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PROVISION OF CHERT AS A SOURCE OF SILICONE (SI) FOR THE GROWTH AND YIELD OF RICE (ORYAMMONIUM SULFATE SATIVA L.) TO SUPPORT A SUSTAINABLE CULTIVATION SYSTEM

Herry Z. Kotta [1], W.I. I. Mella [2], Suwari [3], Paulus Bhuja [4]

[1, 2] Research Center for Environment, Natural Resources and Agroecology, Nusa Cendana University, Indonesia

[3, 4] Faculty of Science and Engineering, Nusa Cendana University, Jl. Adisucipto Kampus Baru Penfui, Kupang, NTT 85361, Indonesia

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ABSTRACT

A combination of silicon and macro nutrients has been proven to increase rice yield above the average of macro nutrient alone. Chert can contain up to 98% of silicon. Rice field in Timor can be alkaline or non-alkaline in nature. The solubility of SiO2 tends to be higher under acidic soil condition. The use of nitrogen fertilizer can reduce the acidity and hence may increase silicon availability. This research in designed to study the effect of the use of chert powder in combination with urea and ammonium sulfate on rice growth and yield. The study was a pot experiment laid-out based on complete randomized design with nine treatments and three replications. The treatments were control, chert powder 55 kg/ha, chert powder110 kg/ha, urea 100 kg/ha; ammonium sulfate 200 kg/ha, urea 100 kg/ha + chert powder 55 kg/ha, urea 100 kg/ha + chert powder 110 kg/ha, ammonium sulfate 200 kg/ha + chert powder 55 kg/ha, and ammonium sulfate 200 kg/ha + chert powder110 kg/ha. Results showed no significant difference in rice plant height and tillers among the treatments. Beside treatment effect, there was an indication of effect of factors other than treatment effects especially on the non-alkaline pots. It was suspected that the additional effect might be due to the presence of allelophatic substances. Therefore, it is suggested to have a future study on a combined effect of allelophatic substance and treatments assigned to this study to observe such an effect on rice growth and yield.

1. INTRODUCTION

1.1. BACKGROUND

According to Makarim (2003), the Si content in paddy fields in general tends to be negative, because the paddy soil continuously releases Si to maintain rice plant growth but Si input is very little or even non-existent. According to Makarim (2003), every year every hectare of wetland will lose 995 kg of SiO_2, because it is absorbed by rice plants, while the input for SiO_2 comes from fertilizers of 100 kg/ha, from compost 140 kg/ha, and from irrigation 291 kg/ha. Lack of silica nutrients will result in unproductive land and rice plants not growing optimally.

Rice plants lack silica, their leaves droop, their root absorption of nutrients is not good, rice plants are susceptible to disease and pests, translocation of photosynthesis results is less efficient, root oxidizing power decreases, thereby reducing rice plant resistance to Fe, Al and Mn poisoning (Makarim et al., 2007; Ma and Yamaji, 2008).

With sufficient silica, it will reduce the use of phosphate and urea fertilizers by more than 50% of the standard dose; neutralizing soil pH which generally tends to be acidic due to urea and pesticides; reduce the rate of transpiration (evaporation) so that it is efficient in using water and is more resistant to drought.

Makarim (2003) states that for optimal rice fields (irrigated rice fields) silica nutrition is formulated to contain 20-22% SiO_2; P_2O_5 10-12%; and the dose of administration is 200 kg / ha. For other rice fields such as rainfed lowland, dry land and tidal swampland, the silica nutrient formulation contains 24-26% SiO_2; P_2O_5 10-12%; with a dose of 200 kg / ha.

The benefits of the element silicon (Si) in plant growth have not been given much attention, either by experts, governments or farmers. Without Silica, plants can still grow. But actually, the function of nutrients that are usually available in the form of SiO_2 (silica) is important for Gramineae plants, especially rice and sugarcane (Tisdale, et al., 1985; Mengel and Kirby, 1987; Makarim et al., 2007).

Silica plays a role in the formation of plant cell walls, strengthening plant growth so that it grows upright and can capture sunlight for optimal photosynthesis. In addition, Silica also strengthens the resistance of stems and leaves against pests and diseases and acts as a counterweight to other nutrients, such as phosphates and trace elements which are toxic.

Silicon for rice plants generally comes from various sources such as irrigation water, soil, fertilizers (organic and inorganic) (Ma and Takhashi, 2002; Rao and Susmitha, 2017). In addition, many experiments by experts use silicate rock (Pereira, et al. al. 2004; Rao and Susmitha, 2017) and even silica gel is also used to provide Si for rice plants (Ma and Takahashi, 2002).

Ma and Takahashi (2002) calculated that in Japan, rice plants receive a supply of SiO_2 per ha of 300 kg (the amount of irrigation water for rice is 14000 tons per ha and the SiO_2 content in irrigation water is 21.6 ppm).

Soil in Timor, which is formed from weathering of limestone (marl and raised coral), has a high SiO_2 content, as stated by Mella and Mermut (2010) that the SiO_2 content in Alfisol soil and Mollisol soil formed on the raised reefs of Timor Island is as big 42.6 ± 3.3% (w / w) and 45.8 ± 3.5% (w / w), respectively.

Sources of Si from rocks/minerals containing SiO_2 that have been tested for rice are silicate clay and schists (Pereira, et al. 2004) and silica powder (Rao and Susmitha, 2017), and silica gel (Ma and Takahasi, 2002). Rao and Susmitha (2017) use silica powder (99% purity) at a dose of 100 kg per ha to fertilize rice and they find that silica powder can be used as an ingredient in providing Si for rice plants. Ma and Takhashi (2002) suggest that silica gel containing very high SiO_2 can dissolve in the soil to provide Si for rice plants. However, Pereira, et al. (2004) also stated that schist and silicate clay did not contribute to providing Si for rice plants.

According to Ma and Takahasi (2002), the amount of available Si in the soil depends on the parent material that forms the soil. Soil derived from volcanic ash containing 28.2 mg available Si per 100 g of soil; while soil derived from Si granite rocks is available in the soil as much as 5.5 mg per 100 g of soil.

Silicon for plants can also come from compost. The Si content in organic fertilizers depends on the type of compost material. Compost which consists of materials containing high Si such as grass-hay will contain more Si than compost made from legume crop residues (Mengel and Kirby, 1987; Tisdale et al., 1985). This is because rice absorbs more Si than legumes (soybean) (Mengel and Kirby, 1987). In an experiment cited by these two experts, it was suggested that giving Si at the same dose of 162 mg Si per L caused rice plants to absorb 124 g of Si while soybean absorbed only 4 g. According to Ma and Takhashi (2002), rice straw contains up to 20% Si.

Chert is a fine-grained, hard, compact silicaan rock formed by silt-sized quartz crystals (micro-quartz) and chalcedony, a form of silica made of radiating fibers several tens to hundreds of micrometers in length. It is usually dark gray, blue, black, or dark brown and is mainly found in the form of nodules in sedimentary rocks such as limestone or limestone. Since the Stone Age, chert has been used to make weapons and tools such as swords, arrowheads, knives, axes, etc.

This mineral is a sedimentary rock deposited in the deep sea (abyssal), which is based on the micro-fossil content of Radiolaria (Wakita, et al 1996) showing that this unit is of upper limestone age, while red limestone is sedimentation of limestone plankton that may accumulate in local elevated parts. local.

Generally, chert beds are composed of residues of silica-producing organisms such as diatoms and radiolaria. These deposits result from sedimentation, compaction and recrystallization (lithification) of organic silica sludge that accumulates on the deep ocean floor. This organic silica mud accumulates together under plangtonic zones of radiolaria and diatoms while living on the surface of water with warm temperatures. When these organisms die, the shells of these organisms are slowly deposited on the deep-sea floor where they accumulate which are still separated from each other. These materials are deposited far from the land arc to the ocean floor, when the terrigenous sediment supply is low, and in the deepest part of the abyssal plain there is a limit called the *carbonate compensation depth* (CCD), where the accumulation of calcareous materials cannot form. This is because one of the properties of water is cold water will bind more CO_2 than warm water. On the seabed, there is a clear boundary where the lower CO_2 content is higher. Below this limit, the CO_2 content is very high as a result, the carbonate-containing organisms will dissolve in the CCD so that they will not settle because they never reach the ocean floor. This carbonate compensation depth is located about 2,500 meters or 2.5 kilometers below sea level. Above the carbonate compensation depth, about 2,000 meters, there is an area called the lysocline. Here, some of the carbonate has started to partially dissolve. Some chert layers do not necessarily come from organic matter. It could be from silica precipitation that comes from the same magma chamber in the underwater basaltic (pillow lava) which experiences precipitation along with chert layers.

Based on the results of research conducted by the Mining and Energy Office of South-Central Timor Regency in 2003, in the area of South Mollo District, it was stated that chert extracted materials were exposed in the Fatumnasi, Tune, Tunua, Ajaobaki, Netpala, Bosen, Eonbesi, Bonleu, Besana, Fatukoko, Binaus, Biloto and Oinlasi with total volume: 1,907,812,500.00 (m^3), with SiO_2 levels ranging from 63 - 98%. Until the research proposal was submitted, the chert mining material was only used for pavement.

Factors influencing the availability of Si in soil dissolution are pH and mineral type (Mengel and Kirby, 1987; Tisdale et al., 1985). Available silicon (available form Si $(OH)_4$, silicic acid) is present in the soil at a very wide pH range between 2 and 9. However, Si availability is also influenced by the content of Al and Fe oxides in the soil. Soils with Al oxide content have higher available Si than soil containing Fe oxide. Therefore, acid soils tend to have more available Si than alkaline soils and applying lime will reduce the absorption of Si by plants (Mengel and Kirby, 1987).

Nitrogen oxidation has long been recognized as a process that causes the release of H^+ ions and therefore lowers pH (Brady and Weil, 2002). When nitrogen fertilizers such as urea or ammonium sulfate break down in the soil, it will produce NH_4^+ ions (available form for plants) which, if the soil conditions are well aerated, these ions will immediately undergo oxidation and produce nitrate ions (NO_3^-, which is also the available form). This process will produce H + ions which contribute to increasing soil acidity (decreasing soil pH).

The use of urea and ammonium sulfate fertilizers does increase rice yields; however, the N element can cause rice plants to be susceptible to abiotic stresses such as lying down and drought as well as biotic stresses such as attack by pest organisms and disease causes. Thus, giving chert powder as a source of Si and nitrogen fertilizers (urea and ammonium sulfate) is expected to provide information on mutually beneficial effects on rice growth and yield. Decreasing soil pH through dissolving urea and ammonium sulfate fertilizers affects soil pH to different degrees. The decrease in soil pH will be greater by dissolving ammonium sulfate than urea because the acidity index of urea is lower than the acidity index of ammonium sulfate (Fageria et al., 2010; Singh, 2010). The equivalent acidity of urea and ammonium sulfate are 80-84 and 110, respectively.

Although Si is the second most abundant element in the earth's crust and of course in the soil and almost all types of soil minerals, its availability is highly dependent on the root environment, for example soil pH and soil mineral types such as the presence of iron oxide and aluminum oxide minerals (Tisdale, et al. 1985; Mengel and Kirkby, 1987). Silicon will be available in higher concentrations in an acidic environment than an alkaline environment. Lime application will reduce the Si concentration in the soil solution (Mengel and Kirby, 1987). On the other hand, giving compounds or elements that acidify the soil will increase the solubility and at the same time the availability of Si in the soil. Urea and ammonium sulfate fertilizers are inorganic fertilizers that have moderate and high soil acidification levels, respectively (http://agropedia.iitk.ac.in/content/acidity-and-basicity-fertilizers; downloaded 27 March 2020 https://www.blinc.com/role-nitrogen-fertilizer-soil-ph; downloaded March 25, 2020). It has long been known that nitrogen oxidation from nitrogen fertilizers such as urea or ammonium sulfate is one of the processes that causes an increase in the concentration of H^+ ions in the soil solution (causing a decrease in pH) (Brady and Weil, 2002). However, giving nitrogen fertilizers such as urea or ammonium sulfate in balance with fertilizers containing other nutrients such as Si will improve soil health and quality (Singh, 2018).

1.2. HYPOTHESIS

This research is based on the hypothesis that:
1) Plant growth is better in the treatment of fertilizer and chert powder than the treatment without fertilizer.
2) Plant growth will be better in the combination treatment of urea fertilizer, ammonium sulfate fertilizer with chert powder than contro and fertilizer and chert individually.

1.3. OBJECTIVES

1) Knowing the effect/response to growth and yield of rice plants that are given and not given chert as a source of silica and without urea fertilizer, as an effort to support a sustainable rice cultivation system.
2) Determined the effect of giving chert as a source of silica combined with urea fertilizer for growth and yield of rice plants.

2. RESEARCH METHODS

This study was a pot experiment arranged in a complete randomized design with nine treatments and three replications. Two kinds of soils were utilized namely alkaline and non-alkaline rice soils. The treatments were control, chert powder 55 kg/ha, chert powder110 kg/ha, urea 100 kg/ha; ammonium sulfate 200 kg/ha, urea 100 kg/ha + chert powder 55 kg/ha, urea 100 kg/ha + chert powder 110 kg/ha, ammonium sulfate 200 kg/ha +chert powder 55 kg/ha, and ammonium sulfate 200 kg/ha + chert powder110 kg/ha.

Rice variety used was Situ Bagendit, a variety that can be grown in a dry-land or in an inundated soil. Plant growth components were studied were plant height, number of tillers, lodging, number of panicles per plant, nmber of grain per panicle, total seed weight per pot.

Chert rock was extracted from Tobu in South Central Timor and Nunpene of North Central Timor. The chert rock was ground to pass a 500-mesh filter. Nitrogen fertilizer applied were urea and ammonium sulfate. The chert is crushed to pass through a 500-mesh sieve and given to the soil before planting. The nitrogen fertilizers were split into three equal dosage and applied consecutively at planting, vegetative fast growth stage, and at early generative stage.

The chemical properties of the soils are presented in the following.

Table 1: Chemical properties of soils utilized in this study.

No.	Organic C	Total N	P (ppm)	K	KTK	Soil reaction
	----------------- (%) -------------			---(cmol(+)/kg) ---		
1.	3.46	0.25	66.23	0.99	35.11	Alkaline
2.	4.07	0.31	81.24	1.27	40.05	Non alkaline

Analysis of variance was performed at a 5% level of significance.

3. RESULTS AND DISCUSSIONS

Plant growth in the form of plant height and number of tillers measured every two weeks after planting are presented for alkaline and non-alkaline soils.

3.1. ALAKALINE SOIL

Plant height

Observation of plant growth every two weeks showed an increase in plant height for all treatments (Figures 4.1 and 4.2). The figure below shows that the average plant height at two weeks after planting was 20-25 cm. Whereas, in the last observation all plants from all treatments showed a height of about 50-60 cm. From the first observation to the last observation, plant height did not appear to differ between treatments. When compared with the description of this rice variety (Var Situ Bagendit), the plant height at two months after planting is below the height of the description (description height 99-105 cm, http://bpatp.litbang.pertanian.go.id/ind/). Plant height according to the variety description is usually the height of the plant that is treated with technology and a good growing environment. This research is a potted study that uses a plastic bucket planting container which greatly limits the growth of plant roots because the amount of soil that can be trampled by the roots is limited by the bucket wall.

The foregoing may be the reason for the absence of differences in plant height. The variance checks on plant height (Table 4.1) shows that the treatment did not show a significant effect on plant height in the last observation. Thus, the plants either fertilized or not fertilized, plants that were given chert or not given chert powder, all had plant heights that were not significantly different at α = 0.05 with a coefficient of variability (CV) of only 8%.

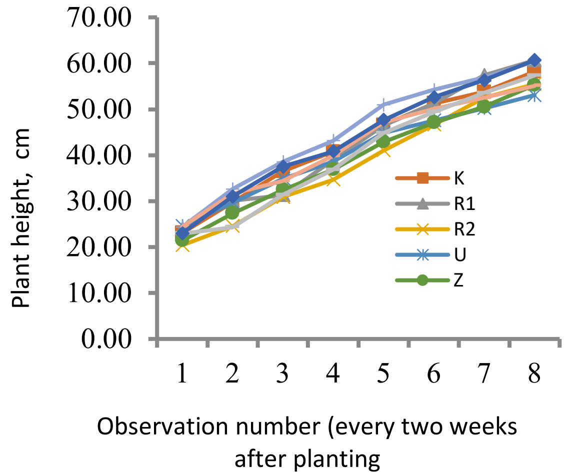

Figure 1: Plant height at each observation (once every two weeks)

Note: K = control; R1 chert powder 55 kg/ha; R2 of chert powder 110 kg/ha;U = Urea 100 kg/ha;Z = ammonium sulfate 200 kg/ha.UR1 = Urea 100 kg/ha + chert powder 55 kg/ha;UR2 = Urea 100 kg/ha + chert powder 110 kg/ha;ZR1 = ammonium sulfate 200 kg/ha + chert powder 55 kg/ha;ZR2 = ammonium sulfate 200 kg/ha + chert powder 110 kg/ha.

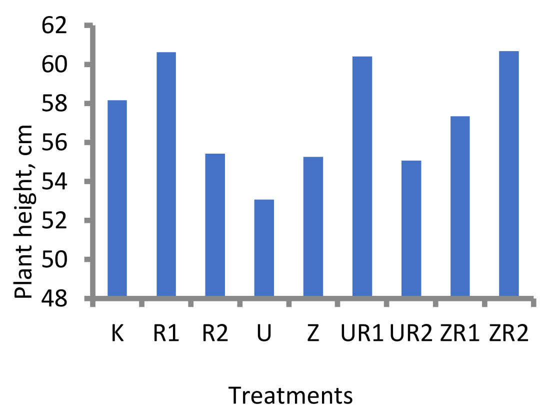

Figure 2: Plant height at last observation

Note: K = control; R1 chert powder 55 kg/ha; R2 of chert powder 110 kg/ha; U = Urea 100 kg/ha; Z = ammonium sulfate 200 kg/ha. UR1 = Urea 100 kg/ha + chert powder 55 kg/ha; UR2 = Urea 100 kg/ha + chert powder 110 kg/ha; ZR1 = ammonium sulfate 200 kg/ha + chert powder 55 kg/ha; ZR2 = ammonium sulfate 200 kg/ha + chert powder 110 kg/ha.

Table 1: Check the height variance of the last crop

Source of variation		df	Sum of squares	Middle square	F count	F table		Conclusion
						5%	1%	
Treatment		8	189.97	23.75	1.24	2.51	3.71	NS
Error		18	342.69	19.04				
Total		26	532.66	20.49				
CV	8%	NS	Not significantly different					

Number of tillers

Like plant height, the number of tillers on alkaline soils also shows an increase over time. However, the number of tillers increased very slightly at each observation.When transferring seedlings, plants from all the treatments planted were only one tiller. In the second observation, almost all of the treatmentshadgrown tillers except for treatment R2 and UR2(Figure 4.3).

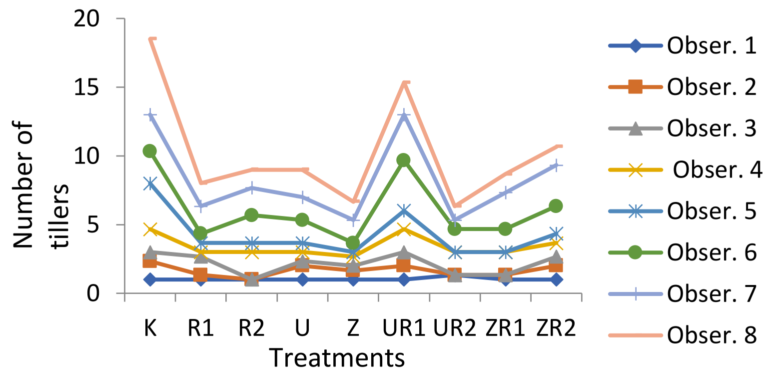

Figure 3: Number of tillers per pengamtan.

Note: K = control; R1 chert powder 55 kg/ha; R2 of chert powder 110 kg/ha; U = Urea 100 kg/ha; Z = ammonium sulfate 200 kg/ha. UR1 = Urea 100 kg/ha + chert powder 55 kg/ha; UR2 = Urea 100 kg/ha + chert powder 110 kg/ha; ZR1 = ammonium sulfate 200 kg/ha + chert powder 55 kg/ha; ZR2 = ammonium sulfate 200 kg/ha + chert powder 110 kg/ha.

Planting before flowering, plants from all treatments already had different numbers of tillers. The question is the control treatment and UR1 has a higher number of tillers compared to the number of tillers in other treatments (Figure 4.4). The number of tillers in these two treatments was 14 while in the other treatments, the number of tillers ranged from 6 to 10. However, statistically, the difference in the number of tillers was not significant at α = 5%. It also has a small coefficient of variability (CV) of 4.52% (Table 4.2).

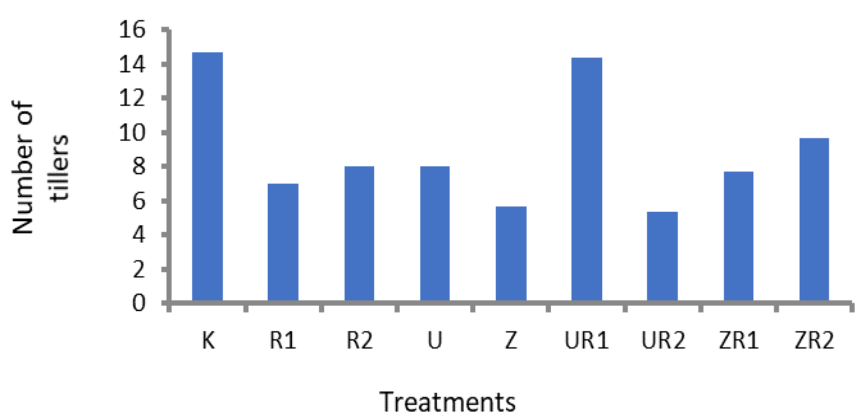

Figure 4: The number of tillers at the last observation

Note: K = control; R1 chert powder 55 kg/ha; R2 of chert powder 110 kg/ha; U = Urea 100 kg/ha; Z = ammonium sulfate 200 kg/ha. UR1 = Urea 100 kg/ha + chert powder 55 kg/ha; UR2 = Urea 100 kg/ha + chert powder 110 kg/ha; ZR1 = ammonium sulfate 200 kg/ha + chert powder 55 kg/ha; ZR2 = ammonium sulfate 200 kg/ha + chert powder 110 kg/ha.

Table2: Check for a variety of tillers at the last observation

Source of variation		df	Sum of squares	Mean square	F count	F table		Conclusion
						5%	1%	
Treatment		8	279.85	34.98	2.141723	2.51	3.71	NS
Error		18	294.00	16.33				
Total		26	573.85	22.07				
C V	4.52%		NS = Not significant					

3.2. NON-ALKALINE SOIL

Plant height

Plant height at planting for all treatments was the same. However, after two weeks after planting, the height of the plants appeared to be visually different. This difference was not that big and all the plants were between 18 cm to 20 cm in height. Observing the following weeks, all plants experienced an increase in plant height until the last observation, plant height ranged from 30 cm to 55 cm. As only in alkaline soils, plant growth is also hampered by limited growth in plants. However, an interesting thing that happens on non-alkaline soils is that the plants are much shorter than the height of the plants on alkaline soils.

This may be caused by the effects of a l lelopati on a non-alkaline soil. The non-alkaline soil used in this experiment comes from paddy soil which has not been planted with rice for a long time so that when the soil was taken for this experiment, the land was overgrown with thick and dense grass. Note: In the last few years, the rice field area from which the experimental land is based has not had enough water to cultivate the entire rice field there.

Allelopati is difined as chemical substances produced by the roots, stems, leaves, flowers, fruits, seeds and even a plant which can inhibit the growth or even toxic to other plants (Putnam and Tang (1986). All types of plants have the ability to produce allelopati. Type grass -Grass (Poaceae) has the ability to produce this chemical According to Sánchez-Moreiras (2003), Poaceae has target vegetation types from various families and not the least the target is also from P. oaceae species. Therefore, most likely, inadequate growth. of the rice plants in this experiment in non-alkaline soils due to the presence of allelopathy.

The presence of allelopathy also affects various soil properties such as phenolic acids affecting pH, electrical conductivity, availability of potassium (K^{+}), and dissolved chloride (Cl^{-}), as well as the nitrification process (Kruse et la., 2000).

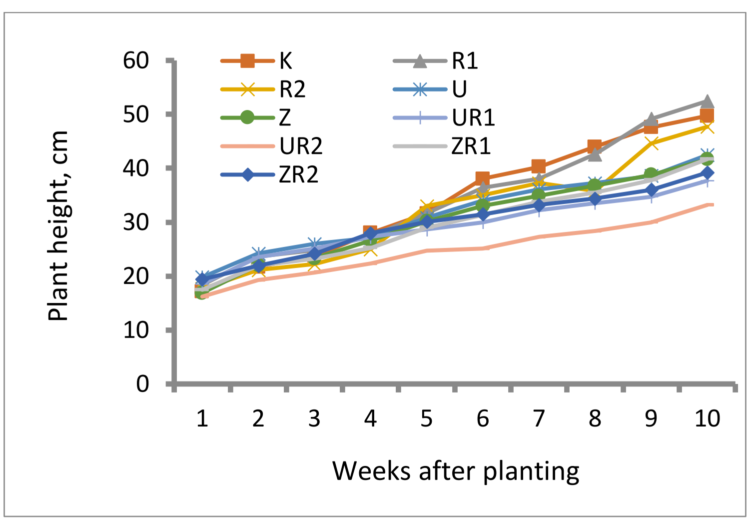

Figure 5: Plant height at different observations made every two weeks after planting

Note: K = control; R1 chert powder 55 kg/ha; R2 of chert powder 110 kg/ha; U = Urea 100 kg/ha; Z = ammonium sulfate 200 kg/ha. UR1 = Urea 100 kg/ha + chert powder 55 kg/ha; UR2 = Urea 100 kg/ha + chert powder 110 kg/ha; ZR1 = ammonium sulfate 200 kg/ha + chert powder 55 kg/ha; ZR2 = ammonium sulfate 200 kg/ha + chert powder 110 kg/ha.

The last observation on plant height also ranges from about 30 for plant treated with urea 100 kg/ha+ chert powder 110 kg/haand the tallest (52 cm) was in treatmentR1 (chert powder 55 kg/ha).

Although there is a tendency for differences in the height of rice plants from various treatments, however, statistically, all of these plant height differences are not in a significant degree of 5% difference with a low coefficient of diversity (CV = 13%) as shown in the variance fingerprint table below. (Table 3).

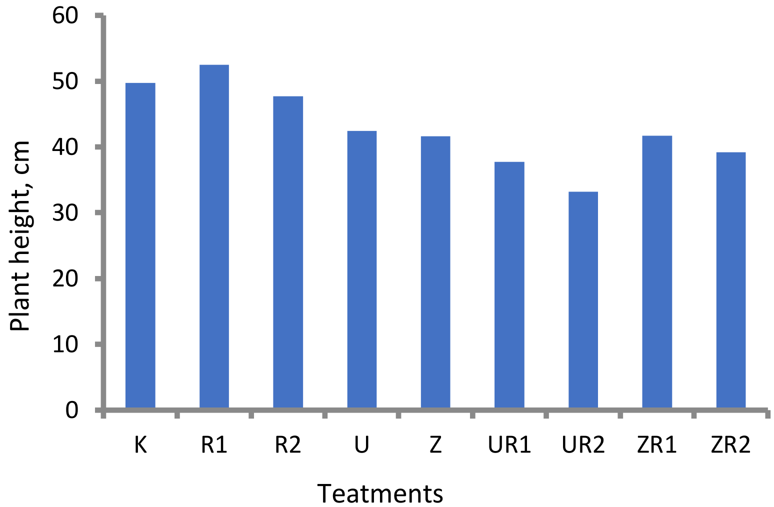

Figure 6: Plant height in the last observation.

Note: K = control; R1 chert powder 55 kg/ha; R2 of chert powder 110 kg/ha; U = Urea 100 kg/ha; Z = ammonium sulfate 200 kg/ha. UR1 = Urea 100 kg/ha + chert powder 55 kg/ha; UR2 = Urea 100 kg/ha + chert powder 110 kg/ha; ZR1 = ammonium sulfate 200 kg/ha + chert powder 55 kg/ha; ZR2 = ammonium sulfate 200 kg/ha + chert powder 110 kg/ha.

Table 3: Check for variance in plant height at the last observation

Source of variation		df	Sum of squares	Mean square	F count	F table		Conclusion
						5%	1%	
Treatment		8	897.89	112.24	3,59575	2.51	3.71	*
Error		18	561.85	31.21				
Total		26	1,459.74	56.14				
CV	13%		* Siginificant at α= 5%					

Number of tillers

The number of tillers / seedlings of rice plants planted in non-alkaline soil is one seed per pot. Generally, this experimental plant begins to produce new tillers at weeks 2 to 4 after planting. However, the UR1 treatment (Urea 100 kg / ha + chert powder 55 kg / ha) the number of tillers remained one until the last observation. This may be caused by chemical resistance due to the presence of allelopathy of the field grass that grows on the soil used as a non-alkaline growing medium (as described in section 4.2.1 above. At the end of the planting, there is a difference in the number of tillers. rice in all treatments It was seen that the R2 and U treatments had more tillers than the other treatments It was also seen that there was a grouping of the number of tillers in the last observation, namely the R2 and U groups in one group and K, UR2, ZR1, ZR2, and Z.

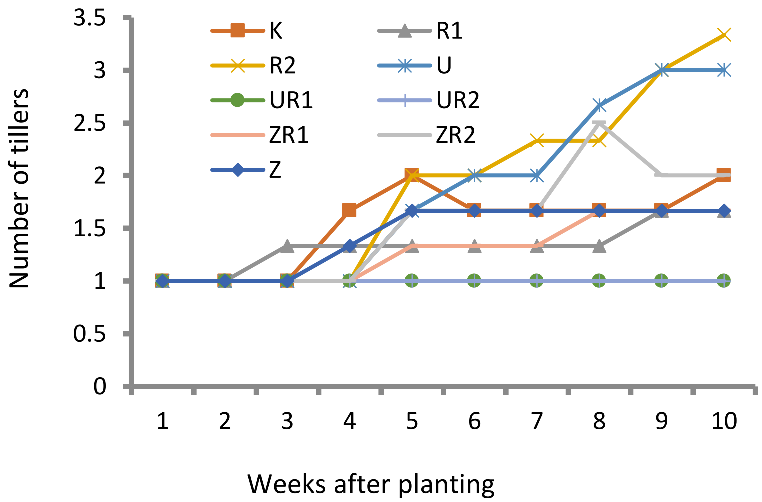

Figure7: The number of tillers with different treatments was observed every two weeks after planting

Note: K = control; R1 chert powder 55 kg/ha; R2 of chert powder 110 kg/ha; U = Urea 100 kg/ha; Z = ammonium sulfate 200 kg / ha. UR1 = Urea 100 kg/ha + chert powder 55 kg/ha; UR2 = Urea 100 kg/ha + chert powder 110 kg/ha; ZR1 = ammonium sulfate 200 kg/ha + chert powder 55 kg/ha; ZR2 = ammonium sulfate 200 kg/ha + chert powder 110 kg/ha.

Although there appeared to be differences in the number of tillers between treatments, especially in the last observation (Figure 4.8), the analysis of variance of number of tillers as shown in Table 4, all these differences were not statistically significant at the 5% difference. Even this absence of significant difference needs attention because it turns out that the coefficient of variance is quite high, namely 66%. This may again be due to the inhibition of plant growth on these non-alkaline soils, which stem from the possibility of chemical compounds that are allelopathic in nature produced by thick and dense field grass in the paddy soil where the experimental soil was taken.

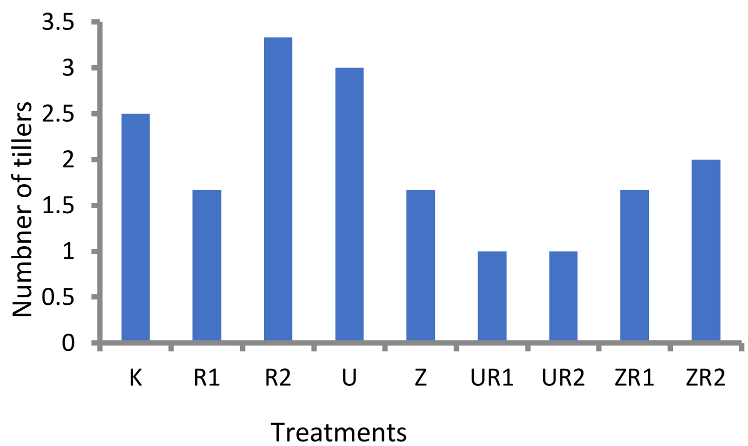

Figure 8: The number of rice tillers in the last observation from various fertilization treatments

Note: K = control; R1 chert powder 55 kg/ha; R2 of chert powder 110 kg/ha; U = Urea 100 kg/ha; Z = ammonium sulfate 200 kg/ha. UR1 = Urea 100 kg/ha + chert powder 55 kg/ha; UR2 = Urea 100 kg/ha + chert powder 110 kg/ha; ZR1 = ammonium sulfate 200 kg/ha + chert powder 55 kg/ha; ZR2 = ammonium sulfate 200 kg/ha + chert powder 110 kg/ha.

Table 4: Investigate the various effects of treatment on the number of tillers in the last observation

Source of variation		df	Sum of squares	Mean square	F count	F table		Conclusion
						0.05	0.01	
Treatment		8	15.3333	1.9166	1.2162	2.51	3.71	N S
Error		18	28.3666	1.5759				
Total		26	43.7	1,6807				
CV	66%		NS = not siginficant					

4. CONCLUSION

The results and discussion led to the following conclusions:

The application of fertilizer and chert powder in various doses did not affect the growth of rice plants grown on alkaline or non-alkaline soils.

The growth of rice plants on alkaline soils was actually better than that of non-alkaline soils, which is probably due to the allelopathic effect of non-alkaline soils.

5. SUGGESTION

With the difference in plant growth on alkaline and non-alkaline soils which are not caused by differences in treatment but possibly due to the presence of allelopathic compounds, it is suggested for allelopathic research on non-alkaline soils used in this experiment, especially to assess the impact of allelopathy and the combination with the treatment tested on soil properties and growth of rice plants.

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CONFLICT OF INTEREST

The author have declared that no competing interests exist.

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