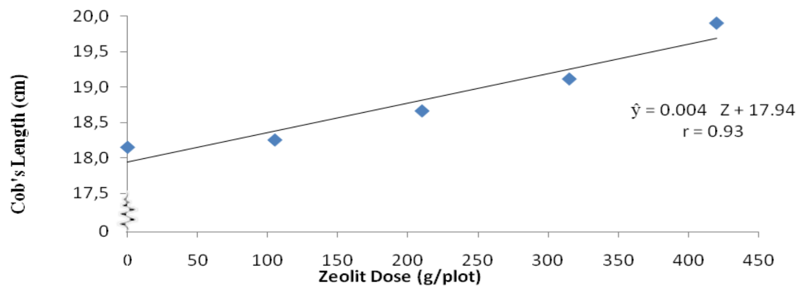

Figure 7. The effect of using Zeolite doses on the length of corn cob

Give urea dose that different much ($p < 0.05$) on cob length. Giving a dose of 8.4 g / plant (U_4) at an average length of 19.85 cm without significant difference ($p > 0.05$) to a lower dose of 4.2 g / plant (U_2) an average of 18.83 cm and recommended for the length of cob. The control (U_o) length of the cob was slightly shorter by an average of 17.92 cm with no significant difference with U_1, give the higher dose of urea will be effective to the length of the cob and based on statistical analysis obtained a linear equation with $\hat{y}$ = 0.217 U + 17.90 r = 0.98 Figure 8.

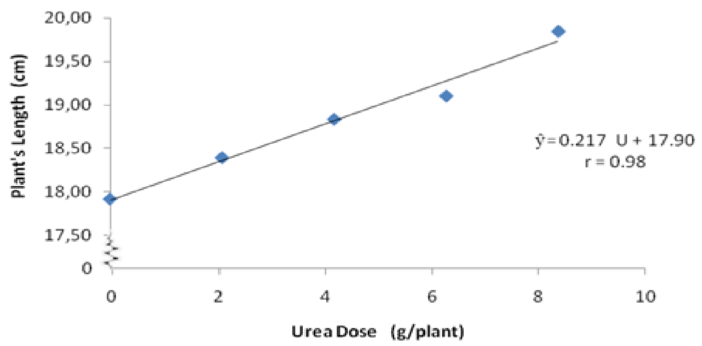

Figure 8. The effect of using urea doses on the length of corn's cob

(Table 5) Zeolite gives no significant effect ($p > 0.05$) on the number of rows/cob, the highest average zeolite administration is at P_4 (420 g / plot) the average number of rows/cob is 15.24 lines, without Zeolite (Z_o) with the number of lines/cobs was slightly lower by an average of 14.29 lines, give urea dose has not given significant effect ($p > 0.05$) on the number of rows/cobs, but the high dose of 8.4 g / plant (U_4) was 15.24 rows and compared with control (U_o) by the number of rows/cobs more low with an average of 14.38 lines.

4.1.6 Quality (Bruto/ Sample, Bruto / Plot, Net / Sample and Net /Plot)

Corn shell production has Bruto (g / sample and kg / plot) and Nett (g / sample and kg / plot). From the results of weighing the seeds of corn shells, the effect of giving different Zeolites and giving Net/plot at harvest with the average weighing results are presented in Table 6.

(Figure 6) giving Zeolite significant effect ($p < 0.05$ on gross production/samples (corn cobs and klobot), giving Zeolite 420 g / plot (Z_4) high dose treatment with corn gross production / the largest sample with an average of 221.80 g / cob followed by the use of Zeolite at a dose of 315 g / plot (Z_3) gross weight 212.05 g / cob and the use of zeolite 210 g / plot gross weight 212.41 g / cob all showed no significant difference, whereas without Zeolite (Z_o) the lowest bruto average income 201.78 g / cob was significantly different from Z_4.

(Figure 6) shows the apparent Zolite support ($p < 0.05$ to gross / plot production (corn cobs and klobot), provision of 420 g / plot (Z_4) Zeolites in high doses supported by gross average corn / plot production of 11, 15 kg / plot Zeolite 315 g / plot (Z_3) Gross weight 10.83 kg / plot and 210 g zeolite plot / plot 10.69 kg gross plot / plot are unrealistically different. markedly against Z_3 and Z_4.

Table 6. The average of production Bruto and Neto for every sample and plot (g and kg) From the effect of using Zeolite Doses and Urea Doses on the Corn Cropping

Sign	Bruto/sampel (g)		Bruto/plot (kg)		Net /sampel (g)		Net/plot (kg)	
Z_o	201.78	B	10.11	c	187.02	c	9.34	b
Z_1	203.75	B	10.35	bc	187.61	bc	9.41	b
Z_2	212.41	Ab	10.69	abc	195.53	abc	9.68	ab
Z_3	212.05	Ab	10.83	ab	199.40	ab	9.74	ab
Z_4	221.80	a	11.15	a	204.77	a	10.27	a
U_o	199.57	c	9.92	c	184.08	c	9.10	c
U_1	202.71	bc	10.19	c	185.62	bc	9.27	c
U_2	208.77	abc	10.44	bc	190.59	abc	9.53	bc
U_3	220.48	ab	11.13	ab	204.24	ab	10.07	ab
U_4	220.26	a	11.46	aa	209.81	a	10.45	a

Note: Letter notation in the same average column shows no significant difference at the 5% level (lowercase) on the DMRT Test.

Net production (g / sample or g / cob) Zeolite administration significantly affected (p <0.05 on net production/cob (corncob and klobot), it was seen that giving Zeolite 420 g / plot (Z_4) high dose net yield (g / cob) an average 204.77 g / cob of Zeolite 315 g / plot (Z3) with a gross weight of 199.44 g / cob and the use of a zeolite dose of 210 g / plot with a gross weight of 1199.4 g / cob where all three showed no significant difference. (Zo) the lowest gross income is 187.02 g / ear with significantly different from Z_3 and Z_4.

Giving Zeolite which is different from the real one (p <0.05 of net yield / plot, giving Zeolite 420 g / plot (Z_4) is a high dose in management with the largest net production/plot with an average of 10, Next 27 kg / plot Zeolite 315 g / plot (Z_3) net weight of 9.74 kg / plot and zeolite 210 g / plot net weight of 9.68 kg / plot all three were not very apparent Without the help of Zeolite (Z_o) the lowest average of 9.34 kg / plot is more significant than Z_4.

Data and statistical analysis of Zeolite administration at 210 g / plot are recommended dose because the higher administration is not significant for Z_3 and Z_4. The main result is the net production of the broad union, the statistical analysis shows that there is a difference between the use of higher doses of Zeolite which results in a higher net weight resulting in a linear equation $\hat{Y} = 0.002\ Z + 9.224$ with r = 0.89 with can be used in Figure 9.

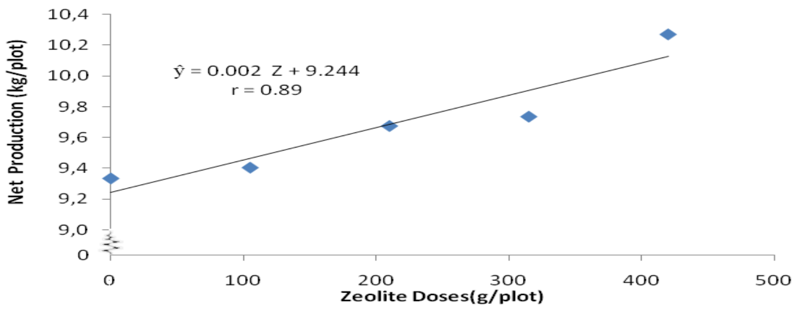

Figure 9. The effect of using Zeolite doses on the net production (kg/plot) the corn's seed

Giving different urea doses are given in Table 6. Urea doses significantly affected (p <0.05 on gross / sample production (corn cobs and klobot), administration of urea 8.4 g / plant (U_4) The highest dose of the gross production of maize / average sample 220.26 g / cob followed by a dose of 6.3 g / plant (U_3) with a gross weight of 220.48 g / cob and a dose of urea 4.2 g / plant with a gross weight of 208.77 g / cob where the three are not significantly different, without urea (U_o) the lowest gross weight yield mean 199.57 g / cob significantly different from U_3 and U_4.

Figure 6 shows the dose of urea fertilizer which has a significant effect (p <0.05 gross yield/plot (corn cobs and klobot), administration of urea fertilizer 8.4 g / plant (U_4) highest dose of gross corn production / average plot of 11.46 kg / plot followed by dose 6.3 g / plant (U_3) \ gross weight 11.13 kg / plot both differences are not significant Without urea (U_o) the lowest gross yield is 9.92 kg / plot significantly different from U_3 and U_4.

Net production (g / cob) of urea dose significantly affected (p <0.05 on net production/cob, urea support at 8.4 g / plant (U_4) is a high dose in assistance with net production (g / cob) of average price average 209.81 g / cob following the dose of urea fertilizer at 6.3 g / plant (U3) net weight 204.24 g / cob and the dose of urea fertilizer 4.2 g / plant net weight an average of 190.59 g / cob three are not easily different. urea fertilizer (Uo), the average net yield of 184,082 g / cob was significantly different from U_3 and U_4, giving urea had a significantly different effect ($p < 0.05$) on net production/plot, where urea fertilizer 8.4 g / plant (U_4) high dose net production/plot yielded the highest average 10.45 kg/plot followed by urea dose 6.3 g / plant (U_3) net weight of 10.07 kg/plot, both showing no significant difference ($p > 0.05$). Whereas without Urea (Zo), the lowest net yield was 9.10 kg/plot with a significantly different effect on U_3 and U_4.

Data and statistical analysis results from the administration of urea 6.3 g / plant (U_3) are recommended dosages for cleaner production, where higher doses are not significantly different from U_4. Based on the main results is the net production of the broad union, the statistical analysis is between the higher dosage of urea fertilizer yields a higher net weight than the results of linear calculations $\hat{Y} = 0.166\ Z + 8.986$ with $r = 0.964$ with availability can be seen in Figure 10.

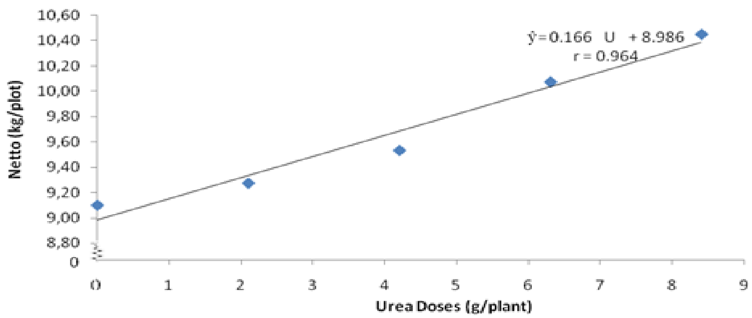

Figure 10. The effect of using urea doses on the net of corn production (kg/plot)

4.1.7 Pipil Weight (g / Sample, kg/Plot) and Weight of 100 Seeds (g)

Data on Figure 7, give zeolite and urea in which the results of the dipilipil statistical analysis were significantly different ($p < 0.05$) to shelled / sample and shelled / plot) and the weight of 100 dried seeds. Zeolite significant effect ($p < 0.05$) on the net production of pipettes/samples, giving Zeolite 420 g / plot (Z_4) the highest results of pipettes/samples an average of 190.77 g / sample was not significantly different ($p > 0.05$) on the administration of Zeolite 315 g / plot (Z_3) yields an average of 185.66 g / sample, and administration of Zeolite 210 g / plot (Z_2) an average of 181.53 g / plot, all three show no significant difference ($p > 0.05$. These results are giving zeolite 210 g / plot (Z_2) is the recommended dose for shelled production (g / sample).

The treatment without Zeolite (Zo) of the lowest pipil yield was an average of 171.66 g / sample not significantly different ($p > 0.05$) to Z_1 (Zeolite 105 g / plot) an average of 174.21 g / sample, whereas for Z_3 and Z_4 were significantly different ($p < 0.05$).

Table 7. the Average of Production on Pipil Net/sample (g), Yeild Pipil/plot (kg) and Weight 100 seeds pipil effected by Zeolit and Urea.

Sign	Pipi lWeight/sampel(g)		Pipil Weight/plot(Kg)		Weight 100 Seeds(g)	
Z_o	171.66	b	8.55	c	30.94	b
Z_1	174.21	b	8.71	bc	31.49	bc
Z_2	181.53	ab	9.08	abc	32.26	abc
Z_3	185.66	ab	9.28	ab	33.13	ab
Z_4	190.77	a	9.61	a	34.48	a
U_o	169.62	b	8.47	c	31.33	c
U_1	172.35	b	8.62	c	31.61	bc
U_2	176.30	ab	8.81	bc	32.77	abc
U_3	188.92	ab	9.43	ab	32.97	ab
U_4	196.65	a	9.90	a	33.61	a

Note: Letter notation in the same average column shows no significant difference at the 5% level (lowercase) on the DMRT Test

The results of pipilan (kg/plot) Table 7 administration of different dosages of Zeolite had a significant effect ($p < 0.05$), Zeolite 420 g / plot (Z_4). The result on the highest of pipilettes / plots was 9.61 kg/plot not significantly different from (Z_3) 315 g / plot, the result on pipil weight/plot an average of 9.28 kg/plot and Zeolite 210 g / plot (Z_2) an average of 9.08 kg/plot) the three gave no significant effect ($p > 0.05$), zeolite (Z_2) it was recommended.

The treatment without Zeolite (Z_o) gives the result of the lowest average pipil weight of 8.55 kg/plot, not significantly different from Z_1 and Z_2. The higher zeolite giving responses to the results of unit area measurements, and the statistical analysis is obtained by the correlation with the linear equation as presented in Figure 11.

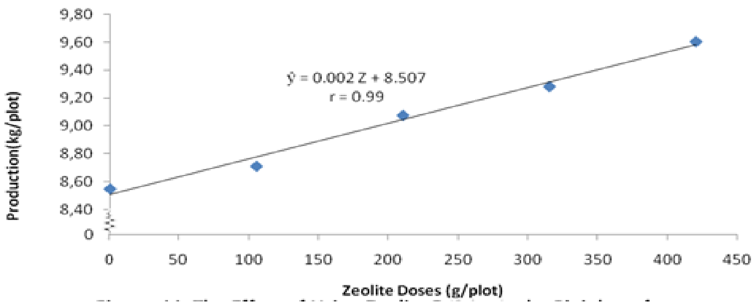

Figure 11. The effect of using Zeolite doses on the pipiplan of production pipilan/plot corn

Gives urea with a different dose can be significantly affected ($p < 0.05$) on the net weight of the Pipil / sample. Figure 7 net pipette weight / highest sample yield of U4 8.4 g / plant with an average of 196.65 g / sample, followed by 6.3 g / plant (U_3) and 4.2 g / plant (U_2) and the three samples were not significantly different ($p > 0.05$). Statistical analysis results that giving urea with the dose is recommended 4.2 g / plant (U_2). The treatment of Uo (without urea) results in the lowest average net weight of 169.62 g / sample, not significantly different from U_1 and U_2.

Gives urea dry pipilan / plot is the result of various doses of significant effect ($p < 0.05$). Figure 7. highest yield of pipil / plot 8.4 g / plant (U_4) average 9.90 kg / plot not significantly different ($p > 0.05$) to 6.3 g / plant (U_3) average 9.43 kg / plot and U_3 dose of urea as a suggestion. The treatment of Uo (without urea) results in the lowest average pipette weight of 8.47 kg/plot, which is not significantly different from the dose of 2.1 g / plant (U_1), average pipette weight of 8.47 kg/plot, and treatment of 4.2 kg/plot (U_2) and is significantly different against U_3 and U_4, Gives urea fertilizer will be increased dry shelled results and statistical analysis results that provide equations with linearity as shown in Figure 11.

The results of the data on 100 dried corn kernels (Figure 7) which gave the Zeolite significant effect ($p < 0.05$). The giving of high-dose Zeolite 420 g / plot (Z_4) with the highest of weight of 100 dry seeds on average 34.48 g was not significantly different from (Z_3) 315 g /plot with an average of 33.13 g and (Z_2) 210 g / plot with an average of 32.26 g the three were not significantly different, the treatment without Zeolite (Zo) was the lowest weight of 100 seeds, an average of 30.94 g was not significantly different ($p > 0.05$) against Z_1, and Z_2, give urea fertilizer (figure 7) with a significant effect ($p < 0.05$) on the net yield of 100 seed pips. Giving a dose of 8.4 g / plant (U_4) the highest of result on the weight of 100 seeds on average 33.61 g was not significantly different from 6.3 g / plant (U_3) an average of 32.97 g / 100 seeds and 4.2 g urea/plant (U_2) on an average of 32.77 g / 100 of the three seeds was not significantly different. Without urea (Uo) weight of 100 seeds, the lowest average of 31.33 g was not significantly different ($P > 0.05$) with 2.1 g / plant (U_1) and a dose of 4.2 g / plant (U_2), but Uo was significantly different ($p < 0.05$) it against U_3 and U_4.

5. Discussions

5.1 The Effect of Zeolite Doses on the Growth of Corn Crop

Data analysis of various parameters of Zeolite influence significantly affects the growth of corn. Different zeolites had effects significantly different ($p < 0.05$) on plant height, stem diameter, and leaf area. But it was not significantly different ($p > 0.05$) on the number of leaves.

The growth vegetative requires a huge supply of nitrogen for the formation of biomass that comes from availability in soil or through fertilization (Kuruseng Haris and Kuruseng Askari Moh., 2008).

Zeolite can reduce to gives fertilizer and also soil acidity by increasing growth and production. It is known that Zeolite is a collection of hydrated aluminosilicates with the main elements consisting of alkali and alkaline earth and have properties as absorbers, separators, and catalysts. In agriculture, zeolites are used as absorbers, ion exchangers and soil cleaners which lead to fertilizer efficiency and increased production (Suwardi, 2009). Giving Zeolite is one of the factors to increase plant growth. The availability of nutrients can be increased with the nutrient absorption response on plant roots. The low zeolite has given to plants that cause soil nutrients to be low, causing stunted outgrowth and the result of maize (Afendi, MR., 2016).

Gives zeolites on soils that have low KTK such as Oxisol, Ultisol, and some Inceptisol can increase KTK. Zeolite is given to the soil because zeolite has a high nutrient absorption capacity, especially K and NH4, the ability of the soil is bind to these elements that can be increased. The reduction of nitrogen is loss either with washing or nitrification can increase crop production (Rasyid, B., 2012).

The capacity of exchange on Zeolite is very able to regulate the release of nutrients and can reduce damage to plant roots due to good aeration and improve the nitrification process. The use of zeolites can be streamlined fertilization, especially the use of urea and reduce damage to excessive watering intensity. This is due to zeolites able to absorb nutrients and redistribute them and be able to maintain moisture for a longer time (Suwandi, 2000; Widyanto, 2013).

5.2 The Effect Of The Using Urea Doses On The Growth of Corn Crop

Statistical analysis data obtained the average variation of the parameters of urea fertilizer on corn plants significantly affected ($p < 0.05$) on growth. Different doses of urea fertilizer give different responses to growth in the field. The parameters show significant differences for plant height, stem diameter. The higher dose of urea provides stimulation to the growth of corn faster. Because plant growth during vegetative growth requires a large supply of nitrogen for biomass formation (Widyanto. A., *et al.*, 2013)

Heard, J. (2004) added that fertilizer application to plants entering the vegetative period would increase growth and increase in the number of cells, nutrient uptake included nitrogen, which is one of the cell components and macromolecular formation, to increase the quality of stronger stems to reduce resistance to cracks.

The higher application of urea fertilizer to plants increases the availability of nutrients, according to opinion Sutedjo, M. M., (2008) stating the need for nutrients for each phase of plant growth is different. Urea fertilizer is a fertilizer containing 45-46% N, is very soluble in water and reacts quickly, is also easily converted into ammonium ions (NH4 +) that can be absorbed by plants (Sutedjo, M. M., 2002).

This is in agreement Nur Aina *et al*., 2017) states that in good environmental conditions to carry out photosynthesis can produce (60-80)% of the assimilate results are translated into other plants in the organs of growth and production. Growth and production will increase if supported by environmental factors such as light and water (Bunyamin and Aqil, 2009), (Heard, J., 2004) but at the time of this study, water could not need to be fulfilled because at the time of this study it coincided with the start of the dry season when the plant growth phase had a lack of water, so the growth and production of plants do not get maximum results.

The statement is confirmed by Bunyamin Z, *et al*. (2012) that corn is a plant that is very sensitive to fertilization, deficiency or excess of one type of macroelements will cause physiological changes in plants. N absorption by maize takes place during its growth, therefore, to obtain good results, macro and micronutrients in the soil must be sufficiently available during the growth phase.

5.3 Effect of Zeolite and Urea Interaction in Soil Improvement of Corn Growth

The results of the analysis of variance showed that there were no significantly different interactions between the treatments of all vegetative parameters observed. The administration of Zeolite and urea on growth and yield of maize were not significantly different ($p > 0.05$). Zeolite can reduce urea in the field, both factors tested on plants support each other, due to the formation of roots in maize plants supported by adequate nutrient content in the soil during planting.

Plants that grow must contain N in forming new cells. Photosynthesis produces carbohydrates from CO2 and H2O, but the process cannot take place to produce proteins, nucleic acids, and so on when N is not available. Severe N deficiency will stop the process of growth and reproduction. N deficiency is one cause of plants becoming stunted (Sabilu, Yusuf, 2016). The use of zeolites in ultisol soils can work to improve the quality of fertilizer use, mixtures to make fertilizer available slowly, soil moisturizers and control water reserves. Natural zeolites have a very good ability to absorb and exchange cations (Afendi, MR. *et al*., 2016).

The results of research on rice showed that zeolite administration could increase yield. The highest concentration of N and K absorbed by rice plants at the age of 6 MST on zeolite treatment was 125 kg ha-1. The uptake of N decreases as the zeolite dose increases, this shows that more N enters the zeolite pores and will be released slowly back to be absorbed by plants (Al-Jabri 2010). The results of the study Yateman Arryanto, *et al*. (2012) combined zeolite dose of 750 kg/ha with urea dose of 50 kg/ha showed the best results on leaf area, plant height, and total dry weight/plant compared with the treatment of urea dose of 300 kg/ha without zeolite administration.

5.4 The Effect of the Using Zeolite Doses on the Corn Cropping

The results of the analysis of variance have a significant effect on production per plant or production per plot. But it shows no significant difference ($p > 0.05$) to the weight of 100 corn seeds. zeolite, which will then be released again according to plant needs.

The use of zeolite is to be able to absorb gas molecules such as CO, CO2, H2S. Zeolites are non-metallic minerals or industrial minerals, have physical and chemical properties, namely as absorbers, ion exchangers, molecular filters and as a catalyst (Kusdarto, 2008) 40. Zeolite as a soil enhancer is a mineral of a hydrated aluminosilicate compound with a hollow structure and contains interchangeable alkali cations. Zeolite, as a fixer that is given into the soil in relatively large quantities can improve the physical, chemical, and biological properties of the soil so that agricultural production can be increased (Al-Jabri, M. 2010).

The proper use of zeolite uses 210 g / plot (Z_2). This is by the results of the study (Al-Jabri M. and R. Soegianto, 2014). Give Zeolites is one factor in increasing the availability of nutrients needed by plants. The potential of zeolites in Indonesia, the chemical and physical properties of zeolites, the use of zeolites in improving the chemical and physical properties of ultisol soils, the use of zeolites in increasing crop production (Kusdarto, 2008).

Increased corn yield of 6-11%, soybean 19%, peanuts 18%, and tomatoes 35% proves that the physical, chemical, and biological properties of the soil can be improved with zeolites. N accumulation of N fertilizer is twice as high compared to control if zeolite is given 3 and 6 tons / ha, this is because the conversion of NH4 + to NO3 - as much as 30-40% can be inhibited by zeolites (Al-Jabri, M. 2010).

5.5 The Effect of the Using Urea Doses on the Corn Cropping

The statistical analysis of observations in the field of variance in the average observations of parameters from the use of urea fertilizer doses on the corn is significantly different ($p < 0.05$) on the corn crop. Give urea with different doses to the result of the corn crop in the field. The parameters show a real difference ($p < 0.05$) obtained gross and net results per sample or plot, resulting in a significant difference in effect on Pipil / sample results and per plot.

Setyo Budi et el., (2015) explains the function of nitrogen (N) for plants is to accelerate plant growth, increase plant height, and stimulate budding by the results of this study which shows the response of plant height and weight of corn canopy to Urea fertilizer is relatively greater than the response of plants to other fertilizers.

Plants absorb N when plants are active, but not always at the same level of need. The amount of N that can be absorbed every day per unit weight of the plant is maximum when it is still young and gradually decreases with increasing plant age. Nitrogen is the main constituent of the dry weight of young plants compared to older plants. Nitrogen must be available in plants before new cells are formed (Sabilu, Yusuf. 2016).

The yield in the form of seeds of urea fertilizer is best using 6.3 g / plant (150 kg/ha), according to the results of the study Nur Aina *et al*. (2017) that the recommended dosage for growth and production of 150 kg/ha corn plants is slightly lower which is planted in the highlands with a recommendation of 4.2 g / plant (U_2). Based on the use of the higher dose of urea fertilizer given to plants is the availability of elements in growth, this is by the opinion

(Kresnatita S. *et el*. 2013) stating the nutrient requirements for each phase of plant growth is different (Sutedjo, M. M., 2000).

5.6 The Effect of the Zeolite Interaction and Urea on the Corn Cropping

Based on the results of the analysis and presented in a variety show that there is no significant interaction ($p > 0.05$) between the treatment of the use of Zeolite doses and the dose of urea fertilizer on all parameters (maize production).

The administration of Zeolite and urea to the soil in the corn crop showed in the production showed that the interaction of different was not significant ($p > 0.05$), but the two plants tested on the plants were mutually supportive. This is due to the use of zeolite and urea doses do not show significant differences. With catalyst with the addition of zeolite and urea doses can overcome the nutrient requirements by plants. This situation is caused by the formation of roots in maize plants supported by sufficient nutrient content in the soil during planting in the field. By the availability of sufficient nutrients in the soil in plants followed by greater production (Al-Jabri, M. 2010).

Plants given zeolite + urea have stem circumference, leaf color intensity, ear weight, wet and dry crown weights, wet and dry root weights are better than other treatments (Polat *et al.*, 2004). According to (Sembiring, *et el*. (2017) the effect of using Nitrogen (N) on the quality and quantity of yields is the refinement of the process of filling the seeds in full so that it can harden and prevent seed downsizing at the tip of the cob, this is positively correlated with the weight of the cob on corn plants.

Give zeolite in soil that has a cation exchange capacity (CEC) is low so that it can increase soil CEC. According to Polat et al., (2004) and Heard, J. (2004) Zeolites are given to the soil because zeolites have nutrient absorption capacity, especially Potassium (K) and Ammonium (NH4), the ability of the soil to bind these elements can increase. The reduction of nitrogen loss either from washing or nitrification can increase crop production.

Increased production due to zeolite administration is due to an increase in nitrogen efficiency, especially in reducing nitrate leaching. The use of zeolites 3 and 6 tons/ha results in higher nitrogen accumulation compared to controls treated with N fertilizer twice. Zeolites can inhibit the conversion of NH4 to nitrate by 30-40% (Suwandi. 2000).

The results of the study Yateman Arryanto *et al*. (2012) combined zeolite dose of 750 kg/ha with urea dose of 50 kg/ha showed the best results on leaf area, plant height, and total dry weight/plant compared with the treatment of urea dose of 300 kg/ha without zeolite administration. Giving zeolite at a dose of 500 kg/ha can increase cob yield compared to plants without zeolite administration.

Suwardi. (2009) from the results of his research and showed that zeolite application and organic fertilizer dosages significantly affected plant height, leaf area, production/sample, production/plot. The best treatment of zeolite was Z_2 (945 g / plot) and urea U_1 fertilizer (4.2 g / plant). Based on the results of research that has been done namely the growth response of corn (Zea mays) by giving zeolite coated urea as slow-release nitrogen, it can be concluded that the weight of the cob and the length of the cob showed different results to other treatments using the application of zeolite coated urea with a concentration of 10% (Sembiring, *et el*., 2017).

6. Conclusions and Suggestions

6.1 Conclusions

Give some Zeolite doses has a real effect in plant's height, rod's diameter, and leaves' wide but not significantly different in leaves' number, weight in 100 seeds to produce a vegetative growth and result from the good height used doses 210 g/plot (Z_2).

Give some Urea doses has a real effect in plant's height, rod's diameter, and leaves' wide but not significantly different in leaves' number for getting growth and good produce used doses 4.2 g/plant (U_2).

Cannot found different real interactions effected to used Zeolite and Urea in Corn's plant, do a good combination for getting a good result with used Zeolite doses 210 g/plot and Urea 4.2 g/plant (Z_2U_2).

6.2 Suggestions

Recommended to give Zeolite doses 210 g/plot (Z_2) and Urea doses 4.2 g/plant (U_2) on the plateau such as *Tanah Karo* and need to research a different plant, the height doses, and different areas.

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