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Rice Ratoon Physiology: Effectiveness of Application N P K and Dolomite on Lowland Paddy

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ABSTRACT

Yield of ratoon rice technology has the potential to match the production of the main crop or the yield of the first crop. As a result of continuous chemical fertilization, the paddy soil becomes acidic. This study aims to obtain information on the effectiveness of neutralizing soil pH and fertilizing nutrients N, P and K in increasing the yield of ratoon rice. The design used was a randomized block design with one factor, namely fertilization, there were 7 types of fertilization treatment for rice plants, namely N (p1), P (p2), K (p3), N + Neutral (p1 Neutral), P + Neutral (Rice Ratoon Physiology: Effectiveness of application N P K and Dolomite On Lowland paddyNeutral), K + Neutral (p3 Neutral) and NPK + Neutral (P4). Observations were made on the growth and production characteristics of the main and ratoon plants as well as on ratoon roots. The results showed that the application of nutrients to the soil with a neutral pH had a significant effect on the growth and production of the main rice plants and ratoons. This study proves that neutralizing soil pH plays an important role in the effectiveness of fertilizing N, P, and K nutrients that are ready to be absorbed by ratoon rice plants.

Keyword : ratoon, fertilizer,dolomite,paddy

INTRODUCTION

Production per unit area, ratoon rice has the potential to match the main crop production, the potential for multiple harvests with only one planting. Practical, without tillage. The practice of ratooning rice cultivation can save production costs, seed costs, planting and labor. Another thing, the significant uniqueness of ratoon rice cultivation innovation is the shorter harvest time compared to cultivation starting from seeds.

However, in terms of cultivation practices, farmers generally ignore technology, because they are not serious and think that ratoon rice cannot produce well. Even though with good and correct management, ratoon rice can be cultivated by attracting the attention of researchers and the wider community (Nainggolan et al., 2013). The innovation of ratoon rice has been widely studied in Asian countries and even in Indonesia (Susilawati et al., 2010).

Susilawati (2012) suggested that N, P and K fertilizers play an important role in increasing the yield and yield of ratoon rice components. The interaction of NPK fertilization with organic fertilizers can reduce the use of chemical fertilizers and increase rice yields (Nangge et al., 2020). The difference in the time and height of cutting the remaining harvest stump can have a significant effect on the growth and production of ratoon rice (Pratama et al., 2018). Intermittent irrigation arrangements or management in ratoon cultivation provide varying production results (Setiawan et al., 2014). Fertilization with various doses of Nitrogen gives an agronomic influence response (Wang et al., 2019). Sirait & Adiwirman (2021) assessed that the interaction between dolomite 5 tons ha-1 with NPK fertilization resulted in a good interaction and could reduce the proportion of nitrogen leaching and could affect the increase in plant growth.

However, research on soil conditions and analysis on ratoon rice has not been widely produced. One of them is the condition of the

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soil acidity level (soil pH). Various studies suggest that soil pH is known to be a limiting factor for uptake nutrition or nutrient absorption by plants (Pratama et al., 2018), rice plants really need macro nutrients (N, P and K) for both vegetative and generative development, but P and K elements are nutrients that are difficult to absorb under certain conditions, including one at a non-neutral soil pH.

The purpose of this study was to obtain data on the comparison of nutrient uptake of N, P and K between neutral pH soil and non-neutral pH soil for ratoon rice plants. Researchers hypothesize that soil with a neutral pH condition can affect the availability of macro nutrients so that they are easily absorbed by plants.

MATERIALS AND METHODS

The research was carried out from June to December 2020 in the Wiringpalennae village, Wajo Regency, South Sulawesi Province, and the Hasanuddin University Laboratory. The materials used were rice seeds of Cigeulis variety, dolomite lime, inorganic fertilizers (urea, SP-36 and KCl), pesticides, and plastic sheet fences. The study used a randomized complete group design which was arranged with 7 treatments of macronutrient fertilizers (kg h-1) p0 = control, p1 = N fertilizer, p2 = P fertilizer, p3 = K fertilizer, p4 = N fertilizer + Dolomite, p5 = fertilizer P + Dolomite, p6 = K fertilizer + Dolomite, the experiment was repeated three times. total experimental units is 21 experimental plots. Soil neutralization was carried out by applying dolomite lime as much as 4 tons ha-1, checking soil pH every 7 days until it showed a pH meter of 6.5. Plants were planted on plots measuring 4 mx 5 m, jajar legowo 2 : 1. Data from all variables observed for both the main and ratoon crops were analyzed for variance with the F test, if there was a treatment that had a significant effect, it was continued with the Duncan Multiple Range Test (DMRT) at level a = 5%. Bunds were made between the treatment plots with a height of about 20 cm from the soil surface. Fertilizer is given at a dose (kg ha-1) of 90 N, 45 P2 O5 and 60 K2 O (200 urea, 150 SP-36 and 100 KCl). Fertilizer was applied twice, i.e. half dose of urea, all doses of SP-36 and KCl were applied 1-2 days before planting, and the remaining half dose of urea was given at 40 days after planting (DAT).

How to make plant ratoon rice is cutting the stump as high as 20 cm from the soil surface is carried out at the same time as harvest. The land was flooded on the 2nd day after harvesting the main crop with a height of 3-5 cm. Fertilizer treatment was given on day 5 after harvesting the main crop with three levels of tested doses. Observations on the main plants and ratoons included growth and production characteristics, namely: plant height, number of productive tillers, flowering age, number of grain per panicle, number of filled grain per panicle, and weight of 1,000 grains. The weight of 1,000 grains was observed by weighing 1,000 grains of pithy grain with a moisture content of 13-14%. All these variables were observed in five plant clumps per plot, which were taken diagonally. In addition, observations were also made on the roots of the ratoon plant, which included root length and number of roots. Rooting was carried out in the early generative period of the ratoon (about 15 days after harvesting the main crop), and at the time of harvesting the ratoon, by taking two plants per plot. The weight of production per plot was observed by weighing the total grain content with a moisture content of 14% in one plot.

RESULTS AND DISCUSSION

Optimum Soil Acidity Indices

Dolomite additional doses have siginificant effect and control is the result of checking the experimental plot that is not given dolomite.

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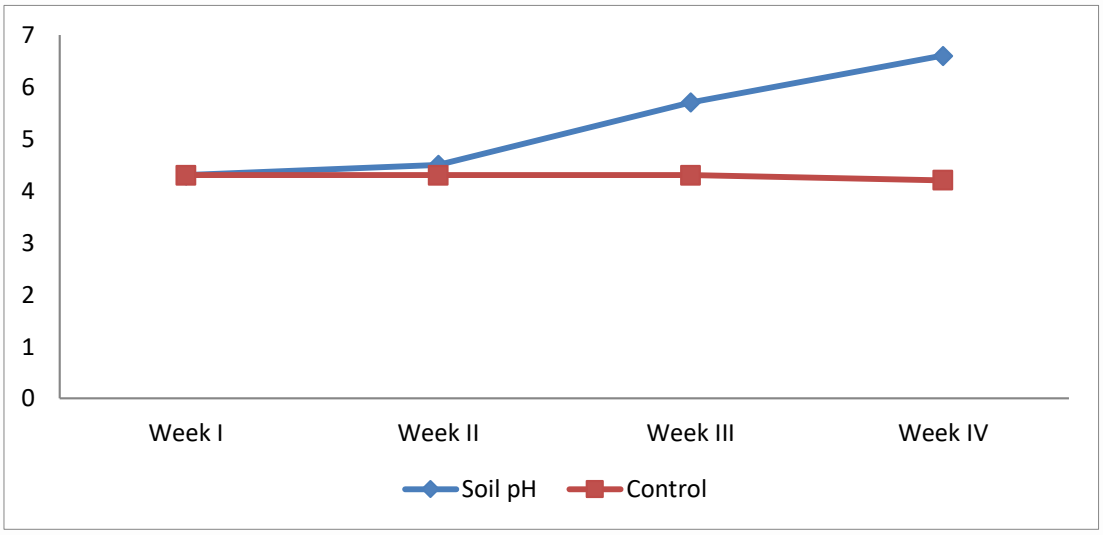

Fig 1. The results of checking soil pH after dolomite application

Vegetative Growth

In vegetative growth, soil pH neutralizing factor had a significant effect on plant height and number of tillers. However, fertilization factors P and K had no significant effect on plant height and number of tillers. Plant height and the highest number of tillers were treated with N + neutral pH fertilization and had no significant effect with N fertilization treatment on soils with a pH not yet neutral. This is an indicator that nitrogen uptake at a soil pH of 5.5 can still be absorbed by ratoon rice plants. neutral pH support.

The application of N nutrients to the soil increases the character of plant height because N functions to form protoplasm in plants, to multiply and lengthen plant cells, including plant stems, thereby increasing plant height. Neutral soil pH means suppressing the solubility of elements that poison plants. Neutralization of soil pH after a long time of urea fertilization is considered important because, given or the addition of N given in the form of NH +, the uptake of cations is greater than the anion so that H + will be released from the roots so that the surface pH will be more acidic than the soil solution and the addition of the dose of N fertilization on non-acidic soil has a significant effect on all variables of plant vegetative observations (Widiyawati et al., 2014). in the Table 1, it can be seen that there are more ratoon tillers than the main plant because the shoots on the ratoon are growing well, this is due to the presence of a high response to cutting the main plant against ratoon showed that there was a supply of carbohydrates to the growth area, which spurred the release of ratoon shoots.

Table 1. Component plant growth main crops (MC) and ratoon(R)

Treatment	Plant Height(cm)		Number of Tillers	
	MC	R	MC	R
N	110.3a	97.5ab	11.7a	12.5ab
P	105.4b	93.6b	10.5b	11.3b
K	103.5b	89.5b	8.3b	13.2a
N + pH Neutral	**113.4a**	**98.7a**	**12.8a**	**13.4a**
P + pH Neutral	**107.6ab**	**94.8b**	**10.7ab**	**13.1a**
K + pH Neutral	**103.7b**	**88.4b**	**9.3b**	**10.7b**

Note: MC = main crops, R = ratoon. Figures in the same column followed by the same letter are not significantly different means to HSD 5% test

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Liming is necessary because dolomite contains alkaline cations which can help in increasing the pH of the soil. The increase in pH was 24.6% because dolomite in addition to containing elements of Ca also contains elements of Mg. These results are in accordance with the results of research conducted by (Wahyudi et al., 2018), which reported that the use of Dolomite had a significant effect in increasing and increasing the level of soil acidity (soil pH), because dolomite contains 30.17% CaO and 16.59% MgO. Dolomite in the soil acts as a substitute for cations such as Al3+ which in the soil is acidic to the soil.

Basuki et al., (2020) also suggested that the use of dolomite was effective in maintaining soil pH compared to kaptan. Dolomite maintains soil pH for up to 17 months after application. The soil pH value at 17 months after dolomite application was 6.64; while the kaptan treatment had a soil pH of 5.56. The reaction of dolomite in the soil in maintaining soil pH is 1.26 times more effective than kaptan. In line with research (Sirait & Adiwirman, 2021) that administration of dolomite and NPK can reduce nitrogen leaching, improve plant physiology and growth. On the other hand, the results of research by Basuki & Sari (2018), Effendy et al., (2015) found that among the things that interfere with plant metabolism is the correlation between micronutrients such as high Fe and low soil pH. So it takes a neutral soil pH to improve nutrient uptake in plants.

Production Component

From the observations of the production yield components, it can be seen in Table 2. In general, the effect of giving dolomite lime to neutralize soil pH had a significant effect on the observations of the amount of filled grain, the number of empty grains, the weight of 1000 seeds and yield conversion per hectare on the main and ratoon crops. It was proven at the three levels of treatment with dolomite lime so as to produce a neutral soil pH, which was different from the observation results from the control treatment. Neutral soil pH is able to optimize the process of organic decomposition in the soil by bacteria so that fertilization of nutrients N, P, and K is optimal, the bacterial consortium is able to reduce 25% of the use of inorganic N fertilizers from the recommended dose (100 kg N ha-1) based on effectiveness relative agronomy (Widiyawati et al., 2014).

Table 2. Component plant growth main crops (MC) and ratoon(R)

Treatment	Number of Grain containing per panicles		Number of Grain empty (%)		1000seeds Weight (g)		Production Ton Ha^{-1}	
	MC	R	MC	R	MC	R	MC	R
N	121.6	40.7b	23a	43a	51	45b	3.7	1.5
P	130.8	40.6b	14b	35ab	75	71ab	4.1	1.8
K	135.7	38.8b	16b	32b	70	68b	4.0	1.7
N + pH Neutral	**130.8**	**49.7ab**	**21ab**	**40ab**	**57**	**45b**	**4.1**	**1.5**
P + pH Neutral	**137.4**	**51.3a**	**12b**	**31b**	**78**	**77a**	**4.6**	**1.9**
K + pH Neutral	**138.4**	**50.2ab**	**15b**	**36b**	**70**	**70ab**	**4.5**	**1.7**

Remarks: MC = main crops, R = ratoon. Figures in the same column followed by the same letter are not significantly different means to HSD 5% test

Nutrient Uptake Components of N and P

Table 3 showed us the general the effect of neutralizing soil pH factors is significant on the uptake of N and P nutrients in the main plants and ratoons. however, did not show a significant difference and tended to absorb nutrients from the components of the ratoon plant itself. This is presumably due to differences in the growth and development of

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the main and ratoon plants, ratoons tend to decrease their productivity.

Fertilizer absorption efficiency means the percentage between the fertilizer absorbed by the plant and the fertilizer applied. Fertilization with the highest efficiency value is P fertilizer. increasing soil pH is important for P fertilization because a neutral soil pH ensures the availability of nutrients that are ready to be absorbed by plants for plant growth and production processes (Muktamar & Lifia, 2020).

Table 3. Components of the main plant nutrient uptake and ratoon

Treatment	N. Uptake Grain (mg/plant)		P Uptake (g 100 g^{-1} Plant dry weight)	
	MC	R	MC	R
N	57ab	56ab	0.65c	0.93ab
P	30b	32b	0.96b	0.73b
K	52b	51b	0.87b	0.64b
N + pH Neutral	**61a**	**60a**	**0.67b**	**0.54**
P + pH Neutral	**54b**	**43b**	**1.53a**	**1.22a**
K + pH Neutral	**53b**	**42b**	**0.97ab**	**0.76b**

Remarks: MC = main crops, R = ratoon. Figures in the same column followed by the same letter are not significantly different means to HSD 5% test

The high production obtained in this experiment is thought to be due to the availability of sufficient nutrients for the main crop and ratoon to produce assimilate, the impact of which is that high availability of assimilate can increase grain yields for both main and ratoon crops. The ability of plants to produce ratoons is one of them determined by fertilization. The increase in yield and yield components was due to the increased transfer of assimilate into the seeds (Bovairi, et all 2016)

CONCLUTIONS

Neutralizing soil pH by giving dolomite 4 tons ha-1 in paddy field management of ratoon rice can increase soil pH so that it becomes neutral, increase K+ content, increase available water content, reduce nitrogen leaching, and increase ratoon rice yield. The addition of dolomite was able to influence the vegetative propagation of ratoon rice plants, the uptake of N and P nutrients as well as the main plant and ratoon production components. Improved farmer management of ratoon rice plants with the application of dolomite can improve the physical, chemical and biological properties of the soil so that it has a good impact on the growth and yield of ratoon rice.

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