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The Effect of Nutrient Concentrations of Cultivating Media and Leaf Manure Concentration on Growth and Nutrient Absorption Rice and Corn Crops

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Abstract. Nutrients are critical components in farming because the level of availability of nutrients for plants greatly determines growth and the quantity and quality of crop production. This study aims to determine the planting medium's nutrient content and foliar fertiliser concentration on rice and maise plants' growth and nutrient uptake. This research will be carried out in the greenhouse of the University of Mataram and lasts for 45 days (vegetative growth) from August to September 2021. The experimental design used was a Completely Randomised Design (CRD), with the first treatment being the provision of essential nutrients through a planting medium with two levels, namely (50 and 100% of optimal needs. These percentages represent the conditions of growing media that are nutrient-deficient/sub-optimal (50%) and optimal (100%). The second treatment is the concentration of fertiliser applied through the leaves, namely 1, 2, and 3%. The dose (amount of nutrients per pot) given through new leaves can be calculated after the experiment is finished, such as the total fertiliser through the leaves the plant receives. The two factors mentioned above are arranged factorial. Each of these treatments was repeated three times so that each experimental set/type of plant consisted of 2 x 3 x 3 = 18 experimental pots. The results showed that increasing the concentration of nutrients in the planting medium (from 50% to 100% standard nutrient solution) decreased growth. (biomass) of rice and corn plants due to poisoning. There is an interaction effect of the two factors, which is significant on the biomass of rice and corn plants, and this effect is antagonistic. The nutrient content of the planting medium, the concentration of the sprayed foliar fertilisers, and their interactions significantly affected rice plant height but did not considerably impact corn plant height. The higher concentration of nutrients in the planting medium and foliar fertiliser increases the total absorption of all essential nutrients. However, the amount of nutrients absorbed through the leaves and stems of plants is relatively small compared to the total nutrient uptake (needs) of plants.

Keywords: Nutrients; concentration of foliar fertilisers; rice; corn.

INTRODUCTION

Nutrients are essential in farming because the level of nutrients available for plants greatly determines growth and the quantity and quality of crop production [1]. Lack of plant nutrients or not getting an adequate and balanced supply of nutrients is generally overcome by fertilising the soil. Fertilisation can be done either through soil or leaves.

Fertilisation through the soil often results in the nutrients provided through the soil usually being fixed, washed and interacting with the soil so that these nutrients are relatively available to plants [2]. Meanwhile, applying fertiliser through the leaves rapidly affects plant growth, saves

fertiliser use and does not cause damage to the soil if the application is done correctly [3]. In addition, according to [4], foliar fertilisation can increase the photosynthesis process, absorb nutrients more quickly, reduce the loss of nutrients from fertilisers, and improve the formation of carbohydrates, fats, and proteins, resulting in increased crop production [4].

METHOD

This research will be carried out in the Mataram University greenhouse for the last 45 days (vegetative growth) from August to September 2021. The materials used are rice and corn seeds, complete essential nutrient solutions (liquid fertilisers) made from pure ingredients (pro analysis/p.a), plastic pots, and cork that is sterile from nutrients. The main research tools used were tape measure, scissors, electric scales, plastic, buckets, markers, duct tape, label paper, books, stationery, cameras and supporting tools to make a complete nutrient solution and analyse nutrients in plant tissue.

The experimental design used was a Completely Randomised Design (CRD), with the first treatment providing essential nutrients through the planting medium with two levels (50 and 100% of the optimal requirement). These percentages represent the growing media conditions, nutrient-deficient/deficient/sub-optimal (50%) and optimal (100%). The second treatment is the concentration of fertiliser applied through the leaves, namely 1, 2, and 3%. The dose (amount of nutrients per pot) given through the new leaves can be calculated after the experiment, i.e., the total fertiliser through the leaves received by the plants. The two factors mentioned above were arranged factorially; each treatment was repeated three times so that each experimental set/plant type consisted of 2 x 3 x 3 = 18 experimental pots.

The parameters studied in this study were plant height, plant dry stover, and measuring the uptake of nutrients P, K, Mg, and Ca in plant tissues and growing media after the research. Analysis of Diversity analysed the data collected at the 5% significance level. Furthermore, the treatment that showed a significant difference was tested further with the Honest Significant Difference (BNJ) test at the 5% level.

RESULTS AND DISCUSSION

Plant Biomass. The average dry biomass weight of rice and corn plants, at the nutrient levels of the planting media and the concentration of foliar fertilisers, are presented in Tables 1 and 2.

Table 1 – The average weight of dry rice biomass

Planting media nutrient levels (%)	Foliar fertiliser concentration (%)		
	1	2	3
M-50	10.15 [a]	9.05 [ab]	7.86 [b]
M-100	4.69 [c]	5.45 [c]	5.31 [c]
BNJ 0.05		1.48	

Notes: Numbers followed by different letter notations in the same column and row are significantly different based on the BNJ test α0.05

Table 2 – Average dry biomass weight of corn plants

Planting media nutrient levels (%)	Foliar fertiliser concentration (%)		
	1	2	3
M-50	2.36	2.81	3.79
M-100	2.28	2.67	2.43
BNJ 0.05	-	-	-

Notes: Numbers followed by different letter notations in the same column and row are significantly different based on the BNJ test α0.05

Table 1 shows that the dry biomass weight of rice plants planted in the planting medium with a nutrient content of 50% is higher than that grown in the planting medium with a nutrient content of 100%. At 50% growing media, the higher the concentration of nutrients in the foliar fertiliser, the lower the dry weight of the paddy plant biomass. This was allegedly due to poisoning by high concentrations of foliar fertilisers (>3%). In 100% growth media, plant biomass (growth) is much lower than in 50% growth media, and the higher the concentration of nutrients in foliar fertiliser, the weight of the biomass tends to be higher as well. The interaction effect of the two treatments had a negative/lousy impact on plant growth.

For the maise plants in Table 2 above, the concentration of nutrients in the planting medium and the foliar fertilisers and their interactions did not significantly affect the plant's dry biomass weight. However, based on the average value, the higher the concentration of nutrients in foliar fertiliser, the biomass tends to

increase. The concentration of foliar fertiliser up to 3% does not cause poisoning of certain nutrients.

Plant Height. For rice plant height, it can be seen in Table 3 that the nutrient content of the planting medium, the concentration of the sprayed foliar fertiliser, and the interaction between the two significantly affected the rice plant height.

Table 3 – The average height of rice plants in the interaction between the nutrient content of the planting medium and the concentration of foliar fertilisers

Planting media nutrient levels (%)	Foliar fertiliser concentration (%)		
	1	2	3
M-50	29.33 a	28.66 ab	26.66 bc
M-100	26.33 c	26.00 c	26.33 c
BNJ 0.05		2.14	

Note: Numbers followed by different letter notations in the same column and row are significantly different based on the BNJ test α0.05

Table 4 – Average height of corn plants on the interaction between nutrient levels in the media planting and foliar fertiliser concentration

Planting media nutrient levels (%)	Foliar fertiliser concentration (%)		
	1	2	3
M-50	26.33	31.00	38.33
M-100	32.33	35.00	34.00
BNJ 0.05	-	-	-

Note: Numbers followed by different letter notations in the same column and row are significantly different based on the BNJ test α0.05

At 50% growing media, the higher the concentration of nutrients in the foliar fertiliser, the lower the plant height. Whereas at 100% nutrient content, the higher the nutrient concentration in the foliar fertiliser, the lower the plant height. It is suspected that nutrients poison the plant.

The availability of nutrients plants need in adequate conditions affects metabolic processes that will form proteins, enzymes, hormones, and carbohydrates so that enlargement, elongation, and cell division occur quickly [5, 6].

Table 4 shows the height of the corn plants. The nutrient content of the planting medium, the concentration of the foliar fertilisers sprayed, and their interactions did not significantly affect the plant height. However, based on the average nominal value, the higher the concentration of foliar fertiliser sprayed, the higher the plant height. So, a concentration of 3% foliar fertiliser does not cause poisoning in corn plants.

Nutrient Uptake. In Tables 5-6 it can be seen that the effect of P, K, Ca and Mg uptake by rice and corn plants, their relation to the treatment on the nutrient content of the planting medium and the concentration of fertiliser sprayed on the leaves and their interactions, has no significant effect on P nutrient uptake, K, Ca and Mg, are very similar to the patterns in plant biomass weight because nutrient uptake is calculated from the weight of the biomass times the concentration of each nutrient element in the tissue.

Table 5 – Average nutrient uptake of P, K, Ca and Mg by rice plants

Growing media	Foliar fertiliser concentration	Nutrient uptake (mg/pot)			
		P	K	Ca	Mg
50 %	1 %	0.027	0.033	0.039	0.001
	2 %	0.027	0.057	0.027	0.020
	3 %	0.027	0.063	0.007	0.020
100 %	1 %	0.013	0.030	0.001	0.001
	2 %	0.013	0.040	0.002	0.020
	3 %	0.020	0.057	0.016	0.027
BNJ 0.05		-	-	-	-

Note: Numbers followed by different letter notations in columns and rows are significantly different based on the BNJ α0.05 test

Table 6 – Average absorption of nutrients P, K, Ca and Mg by corn plants

Growing media	Foliar fertiliser concentration	Nutrient uptake (mg/pot)			
		P	K	Ca	Mg
50 %	1 %	0.018	0.026	0.009	0.003
	2 %	0.022	0.032	0.020	0.005
	3 %	0.033	0.051	0.016	0.006
100 %	1 %	0.020	0.031	0.010	0.004
	2 %	0.025	0.040	0.012	0.005
	3 %	0.022	0.034	0.011	0.004
BNJ 0.05		-	-	-	-

Notes: Numbers followed by different letter notations in columns and rows are significantly different based on the BNJ α0.05 test

The pattern of nutrient uptake response to treatment shows that the concentration of each type of nutrient in the tissue is relatively the same (not affected by treatment).

Nutrient poisoning caused by the concentration of foliar fertiliser sprayed is too high, causing low plant biomass and low total absorbed nutrients. However, the concentration of nutrients in the tissue is not affected by treatment (relatively the same).

CONCLUSIONS

1. Increasing the concentration of nutrients in the planting medium (from 50% to 100% standard nutrient solution) reduces rice and corn plants' growth (biomass) due to poisoning. The higher concentration of nutrients in foliar fertilisers applied to plants in growing media containing 50% nutrients tends to reduce growth. On the contrary, it tends to increase the growth of rice and corn plants in growing media with nutrient levels of 100% (optimal). There is an interaction effect of the two factors, which is significant on the biomass of rice and corn plants, and this effect is antagonistic.

2. The planting medium's nutrient content, the sprayed foliar fertiliser concentration, and their interactions significantly affected the rice plant height. Still, it did not significantly affect the corn plant height.

3. The higher concentration of nutrients in the planting medium and foliar fertiliser increases the total absorption of all essential nutrients. However, the amount of nutrients absorbed through the leaves and stems of plants is relatively small compared to the total nutrient uptake (needs) of plants.

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