The effects of nano inorganic fertilizer application on rice 
(Oryza sativa L) productivity

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Abstract. Lowland rice production has experienced fluctuation and stagnation due to uncertain climatic factors and lowering soil fertility. Use nano fertilizer has the advantage of being more reactive, can reach target or target due to its fine size, as well required in small quantities. So that agricultural results can be achieved optimally. The research aims to test the effectiveness of inorganic fertilizers containing nano-meter-sized Ca for plant growth and rice yield. The research was carried out at farmland of PT. Sang Hyang Seri (Persero) in the dry season 2018. The study used a randomized block design with 8 treatments and each had 4 replications. The treatment consists of two levels of dilution of nano inorganic fertilizers, 200 and 400 times, which were applied to treatments without fertilizer, NPK + Urea fertilization 100% and 75%. Nano inorganic fertilizers are given by spraying on the lower rice leaves, in sunny weather conditions between the hours of 07.00 to 10:00 am. The results showed that the use of nano inorganic fertilizer application with 400 times dilution on 75% NPK + Urea fertilization recommendation was able to increase the weight of milled dry grain by 11.3% when compared to 100% NPK + Urea fertilization.

1. Introduction

Indonesia is the third largest rice producing countries in the world where total rice production in 2011 was around 65.74 million t of unhulled rice [1]. The adoption of green revolution technology has increased rice productivity in most Asian countries, including Indonesia. Over the last 15 years (2001-2015), rice production in Indonesia increased from around 50.46 million t in 2001 to around 75.40 million t in 2015 [2]. However, this increase is no longer sufficient to meet demand for rice. Although rice productivity averages about 5.2 t ha⁻¹, it has fluctuated and stagnated over the past decade. Apart from climatic factors, changes in soil fertility may have influenced the fluctuation and stagnation of rice productivity in Indonesia.

In terms of overcoming the problem of rice imports, the government seeks to increase national rice production, however the productivity of Indonesian rice plants has not yet met expectations [3]. Therefore, going forward, increasing rice production requires increased productivity and efficiency. In the context of food security, efforts to pursue national food self-sufficiency, especially rice, have become the main concern of the government in Indonesia.

The purpose of this research is the use of nano inorganic fertilizer technology is expected to help increase rice production. The development of nanotechnology in agriculture has a pretty good prospect to be able to answer the challenge of precisely providing nutrients for plants through a more efficient nutrient delivery system [4]. The challenge of exploring various forms of nanotechnology for...
agricultural improvement through the application of high-tech fertilizers is one of the important opportunities to develop high-tech agriculture in the future [5].

The nano inorganic fertilizers used are foliar fertilizers that come from natural minerals and without chemical additives. This product was developed to accelerate the photosynthetic process of plants which allows increased plant growth.

2. Research and methods

2.1. Location and time of research
The research was conducted in the dry season 2018 (May to November 2018) on rice fields in the Research Plantation of PT. Sang Hyang Seri (Persero), Ciasem Girang Village, Ciasem District, Subang Regency, West Java Province, Indonesia (06°20'26" S - 107°39'12" E). The indicator crop used was Inpari 30 variety.

2.2. Experiment and Treatment Design
This study used a randomized block design with 8 treatments and each had 4 replications. Treatments was consist of: A = (without fertilizer), B = (NPK + Urea) according to the recommendations (100%), C = nano inorganic fertilizer (1:200 dilution), D = 100% standard fertilizer + nano inorganic fertilizer (1:200 dilution), E = 75% standard fertilizer + nano inorganic fertilizer (1:200 dilution), F = nano inorganic fertilizer (1:400 dilution), G = 100% standard fertilizer + nano inorganic fertilizer (1:400 dilution), H = 75% standard fertilizer + nano inorganic fertilizer (1:400 dilution). Nano inorganic fertilizers are solid fertilizers whose application is sprayed onto the lower leaves (stomata) so that they need to be diluted with clean water (free of Cl).

The indicator plants used in the effectiveness test were Inpari 30 variety with the size of each treatment plot / plot 25 m² (5 m x 5 m). The dosage of nano inorganic fertilizer is 8 kg ha⁻¹ for 400 dilutions and 16 kg ha⁻¹ for 200 dilutions, so the requirements per plot are presented in table 1.

| No. | Treatment  | Fertilizer Dosage (kg ha⁻¹) | NPK compound | Urea | Nano inorganic |
|-----|------------|-----------------------------|--------------|------|----------------|
| 1.  | Control (Without fertilizer) | - | - | - |
| 2.  | (NPK + Urea) 100% (Standard Fertilizer) | 200 | 250 | - |
| 3.  | Nano inorganic fertilizer 200 | - | - | 8 |
| 4.  | (NPK + Urea) 100% + nano inorganic fertilizer 200 | 200 | 250 | 8 |
| 5.  | NPK + Urea) 75% + nano inorganic fertilizer 200 | 150 | 187.5 | 8 |
| 6.  | Nano inorganic fertilizer 400 | - | - | 16 |
| 7.  | (NPK+Urea) 100% + nano inorganic fertilizer 400 | 200 | 250 | 16 |
| 8.  | (NPK + Urea) 75% + nano inorganic fertilizer 400 | 150 | 187.5 | 16 |

The application of the seed is spread evenly and allowed to grow until it is about 20 days old. At the age of 14 days after spreading, spraying with nano inorganic fertilizer 25 g in 5 liters of water per 40 m² (5 g m⁻²) for 200 times dilution, and 12.5 g in 5 L of water per 40 m² (2.5 g per m²) for 400 dilutions. Compound NPK fertilization is carried out 7 days after planting (transplanting), while urea fertilizer is applied as a supplementary fertilizer at the age of 21 and 35 days after planting, according to the treatment. Fertilization of nano inorganic fertilizers was carried out 3 (three) times after planting for rice varieties aged 110 days after transplanting. The first spraying was carried out at the age of 7 days after planting, the second and third spraying at the age of 21 and 35 days after planting. Each application uses
a "wetting agent" at a dose of 1 ml per liter of solution. The dosage of nano inorganic fertilizers and the amount of water as a solvent are presented in Table 2.

### Table 2. Treatment and dosage of nano inorganic fertilizers per treatment plot (25 m²)

| No. | Treatments                                      | Dosage of nano inorganic fertilizers (g 25 m²) |
|-----|------------------------------------------------|-----------------------------------------------|
|     |                                                | 7 DAP  | 21 DAP | 35 DAP |
| 1.  | Control (Without fertilizer)                   | -      | -      | -      |
| 2.  | (NPK + Urea) 100% (Standard Fertilizer)        | -      | -      | -      |
| 3.  | Nano inorganic fertilizer 200                  | 5 g L⁻¹ water | 5 g L⁻¹ water | 5 g L⁻¹ water |
| 4.  | (NPK + Urea) 100% + nano inorganic fertilizer 200 | 5 g L⁻¹ water | 5 g L⁻¹ water | 5 g L⁻¹ water |
| 5.  | (NPK + Urea) 75% + nano inorganic fertilizer 200 | 5 g L⁻¹ water | 5 g L⁻¹ water | 5 g L⁻¹ water |
| 6.  | Nano inorganic fertilizer 400                  | 2.5 g L⁻¹ water | 2.5 g L⁻¹ water | 2.5 g L⁻¹ water |
| 7.  | (NPK+Urea) 100% + nano inorganic fertilizer 400 | 2.5 g L⁻¹ water | 2.5 g L⁻¹ water | 2.5 g L⁻¹ water |
| 8.  | (NPK + Urea) 75% + nano inorganic fertilizer 400 | 2.5 g L⁻¹ water | 2.5 g L⁻¹ water | 2.5 g L⁻¹ water |

Note: DAP = the day after planting

Observations were made on plant height and number of tillers (including productive tillers) at the age of 30, 60 days after transplanting and before harvesting, number of panicles per clump, weight of filled grains, weight of 1000 unhulled grains, unhulled grain (4 m x 4 m) of each treatment at each replication and measuring the moisture content and weight of milled dry grain. Soil analysis was carried out before planting, including soil texture (sand, dust and clay) soil pH, C-organic, Total N, P and K, available P, Ca, Mg, K and Na (NH₄OAc 1 N pH 7), KTK and KB.

3. Results and discussion

3.1. Analysis of nano inorganic fertilizers

The results of the analysis of nano inorganic fertilizers contained 53.59% CaO and 99.98% CaCO₃ equivalent, and a low water content of 0.17%. These fertilizers contained heavy metals Pb, Cd, As and Hg respectively 29; 5; 7 ppm, and were undetectable (Table 3).

### Table 3. Analysis results of nano inorganic fertilizers

| Parameters          | Unit | Results |
|---------------------|------|---------|
| Ca as CaO           | %    | 53.59   |
| Equivalent CaCO₃    | %    | 99.98   |
| Water content       | %    | 0.17    |
| Heavy metal         |      |         |
| As                  | ppm  | 7       |
| Hg                  | ppm  | td      |
| Cd                  | ppm  | 5       |
| Pb                  | ppm  | 29      |

Note: nd: not detected.

3.2. Soil analysis results

Soil samples were taken in a composite manner in replications I, II, III and IV. As sample, each plot was taken in each of these replications and combined, homogenized and taken + 1 kg as an example. The samples were taken to the IAARD testing laboratory for analysis [6].
Based on the results of the analysis of soil samples in the laboratory, the soil in the effectiveness test location was dusty clay texture, slightly acidic with a pH of 5.48 (Table 4). Soil pH dissolved in water is higher than that dissolved in KCl 1 N, this means that in the negatively charged soil entrapment complex, fertilization is quite effective.

Table 4. Physical and chemical properties of experimental land used for nano inorganic fertilizers on rice growth

| Soil Properties       | Unit            | Result     |
|-----------------------|-----------------|------------|
| Soil Texture          | Sandy-silt loam |            |
| Sand                  | %               | 1          |
| Silt                  | %               | 61         |
| Clay                  | %               | 38         |
| pH (1:5)              |                 |            |
| H₂O                   |                 | 5.48       |
| KCl                   |                 | 5.09       |
| Organic material      |                 |            |
| C                     | %               | 1.38       |
| N                     | %               | 0.14       |
| C/N                   |                 | 10         |
| P-Bray 1              | mg kg⁻¹         | 13         |
| Extract HCl 25%       |                 |            |
| P₂O₅                  | mg 100 g⁻¹      | 86         |
| K₂O                   | mg 100 g⁻¹      | 4          |
| Cation-exchange       |                 |            |
| capacity (NH₄-Asetat 1N, pH7) | cmol(+)kg⁻¹ | 6.14       |
| Ca                    | cmol(+)kg⁻¹     | 1.34       |
| Mg                    | cmol(+)kg⁻¹     | 0.07       |
| K                     | cmol(+)kg⁻¹     | 0.34       |
| Na                    | cmol(+)kg⁻¹     | 11.19      |
| Base saturation       | %               | 71         |

The C-organic content is very low with <1.5%, this happens mostly in intensively managed rice fields. The results of the study by [7] and [8] state that the C-organic content of most of the rice fields is less than 1.5%. In this condition, fertilization becomes ineffective and productivity slows down. N nutrient is a nutrient that is needed by plants for growth and production. Without N fertilization, the yield of rice plants will be low and almost the same as those without inorganic fertilization research result by Kasno et al. [9] stated that N nutrient is a limiting factor for growth and yield of rainfed lowland rice, N fertilization can increase from 30 to 137% of rice yield. The nutrient content of P and K extracted with HCl 25% had high and low status, respectively. The status of P nutrients is high because P nutrients are stable in the soil and are given every planting season. Apart from NPK fertilizer, the source of P nutrient which is commonly used in paddy fields is SP-36. Based on the research, the P nutrient status of paddy fields has actually increased, while the K nutrient has decreased.

3.3. Rice plant growth

Fertilization tends to increase the height of rice plants (table 5). The application of nano inorganic fertilizers without fertilization (NPK + Urea) was not able to increase plant height compared to the control. The application of nano inorganic fertilizers with 200 times dilution of 100% NPK + Urea
fertilization and 75% recommendation can not increase plant height compared to 100% fertilized rice plants. The highest plant height was achieved by applying nano inorganic fertilizers with a dilution of 400 times and tended to be higher when compared to the control. However, when compared to 100% it cannot increase plant height. Thus it can be said that the use of nano inorganic fertilizers without NPK + Urea fertilization cannot increase the height of rice plants both at the age of 30 and 60 DAP and just before harvest.

Table 5. Effect of nano inorganic fertilizers on plant height at 30 and 60 days after planting and at harvest

| No. | Treatment                                      | Plant height (cm) |            |            |            |
|-----|-----------------------------------------------|-------------------|------------|------------|------------|
|     |                                               | 30 DAP            | 60 DAP     | At harvest |            |
| 1.  | Control (Without fertilizer)                  | 52.33 bc          | 89.32 b    | 104.18 c   |            |
| 2.  | (NPK + Urea) 100% (Standard Fertilizer)       | 55.70 abc         | 92.40 ab   | 110.00 a   |            |
| 3.  | Nano inorganic fertilizer 200                 | 51.25 c           | 91.65 ab   | 104.30 c   |            |
| 4.  | (NPK + Urea) 100% + nano inorganic fertilizer 200 | 56.78 ab         | 92.85 ab   | 110.03 a   |            |
| 5.  | (NPK + Urea) 75% + nano inorganic fertilizer 200 | 54.98 abc        | 93.45 ab   | 105.92 bc  |            |
| 6.  | Nano inorganic fertilizers 400                | 54.23 ab          | 94.8 ab    | 105.57 bc  |            |
| 7.  | (NPK+Urea) 100% + nano inorganic fertilizer 400 | 57.95 a           | 93.80 ab   | 108.53 ab  |            |
| 8.  | (NPK + Urea) 75% + nano inorganic fertilizer 400 | 57.95 a          | 96.05 a    | 109.23 a   |            |
|     | % CV                                          | 4.19              | 2.05       | 2.17       |            |

Note: DAP = days after planting
Numbers in the same column followed by the same letter are not significantly different at the 5% level based on the DMRT test

The application of nano inorganic fertilizers with 200 times dilution of NPK + Urea fertilization with 75% recommendation resulted in plant height that was not significantly different compared to 400 times dilution with 100% NPK + Urea fertilization, and was the highest plant. It can be said that nano inorganic fertilizers can make the use of NPK + Urea compound fertilizer more efficient by 25%. The application of nano inorganic fertilizers without inorganic fertilization did not significantly increase the number of tillers. However, the application of nano inorganic fertilizers either with 200 or 400 dilutions at 100% NPK + Urea fertilization or 75% recommendation gave the same number of tillers at the age of 30 and 60 DAP (table 6). Meanwhile, the use of nano inorganic fertilizers with a dilution of 400 times with 75% NPK + Urea fertilization, the recommendation gives the number of productive tillers which are statistically the same as NPK + Urea fertilization 100% without the application of nano inorganic fertilizers. It can be said that the application of nano inorganic fertilizers with a dilution of 400 times can reduce the use of inorganic fertilizers by 25%.

3.4. Rice Results
The application of nano inorganic fertilizers on rice plants without NPK + Urea fertilization could not increase the weight of harvested dry grain, weight of milled dry grain, weight of dry straw (table 7). The application of nano inorganic fertilizers both at 200 and 400 times dilution at 75% NPK + Urea fertilization resulted in the weight of harvested dry grain, dry milled grain weight and dry straw weight which were statistically the same as the 100% recommendation of NPK + Urea fertilization. The application of nano inorganic fertilizers with 400 times dilution resulted in statistically the same weight of harvested dry grain and dry milled grain weight compared to 200 times dilution at the same NPK + Urea fertilization, namely 75% recommendation. However, the highest yield was obtained in the application of nano inorganic fertilizers with a dilution of 400 times at 75% recommendation of NPK + Urea fertilization. It can be concluded that the use of nano inorganic fertilizers can increase the efficiency of using NPK + Urea by 25%. The application of nano inorganic fertilizers at a dilution of
400 times more efficient than the 200 times dilution of 75% recommendation of NPK + Urea fertilization.

Table 6. The effect of nano inorganic fertilizers on the number of tillers aged 30 and 60 days after planting and the number of productive tillers at harvest.

| No. | Treatment                                              | Number of tillers (stems) | Number of productive tillers At harvest time |
|-----|--------------------------------------------------------|---------------------------|---------------------------------------------|
| 1.  | Control (Without fertilizer)                          | 27.80 ab                  | 27.03 b                                     | 20.30 b                                   |
| 2.  | (NPK + Urea) 100% (Standard Fertilizer)               | 30.63 a                   | 33.15 ab                                    | 24.50 a                                   |
| 3.  | Nano inorganic fertilizer 200                         | 24.08 b                   | 30.43 ab                                    | 23.08 ab                                  |
| 4.  | (NPK + Urea) 100% + nano inorganic fertilizer 200     | 31.25 a                   | 33.85 a                                    | 23.85 ab                                  |
| 5.  | (NPK + Urea) 75% + nano inorganic fertilizer 200      | 26.70 ab                  | 32.60 ab                                    | 24.00 ab                                  |
| 6.  | Nano inorganic fertilizer 400                         | 25.98 ab                  | 31.5 ab                                     | 23.55 ab                                  |
| 7.  | (NPK+Urea) 100% + nano inorganic fertilizer 400       | 30.15 ab                  | 33.40 ab                                    | 23.25 ab                                  |
| 8.  | (NPK + Urea) 75% + nano inorganic fertilizer 400      | 31.30 a                   | 34.98 a                                    | 24.25 a                                  |
|     | % CV                                                   | 8.97                      | 7.23                                       | 5.29                                      |

Note: DAP = days after planting
Numbers in the same column followed by the same letter are not significantly different at the 5% level based on the DMRT test.

The use of nano inorganic fertilizers both 200 and 400 times dilution without NPK + Urea fertilization gave a low yield increase of <5% (table 8). The highest yield increase was achieved at 75% NPK + Urea fertilization for both 200 and 400 dilution nano fertilizer applications. Meanwhile, nano inorganic fertilizers are relatively the same as NPK + Urea fertilization 100% without nano inorganic fertilizers. The increase in rice yields based on standard fertilizers, in the application of nano inorganic fertilizers both 200 and 400 times the dilution at 100% NPK + Urea fertilization was relatively small (<4%). Meanwhile, the yield increase in the application of nano inorganic fertilizers 200 and 400 times the dilution of NPK + Urea was 75% higher, namely >7.5%. So the highest yield increase was achieved in the application of nano inorganic fertilizer 400 times dilution at 75% NPK + Urea fertilization of 8.4% for the weight of harvested dry grain and 11.3% for the weight of milled dry grain. Thus it can be said that the application of nano inorganic fertilizers can reduce the need for NPK + Urea by 25%.

3.5. Relative Agonomic Effectiveness (RAE) Value
Research result by Matchay et al. [10] to determine the effectiveness of inorganic fertilizers, the effectiveness of the tested fertilizers can be estimated using the Relative Agronomic Effectiveness (RAE) approach. Nano inorganic fertilizers without NPK + Urea provide a much lower RAE value than the standard (100% recommendation of NPK + Urea) (table 9). The RAE value of the dry weight of harvested and milled dry grain produced from nano inorganic fertilizers with 200 times dilution of 100% NPK + Urea fertilization were 104 and 133%, respectively. Whereas in the application with the same dilution, 75% NPK + Urea fertilization with the addition of nano fertilizer was 176% for the weight of harvested dry grain and 161% for the weight of milled dry grain. Meanwhile, fertilizer application with 400 times dilution with NPK + Urea 100% recommendation resulted in RAE value of 119% for the...
weight of harvested dry grain and 140% for the weight of milled dry grain. The RAE value achieved by
the application of inorganic nanofertilizer with 400 times dilution at 75% NPK + Urea fertilization is
181% for the weight of harvested dry grain and 223% for the weight of milled dry grain. Thus it can be
said that the application of nano inorganic fertilizers with a dilution of 400 times at 75% NPK + Urea
fertilizer is the most effective treatment for rice plants.

3.6. Rice Yield Components
The combination of NPK and inorganic nano fertilizers could not reduce unhulled grain, increase the
weight of 1000 grains and panicle length (table 10).

Table 7. Effect of nano inorganic fertilizers on harvested dry grain weight, milled dry grain weight,
and dry straw weight in Sukamandi, Dry Season. 2018.

| No. | Treatment | Weight of Harvested Dry Grain | Weight of Milled Dry Grain | Dry Straw Weight |
|-----|-----------|-------------------------------|---------------------------|-----------------|
| 1.  | Control (Without fertilizer) | 8.53 b | 7.07 b | 12.29 c |
| 2.  | (NPK + Urea) 100% (Standard Fertilizer) | 9.51 ab | 7.79 ab | 17.29 ab |
| 3.  | Nano inorganic fertilizer 200 | 8.77 b | 7.27 b | 14.36 bc |
| 4.  | (NPK + Urea) 100% + nano inorganic fertilizer | 9.55 ab | 8.02 ab | 17.09 ab |
| 5.  | (NPK + Urea) 75% + nano inorganic fertilizer 200 | 10.25 a | 8.23 ab | 18.53 a |
| 6.  | Nano inorganic fertilizer 400 | 8.83 b | 7.42 b | 15.17 abc |
| 7.  | (NPK + Urea) 100% + nano inorganic fertilizer 400 | 9.70 ab | 8.08 ab | 17.93 ab |
| 8.  | (NPK + Urea) 75% + nano inorganic fertilizer 400 | 10.31 a | 8.67 a | 18.17 ab |

% CV | 6.65 | 6.43 | 12.57 |

Numbers in the same column followed by the same letter are not significantly different at the 5% level based on
the DMRT test

Table 8. Increasing rice yields with the application of fertilizer applications and NPK + Urea
fertilization in Sukamandi, dry season. 2018.

| No. | Treatment | Yield increasing compared to control (%) | Yield increasing compared to standard (%) |
|-----|-----------|-----------------------------------------|-----------------------------------------|
|     |           | Weight of harvested dry grain | Weight of milled dry grain | Weight of harvested dry grain | Weight of milled dry grain |
| 1.  | Control (Without fertilizer) | - | - | - | - |
| 2.  | (NPK + Urea) 100% (Standard Fertilizer) | 11.5 | 10.2 | 2.8 | 2.8 |
| 3.  | Nano inorganic fertilizer 200 | 2.8 | 2.8 | 2.8 | 2.8 |
| 4.  | (NPK + Urea) 100% + nano inorganic fertilizer 200 | 12.0 | 13.4 | 0.4 | 3.0 |
| 5.  | (NPK + Urea) 75% + nano inorganic fertilizer 200 | 20.2 | 16.4 | 7.8 | 5.7 |
| 6.  | Nano inorganic fertilizer 400 | 3.5 | 5.0 | 3.5 | 5.0 |
| 7.  | (NPK + Urea) 100% + nano inorganic fertilizer 400 | 13.7 | 14.3 | 2.0 | 3.7 |
| 8.  | (NPK + Urea) 75% + nano inorganic fertilizer 400 | 20.9 | 22.6 | 8.4 | 11.3 |
Table 9. Effect of nano inorganic fertilizers on the RAE value on the weight of dry unhulled rice and the weight of dry milled unhulled rice in Sukamandi, Dry Season. 2018.

| No. | Treatment                                           | RAE value | Weight of Harvested Dry Grain | Weight of Milled Dry Grain | % |
|-----|-----------------------------------------------------|-----------|-------------------------------|---------------------------|----|
| 1.  | Control (Without fertilizer)                        | -         | -                            | -                         | -  |
| 2.  | (NPK + Urea) 100% (Standard Fertilizer)             | 100       | 100                           | 100                       |    |
| 3.  | Nano inorganic fertilizer 200                       | 24        | 28                            |                           |    |
| 4.  | (NPK + Urea) 100% + nano inorganic fertilizer 200  | 104       | 133                           |                           |    |
| 5.  | (NPK + Urea) 75% + nano inorganic fertilizer 200    | 176       | 161                           |                           |    |
| 6.  | Nano inorganic fertilizer 400                       | 30        | 48                            |                           |    |
| 7.  | (NPK+Urea) 100% + nano inorganic fertilizer 400     | 119       | 140                           |                           |    |
| 8.  | (NPK + Urea) 75% + nano inorganic fertilizer 400    | 181       | 223                           |                           |    |

Table 10. Effect of nano inorganic fertilizers on unhulled grain, weight of 1000 grains, and panicle length in Sukamandi, dry season. 2018.

| No. | Treatment                                           | Empty grain | 1000 grain weight | Panicle length |
|-----|-----------------------------------------------------|-------------|-------------------|----------------|
| 1.  | Control (Without fertilizer)                        | 4.87 a      | 27.28 a           | 25.17 a        |
| 2.  | (NPK + Urea) 100% (Standard Fertilizer)             | 5.74 a      | 28.58 a           | 26.22 a        |
| 3.  | Nano inorganic fertilizer 200                       | 4.98 a      | 27.73 a           | 25.73 a        |
| 4.  | (NPK + Urea) 100% + nano inorganic fertilizer 200  | 4.82 a      | 28.23 a           | 26.16 a        |
| 5.  | (NPK + Urea) 75% + nano inorganic fertilizer 200    | 5.95 a      | 29.08 a           | 25.36 a        |
| 6.  | Nano inorganic fertilizer 400                       | 4.86 a      | 28.93 a           | 25.79 a        |
| 7.  | (NPK+Urea) 100% + nano inorganic fertilizer 400     | 5.49 a      | 27.98 a           | 25.97 a        |
| 8.  | (NPK + Urea) 75% + nano inorganic fertilizer 400    | 5.26 a      | 28.03 a           | 26.07 a        |

Numbers in the same column followed by the same letter are not significantly different at the 5% level based on the DMRT test

4. Conclusions
Application of inorganic nano fertilizer is effective when used together with NPK + Urea fertilizer. The application of 400 times dilution of nano inorganic fertilizer used together with NPK + Urea fertilizer at a recommended dose of 75% results in an RAE value of 223%. The application of 400 times dilution of nano inorganic fertilizers can make the use of NPK + Urea fertilizer more efficient by 25%. An 11.3%
increase in the yield of milled dry unhulled rice was achieved by the application of nano inorganic fertilizers with 400 times dilution used together with NPK + Urea fertilizer at a recommended dose of 75% compared to using only 100% NPK + Urea fertilizer.

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