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***RESEARCH ARTICLE***

# ORGANIC FERTILIZER FROM SILK TREE LITTER (*Albizia falcataria* L.) TO ENHANCE MAGNESIUM AVAILABILITY FOR PADDY (*Oryza sativa* L.) IN ALFISOL

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**ABSTRACT**

The research had been done in Pereng, Mojogedang, Karanganyar. The aim of the research is to know the influence of enrichment of organic fertilizer with the addition of Silk Tree litter (*Albizia falcataria L.*) in improving the availability and Mg uptake of rice plants (*Oryza sativa L.*) fields in Alfisol. The research used a basic design factorial with two factors, it were dose and cropping systems. The data analysis used F test on level 5%, Kruskal-Wallis test, DMR test on level 5%, Mood Median test, and correlation test. The results of the research showed that the availability and uptake of Mg in conventional cultivation system is higher than the SRI cultivation system. Mg uptake in conventional cultivation systems of 0.015 g/plant. The highest Mg availability can be achieved in the combined treatment D6B1 (conventional and 50 % + 100% organic fertilizer dose recommendations Silk Tree litter + 15% weight of organic fertilizer) of 2.34 cmol(+)/kg. Organic fertilizer with the addition of Silk Tree litter can not enrich the availability and uptake of Mg, but conventional cultivation systems influence the availability and uptake of Mg. Conventional cultivation systems influence the availability and uptake of Mg is higher than the SRI cultivation system.

***Keywords***: inorganic fertilizer, organic fertilizer, Silk Tree (*Albizia falcataria L.*), Mg avability, Mg uptake

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## INTRODUCTION

Rice (*Oryza sativa L.*) is one of the major food crop in the world. Rice production centers, it were China and India, respectively by 35 and 20 percent of total world production. Now, rice is the staple food of most the people of Asia, like China, Japan, Korea, Vietnam, Malaysia, Philippines, and Indonesia. Rice is the staple food of Indonesia derived from rice plants, the majority of Indonesian people usually eat white rice so the requirement should be maximized. The lack of carbohydrates can cause the body to become weak and the body's metabolism can not proceed smoothly (Kristamtini and Purwaningsih, 2009).

As one of the tropical countries, paddy field is a land that generally have enough water available. Physically, paddy fields are characterized by the formation of top layer that are oxidative-reductive and aerobic-anaerobic as a result of flooded. Intensive management of paddy field with monocultures and the used superior rice varieties continuously can lead to nutrient imbalances and decreased production (Hardjowigeno and Rayes, 2005).

Alfisols is arable land, despite the danger of erosion need to be considered. Efforts are needed to increase production intensity, including fertilizing and maintenance of soil and plants. Management of paddy field mechanically or chemically continuously can cause degradation of soil fertility so it will affect the efficiency of

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nutrient uptake which would cause a decrease in production (Safuan et al., 2002). Magnesium loss in paddy soil can occur because the elements of Mg easily lost, but also can be adsorbed by organic compounds.

Magnesium is a nutrient that is required for the formation of chlorophyll. Magnesium deficiency can be caused by large amounts of potassium fertilization. Mg supply to the ground can be provided in the form of organic fertilizer derived from cow manure with Silk Tree litter. Cow manure owned by many farmers and it has a relatively high Mg content.

One of the organic material that can be used to increase the availability of nutrients Mg is an organic material derived from organic matter which is Silk Tree litter (*Albizia falcataria* L.). The addition of organic matter such as Silk Tree litter expected to increase the availability of Mg in the soil and it can improve soil physical properties so it can increase the production of rice plants (Nasution, 2008).

Increasing rice production is not only done by fertilizing. Indonesia has developed another way to increase the production of rice plants by farming systems, such as conventional and System of Rice Intensification (SRI). Conventional systems are generally made by farmers. While SRI is a farming system that has been developed to reduce external inputs such as chemical fertilizers, irrigation water and others. The different cultural systems of the most prominent are the addition of water. Water levels in conventional systems are 5 cm to 10 cm from the ground that is added continuously (Suastika et al., 1997), while in the SRI system, water levels only 2 cm of soil or muddy conditions has added gradually (Sampoerna, 2009).

Based on these problems need to study the increasing of Mg to improve the efficiency of Mg absorption at some dose combinations of organic manure with Silk Tree litter to increase the availability of Mg and rice production.

**MATERIALS AND METHODS**

The research had been done on June 2009 to December 2009. Seeding, cultivation of rice plants, soil sampling and plant sampling were taken in the Pereng village, Mojogedang, Karanganyar, with an elevation of 280 meters above the sea level and it is located at $7^0$32'10 South Latitude and $11^0$10'05 East Longitude. Laboratory analysis was conducted at the Laboratory of Soil Chemistry and Fertility, Faculty of Agriculture, Sebelas Maret University, Surakarta.

Materials used include: air dried soil samples Φ 0.5 mm, cow manure, Silk Tree litter (*Albizia falcataria L.*), Rice seeds (*Oryza sativa*) Sintanur varieties, inorganic fertilizers (Urea, SP36 and KCl) and some chemical analysis for soil and part of the crop : $H_3BO_3$ 1%, 40% NaOH, aquadest, ammonium acetate, 0.05 N $H_2SO_4$, $K_2Cr_2O_7$, $H_2SO_4$, $H_3PO_4$ 85%, Diphenylamin indicator, $FeSO_4$ 1N, Alcohol, NaCl 10%, NaOH 45% , Grain Zn, $H_3BO_3$ 2%, universal indicator, HCl 0,2N, KCl. The tools used include: Hoes, soil auger, Erlenmeyer, Beaker Glass, Pipette, Flakon, Paper Whatman, Tube Khjedhal, Destructor, Erlenmeyer 50 ml, Distillation Tubes, pH meter.

This research used Complete Randomized Block Design (CRBD) with 2 factors, that were factor I: fertilizer doses and the factor II: the system of cultivation. The treatment of the following factors are the dose of fertilizer consist of farmers habit dose 400 kg urea, 100 kg SP36, 100 kg KCl (D1); 250 kg urea, SP36 75 kg, 100 kg KCl (recommended dose) (D2); 10 tons/ha cow manure (organic fertilizer) (D3); 50% organic fertilizer + 100% recommendations + Silk Tree litter amount 10% of the weight organic fertilizer (D4); 50% + 50% organic fertilizer dose recommendations Silk Tree litter + 10% weight of organic fertilizer (D5); 50 % organic fertilizer +

100% recommendations dose + Silk Tree litter amount 15% of the weight organic fertilizer (D6); 50% organic fertilizer + 50% recommendations dose + Silk Tree litter amount 15% of the weight organic fertilizer (D7), 50% organic fertilizer + 100% recommendation dose + Silk Tree litter amount 20% of the weight organic fertilizer (D8); 50% organic fertilizer + 50% recommendation dose + Silk Tree litter amount 20% of the weight organic fertilizer (D9). While the factors of cultivation system are conventional cultivation systems and System of Rice Intensification (SRI). From these two factors were obtained 18 treatment combinations, each treatment was repeated 3 times in 3 blocks that obtained 54 combination.

Data were analyzed using the F test at the 5% significance level (if normal data) and Kruskal Wallis (when not normal data). For comparing the mean between treatments used Duncan's Multiple Range Test (DMRT) at the 5% significance level (if normal data) and the median mood (when not normal data). Correlation test was used to determine the relationship between variables.

## RESULT AND DISCUSSION

### The availability of Mg

The results of F test indicate that application of cow manure with Silk Tree litter to the availability of Mg are not significant ($P > 0,05$), cultivation systems and its interaction are significantly different ($P < 0,01$) to the availability of Mg. The influence of cultivation system and its interaction with dose combination of Mg are presented in the Figure 1.

Figure 1 showed that conventional cultivation systems the availability of Mg amount to 1,87 cmol(+)/kg, which is higher than the SRI cultivation system amount to 1,63 cmol(+)/kg. The interaction of cultivation system with dose combination ($P = 0,002$) are significantly different.

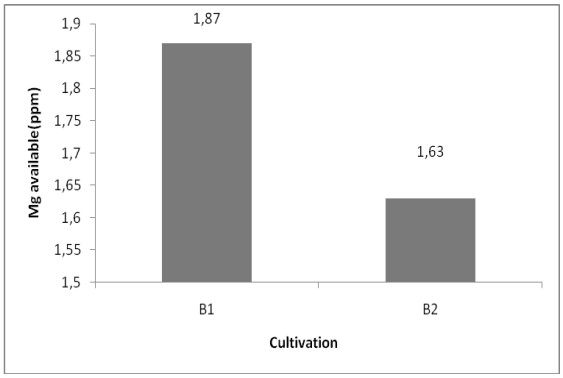


**Figure 1**. The influence of cultivation systems on the availability of Mg in the soil (ppm); B1 : Conventional; B2 : System of Rice Intensification

The availability of Mg is high in the conventional cultivation system caused by flooding continuously. Flooding can change chemical properties, physical-chemical (electrochemistry) and soil biology that affected to the uptake of nutrients by paddies. The changing of chemical properties is influenced by the biologic reduction-oxidation process as a result of lack $O_2$ (Hardjowigeno *et al*., 2005).

Mg in the soil not all be absorbed by plants. Properties Mg easily leaching because of continuous flooding so $Mg^{2+}$ in the form available in the soil. The SRI cultivation systems, there Mg that is not soluble, that is precipitated because lack of flooding or soil of mudded condition.

The results of DMRT test at the 5% significance level are known that highest availability of Mg achieved in the dose of 50% organic fertilizer + 100% dose recommendation + Silk Tree litter amount 15% of the weight organic fertilizer (D6B1) amount to 2,34 cmol(+)/kg. It can be caused by applying organic fertilizer derived from cow manure with Silk Tree litter and KCL which is the source of potassium (K) in the soil, thus it may increase the availability of K so it can cause Mg deficiency. In this case flooding plays an important role on the

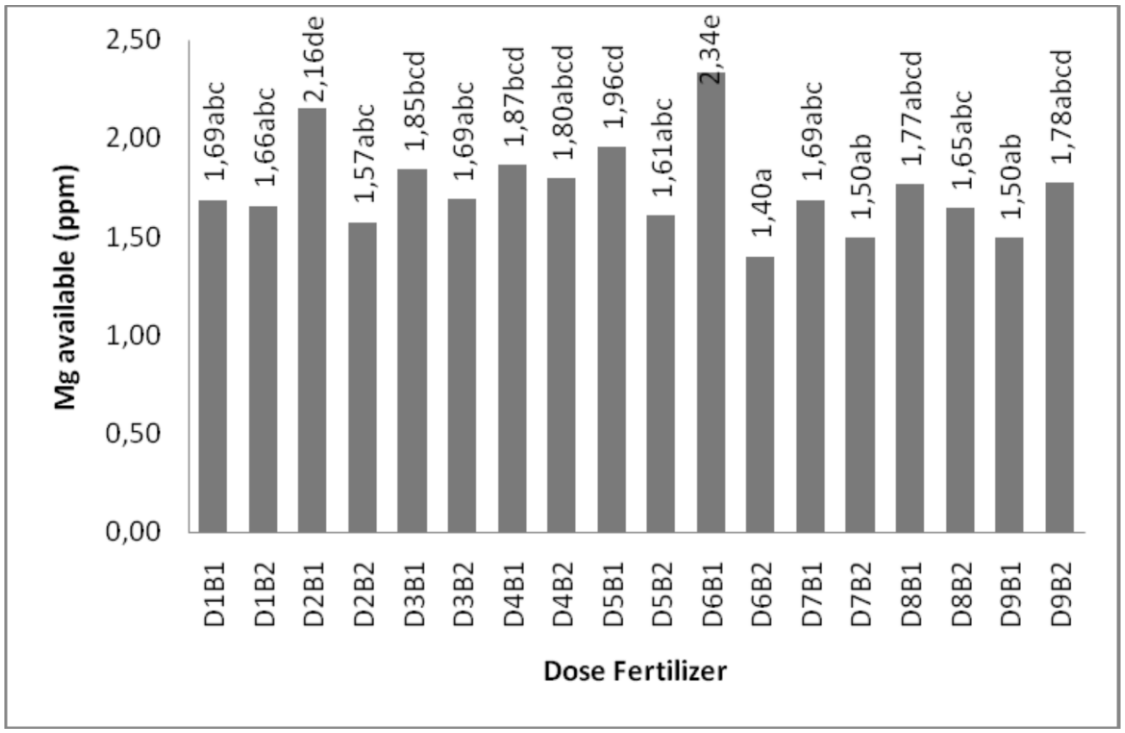


**Figure 2.** The combined dose of organic fertilizer, anorganic fertilizer, Silk Tree litter and cultivation system to the availability of Mg (D = Dose of organic fertilizer, anorganic fertilizer and Silk Tree litter; B = cultivation system); Numbers that followed by the same letter indicate that is not significantly different on DMRT test at the 5% significance level

availability of Mg in the soil because Mg is easily soluble (Winarso, 2005).

Unbalance of Ca and Mg in the soils that CEC is low so it can cause Mg deficiency. If the ratio of Ca/Mg is high in the soil, the plant will absorb a little Mg. As well as the increasing availability of K and ammonium ($NH4^+$) can cause Mg deficiency (Winarso, 2005).

Interactions of dose with cultivation system are significantly difference thus the same dose that given to the plant would be different in the results if the cultivation systems are different. This is because of all the planting activities that are almost different, such as land preparation systems, seed selection, nursery, seed treatment before planting, planting, irrigation, fertilizing, weeding and pest control.

The results of correlation test showed that the availability of Mg positively correlated to Mg in the plant tissue (r = 0,317) and the uptake of Mg (r = 0,299). The result of F test showed that conventional cultivation systems significantly influenced by the availability of Mg, Mg in the plant tissue and Mg uptake. The increasing of Mg available in the soil mean the uptake of Mg by plants also high, so it affects to Mg in the plant tissue, so the plant needed of Mg is fulfilled.

**Mg Uptake**

The result of F test indicated that the dose did not really affect the uptake of Mg with a P value (0.169), meanwhile cultivation systems (P = 0.000) and the effect of dose with a cultivation system for the uptake of Mg is significantly affected (P = 0.010) to the absorption of Mg.

In Figure 3, the highest Mg uptake is in the conventional cultivation system. The amount of Mg absorption in the conventional cultivation system of 0.011 g/plant is higher

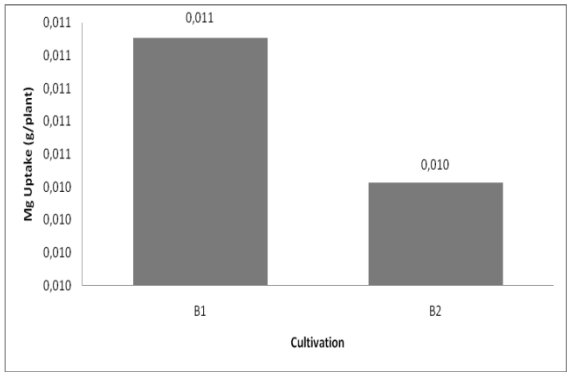


**Figure 3.** Effect of cultivation (B1: Conventional, B2: System of Rice Intensification) on Mg absorption (g/plant); The numbers that are followed by the same letter indicates not significantly different in the Mood Median test at the 5% significance level

than the SRI cultivation (0.010 g/plant). According to the Hanafi (2005) generally plant requires 0.2%, of Mg, while according to Dierolf et al (2001), a local rice plant absorbs as much as 5 kg Mg/ha for superior rice reach to 10 kg/ha, but in rice plants Mg absorbed amount to 0.1% (Sanchez, 1976).

The result of correlation test showed that Mg in the plant tissue is positively correlated with Mg uptake (r = 0.970) in paddies. Interaction between conventional cultivation systems with a dose treatment significantly correlated to the Mg in plant tissue and the uptake of Mg. This causes the absorption of Mg by the plant tissue.

Mg uptake in conventional cultivation systems is high due to the availability of K and ammonium ($NH4^+$), so the presence of K and the availability of ammonium ($NH4^+$) can lead to increased Mg deficiency.

It can be shown in all treatments, thus it obtained the highest rates uptake of Mg crops that is achieved in the treatment D1B1 (Dose habits of the farmers) of 0.015 g/plant. This is caused by the mineralization of organic matter that produces Mg minerals ($Mg^{2+}$) then it absorbed by plants because cow manure and Silk Tree litter are slow released and not fixed by Fe, Al and Ca, meanwhile the mineralization of organic matter produces

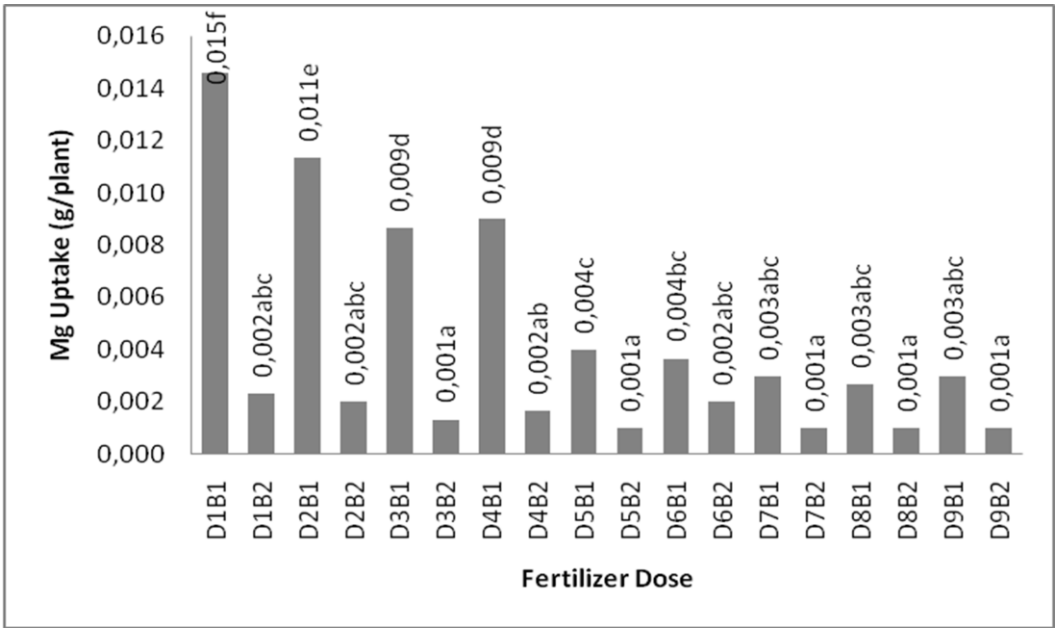


**Figure 4.** Dose treatment of organic fertilizer, inorganic fertilizer, Silk Tree litter and cropping systems on Mg absorption (D = dose of organic fertilizer, inorganic fertilizer and Silk Tree litter; B = cultivation system); The numbers that are followed by the same letter indicates not significantly different at the 5% significance level of DMRT test

organic acids and $C0_2$. Organic acids produce an organic anion that is able to bind ions such as Al, Fe and Ca from the soil solution and it forms a complex insoluble compound (Suntoro, 2006).

The amount of Mg uptake directly affects the amount of Mg in plant tissues. The greater the Mg that can be absorbed Mg in the plant tissues will also be greater. The results of the Kruskal Wallis test showed that Mg in the plant tissue are not affected significantly by the dose of organic fertilizer, inorganic fertilizer and Silk Tree litter (P = 0.268), cultivation systems are affected significantly to the amount of Mg in plant tissue (P = 0.000 ) and the interaction between organic fertilizer, inorganic fertilizer and Silk Tree litter with cultivation system are affected significantly on the amount of Mg in plant tissue (P = 0.005).

The results of Mood Median's test at the 5% significance level showed that the system is significantly different from conventional cultivation to SRI on the amount

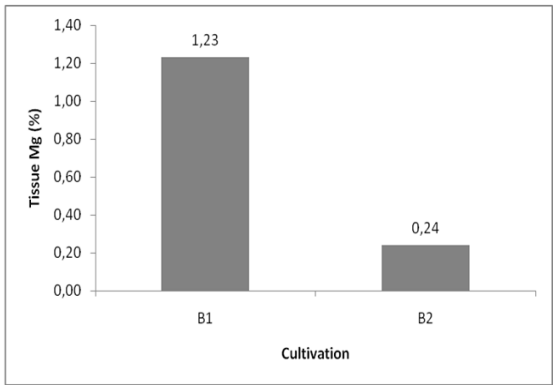


**Figure 5.** The cultivation system effect (B1: Conventional, B2: System of Rice Intensification) on Mg in plant tissue; The numbers that are followed by the same letter indicates not significantly different in the Mood Median's test at the 5% significance level

of Mg in plant tissue. Mg on the plant tissue in the conventional cultivation system amount to 1.23%, while in the SRI amount to 0.24%. The results of this study showed that Mg on plant tissue in conventional cultivation systems are greater than the SRI because of continuously flooding. Flooding can change chemical properties, physico-chemical

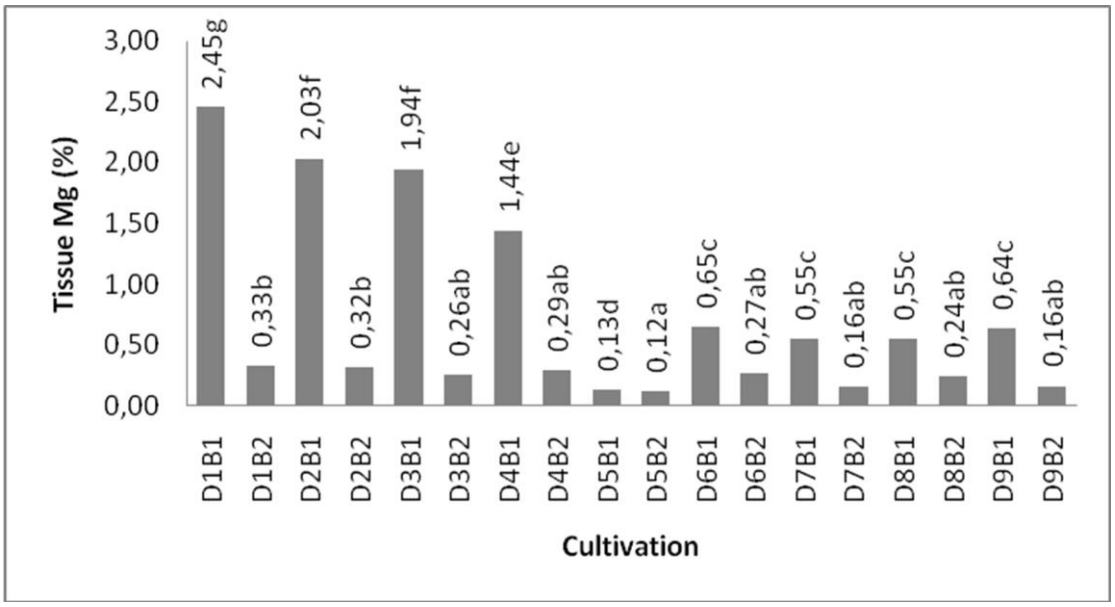


**Figure 6.** Dose treatment of organic fertilizer, inorganic fertilizer, Silk Tree litter and cultivation system on Mg in plant tissue (D = dose of organic fertilizer, inorganic fertilizer and Silk Tree litter; B = cultivation system)

(electrochemical) and it can influence biologically soil nutrient supply to the paddies. The Changing in the chemical properties are influenced by the process of biological oxidation-reduction as a result of the lack of $O_2$ (Hardjowigeno et al., 2005). The number of Mg that is available in the soil greatly affects to the amount of Mg which is absorbed by plants, but there is Mg that cannot be absorbed by plants.

These results indicate that the highest Mg in the plant tissue can be achieved in a habit dose of farmers (D1B1), amount to 2.45% (Figure 6). This was due to organic fertilizer from cow manure that is one of Mg nutrient sources that is large enough. The number of Mg available in the soil related to the amount of Mg that can be absorbed by plants, if the amount of Mg is high, Mg in the plant tissue is also getting bigger.

**CONCLUSION**

1. The high availability of Mg on rice plant in Alfisol is achieved on the treatment D6B1 (50% organic fertilizer + 100% dose recommendation + Silk Tree litter amount 15% of the weight organic fertilizer) amount to 2,34 cmol(+)/kg.
2. The highest uptake of Mg by the rice plant in Alfisol is treatment D1B1 (400 kg urea, 100 SP36, 100 kg KCl) with the conventional cultivation system amount 0,015 g/plant.
3. Addition of organic manure and Silk Tree litter cannot enrich the availability and absorbent of Mg, but the conventional cultivation system gives an influence of mg availability and Mg absorbent that are better than System of Rice Intensification.

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