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THE RATIO OF SILICA FERTILIZATION TO NITROGEN ON RICE PLANT PRODUCTIVITY

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ABSTRACT

Rice plants are Si accumulators, but in the field farmers rarely apply silica fertilizer, farmers tend to prioritize nitrogen fertilizer. In fact, rice plants need balanced elements of silica and nitrogen in the soil.. The aim of this research is to determine the effect of application the ratio of silica to nitrogen fertilizer and to obtain the best ratio of silica application to nitrogen fertilizer. The method used in this research was a randomized block design with 6 treatments and 5 replications, the treatments give were: A = control; B = Si: N (0,8); C = Si: N (1); D = Si: N (1,2); E = (Si: N 1,4); F = (Si: N 1,6). As indicators for rice plant productivity in this research were productive tiller, weight of 1000 grains, and rice plant yield per clump. The research results showed that the ratio (0, 8) of applying silica fertilizer to nitrogen fertilizer was potential to increase rice plant productivity.

Key words: IR-64, nitrogen, Silicon, Yield.

INTRODUCTION

Rice is a staple food for Indonesians, and it is currently difficult to substitute with other staple foods (Septiadi & Joka, 2019). Indonesia's population growth rate continues to increase, with an increase of approximately 2.9 million people expected from 2022 to 2023 (Central Bureau of Statistics, 2023) . This population growth is directly proportional to the increasing demand for food. Therefore, efforts are needed to increase national rice productivity through government programs such as fertilization. Government programs focus on nitrogen, phosphorus, and potassium fertilization (Qurrohman *et al*., 2022). Good soil is optimally maintained through fertilization with various essential nutrients, including nitrogen. Nitrogen is essential for rice plant growth. Farmers in Indonesia consider nitrogen fertilizer a primary requirement for rice cultivation, often overapplying it (Nafsiah, 2019).

Currently, farmers use approximately 400-600 kg ha^{-1} of nitrogen fertilizer per crop. The government's recommendation for nitrogen fertilizer use is 200 kg ha-1 for low productivity (<5 t ha^{-1}), 250-300 kg ha^{-1} for medium productivity (5-6 t ha-1), and 300-400 kg ha-1 for high productivity (>6 t ha^{-1}) (Husnain *et al*., 2020).

The application of nitrogen fertilizer is often not balanced with other fertilizers such as silica, which functions to increase growth and yield as well as nutrient absorption. Silica (Si) is an abundant plant nutrient on earth, with a total Si (SiO2) content of around 26.7%. The problem is that rice absorbs Si in the form of mono silicic acid (H4SiO4), the availability of which varies depending on the parent material, soil pH, soil temperature, and redox potential (Liang *et al*., 2015).

Silica fertilization is still rare in Indonesia, but it is crucial for increasing rice productivity as intensification has reached a leveling stage. A lack of Si makes rice plants vulnerable to attacks by plant-disturbing organisms (OPT) and can easily collapse due to small stems (Subiksa, 2018).

The ratio of silica to nitrogen fertilizer in the field varies. Research by Wang *et al*. (2019) showed that the optimal silica to nitrogen ratio for rice plant growth and production was 1.8 with 225 kg ha^{-1} silica and 119.6 kg ha^{-1} nitrogen. In contrast, research by (Viciedo *et al*., 2019), showed an optimal ratio of 1.08 with 250 kg ha^{-1} silica and 69 kg ha^{-1} nitrogen.

Based on the above background, further research is needed regarding the effect of the ratio of silica fertilizer to nitrogen fertilizer on yield of rice plants (Oryza sativa L.).

MATERIALS AND METHODS

This research was conducted from December to April 2024 at the Food Crop, Horticulture, and Livestock Nursery Technical Implementation Unit (UPT) of the Bandung City Food Security and Agriculture Agency (DISPANGTAN), Palasari Village, Cibiru District, Bandung City, West Java Province. The research location is at an altitude of 791 meters above sea level (masl).

The materials used in this study were soil on the Campus II Land of UIN Sunan Gunung Djati Bandung with a sand content of 3.5%, dust 30.5%, clay 66%, C-Organic (%) 2.9, P_2O_5 43.5 ppm, K_2O 291 ppm, Ca 18.4 kg^{-1}, Mg 5.76 cmol kg^{-1}, K 0.54 cmol kg^{-1}, Na 1.16 kg^{-1} Si 526 ppm, (Soil Center, 2020), IR-64 variety rice seeds, N, P, K fertilizer, urea fertilizer 350 kg ha-1 equivalent to nitrogen 161 kg ha^{-1}, pesticides, silica fertilizer, thinner, black paint and water. The silica fertilizer used contains 73.33% SiO2, 0.05% N, 0.10% P_2O_5, 0.64% K_2O, 2.49% CaO, 0.87% MgO, 1.35% Fe, 6.65% Zn, and a Cation
Exchange Capacity (CEC) of 163.98.

The tools used in this study were 15 cm x 30 cm x 15 cm gallons, sickles or machetes, hoes, meters, jerry cans, analytical scales, sprayers, label paper, mobile phones, thermohygrometers, koas, raffia ropes, sacks, sieving tools, HVS paper, wooden stakes, plastic, duct tape, and stationery. This study used the Randomized Block Design (RAK) method consisting of 6 treatments and 5 replications obtained 30 treatment units with the number of seeds used being 2 per gallon.

The ratio used is:

A = 0 kg ha^{-1} (without Silica fertilization), B = Si:N ratio 0.8 (equivalent to 129 kg ha^{-1} Silica fertilizer
: 161 kg ha^{-1} Nitrogen), C = Si:N ratio 1 (equivalent to 161 kg ha^{-1} Silica fertilizer : 161 kg ha^{-1} Nitrogen), D = Si:N ratio 1.2 (equivalent to 193 kg ha^{-1} Silica fertilizer : 161 kg ha^{-1} Nitrogen), E = Si:N ratio 1.4 (equivalent to 225 kg ha^{-1} Silica fertilizer : 161 kg ha^{-1} Nitrogen), F = Si:N ratio 1.6 (equivalent to 257 kg ha^{-1} Silica fertilizer : 161 kg ha^{-1} Nitrogen).

In this study, the observations observed were plant height, number of tillers per clump, and panicle emergence time. The observation data were analyzed using analysis of variance with Duncan's further test if the observation results showed significant differences. Plant height was observed 20-60 days after planting. The number of tillers per clump was observed 20, 40, and 60 days after planting, while panicle emergence was observed when panicles began to emerge.

RESULTS AND DISCUSSIONS

Number of productive tiller

The ratio of silica fertilizer to nitrogen fertilizer to rice plants did not have a significant effect on the number of productive tillers per clump in all treatments.

Tabel 1. Average of Number of Productive Tillers Per Clump

Treatments		Average of Number of Productive Tillers Per Clump
A	Without silica	18.9 a
B	Ratio Si:N 0.8	20.0 a
C	Ratio Si:N 1	20.8 a
D	Ratio Si:N 1.2	19.5 a
E	Ratio Si:N 1.4	18.8 a
F	Ratio Si: N 1.6	21.4 a

Remarks: The average value in each column marked with the same letter shows no significant difference based on Duncan's Advanced Test at the 5% level.

Weight of 1000 grains

Si fertilization has a direct and positive effect on rice grain production. Si supply increases grain yield by increasing straw biomass, the number of grains per panicle, and especially the percentage of filled grains, as well as significantly affecting the 1000-grain weight. By adding silica to the soil, it can help the grain filling process, which causes an increase in the rate of carbohydrate assimilation in the panicle (Lavinsky *et al*., 2016). According to Afshar (2018), the 1000-grain weight of IR-64 rice plants will increase by up to 29.66 g if the use of nitrogen fertilizer is around 138 kg ha-1.

Tabel 1. Weight 1000 grains

	Treatments	Weight of 1000 grains (gram)
A	Without silica	19.95 a
B	Ratio Si:N 0.8	25.68 b
C	Ratio Si:N 1	22.69 b
D	Ratio Si:N 1.2	24.53 b
E	Ratio Si:N 1.4	23.37 b
F	Ratio Si: N 1.6	24.22 ab

Remarks: The average value in each column marked with the same letter shows no significant difference based on Duncan's Advanced Test at the 5% level.

Rice plant yield per clump

The ratio of silica fertilizer to nitrogen fertilizer has no significant effect because the Si content in the soil is at a low criterion (526 ppm). To increase the weight of dry grain harvested, it is necessary to increase the silica content in the soil.

Tabel 2. Rice plant yield per clump

Treatments	Rice plant yield per clump (g)

A	Without silica	80.0 a
B	Ratio Si:N 0.8	80.5 a
C	Ratio Si:N 1	83.5 a
D	Ratio Si:N 1.2	79.0 a
E	Ratio Si:N 1.4	84.5 a
F	Ratio Si: N 1.6	87.5 a

Remarks: The average value in each column marked with the same letter shows no significant difference based on Duncan's Advanced Test at the 5% level.

In this study, the grain yield was quite abundant, but the ratio of silica fertilizer to nitrogen fertilizer had no significant effect. According to (Amrullah *et al*., 2014), the application of silica fertilizer with nitrogen fertilizer can produce the best dry grain harvest weight (GKP) of around 50.8% through the use of nano silica colloid (NSK).

CONCLUSION

The ratio of silica to nitrogen fertilizer dose in this study did not affect the number of productive tillers and harvest yield per clump, but affect the increase in weight of 1000 grains.

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