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EFFECT OF LIQUID ORGANIC FERTILIZER AND UREA ON THE GROWTH AND PRODUCTIVITY OF RICE WITH ASYMMETRICAL IRRIGATION

Z.A. AKHMAD[1], A. YASSI[2*], A.H. BAHRUN[2], and S. ZAENAB[3]

[1]Magister Program of Agrotechnology, Faculty of Agriculture, Hasanuddin University, South Sulawesi, Indonesia
[2]Faculty of Agriculture, Hasanuddin University, South Sulawesi, Indonesia
[3]Department of Aquaculture, Faculty of Fisheries, Universitas Cokroaminoto Makassar, South Sulawesi, Indonesia
*Corresponding author's email: amiryassi32@gmail.com
Email addresses of co-authors: adnanzulvicar@gmail.com, harisbahrun@yahoo.com, nhenhabsitti@gmail.com

SUMMARY

Long-term use of inorganic fertilizers has negatively influenced rice productivity, being unsafe environmentally. The planned strategy sought to improve rice (*Oryza sativa* L.) production with a quality of environment-friendly rice cultivation by reducing the excessive inorganic fertilizers. The latest research aimed to analyze the effects of liquid organic fertilizer and urea on the growth and productivity of lowland rice managed with irregular irrigation. The urea (U) comprised four doses, i.e., control 0 kg/ha (U0), 50, 100, and 150 kg/ha (U1-U3, respectively), which fertilized the main plots. The liquid organic fertilizer (LOF) (P) also comprised four levels, viz., control 0 cc/L (P0), 2, 4, and 6 cc/L of water (P1-P3, respectively), which treated the subplots. The urea (100 kg/ha) application resulted in the highest average number of productive tillers (16.8) and the topmost percentage of full grain (84.47%). However, the urea fertilizer (150 kg/ha) produced the maximum flag leaf length (32.3 cm). The LOF concentration (4 cc/L) produced the superior 100-grain weight (2.84 g). The LOF (6 cc/L) produced the utmost index of chlorophyll a (236.43 $\mu mol/m^2$), chlorophyll b (95.83 $\mu mol.m^{-2}$), and total chlorophyll (339.64 $\mu mol.m^{-2}$). The results showed that the combination of urea fertilizer (150 and 100 kg/ha) and liquid organic fertilizer concentration (LOF 6 cc/L) provided the best productivity of 6.26 and 6.13 t/ha, respectively.

Keywords: Rice (*Oryza sativa* L.), inorganic and organic fertilizers, irrigation system, growth and productivity traits, chlorophyll content

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Key findings: The rice (*O. sativa* L.) productivity can attain enhancement by providing optimum nutrients to the crop. Combining organic and inorganic fertilizers can quickly develop and maintain fertilizer use efficiency and increase plant productivity. The results showed that the combination of urea fertilizer (150 and 100 kg/ha) and liquid organic fertilizer concentration (LOF 6 cc/L) provided the best grain yield of 6.26 and 6.13 t/ha, respectively.

INTRODUCTION

Agriculture plays a vital role in fulfilling the economic needs of Indonesia. Rice (*O. sativa* L.) is a strategic commodity in the agriculture sector (Prasad *et al*., 2017). It needs serious attention to meet the food demands and ensure food security (Hara *et al*., 2015). Continuing food security requires developing strategies for the welfare of the farming community and increasing their income by raising rice production in Indonesia (Sitaresmi *et al*., 2023).

Around 90% of Indonesia's population consumes rice as a staple (Hara *et al*., 2015). In 2020, rice production reached 54.6 million tons from around 10.6 million ha of cultivated lands in Indonesia, accounting for 7.1% of the world's total rice production (FAOSTAT, 2022). Sidrap Regency is one of the largest rice-producing areas in Indonesia, well known as a rice production center in South Sulawesi Province due to its wide rice planting area. Indonesian people make rice their staple food, causing an increased demand for rice. Therefore, efforts are necessary to boost rice production in the future. The rice-reduced yield may threaten food security because rice is crucial in maintaining food self-sufficiency in Indonesia (Sitaresmi *et al*., 2023).

Low rice production is due to farmers still using conventional rice growing technology, with no enhancement in the application of different fertilization measures and production technology in Indonesia (Rafiuddin *et al*., 2021). In addition, rice intensification lowers soil nutrient supplies, especially macronutrients, decreasing rice yield and land quality (Agussalim *et al*., 2022).

When a decline in production happens, farmers compensate for the loss of soil fertility by an enhanced use of inorganic fertilizers (Supandji *et al*., 2019). However, the continuous and excessive use of inorganic fertilizers negatively affects rice productivity and soil quality, instigating environmental damage in the long term (Mondal *et al*., 2023). Intensive management of rice fields proceeded with the highest inorganic fertilization without adding organic material and C-organic content (Amann *et al*., 2018). Furthermore, limited efforts to maintain soil fertility, such as fertilizing with the right type and dose, resulted in lower rice production (Chen *et al*., 2016). Therefore, to improve rice productivity through sustainable soil fertility innovation is urgent (Li *et al*., 2020).

Optimum rice production can prevail, acquiring enhancements by fertilizing the soil with the needed plant requirements (Gao *et al*., 2023). Adding organic material to paddy fields is necessary, especially with integrated fertilization. Integrated fertilization is a simultaneous combination of organic and inorganic nutrient inputs. These fertilizer combinations can develop well-maintained soil conditions achieving fertilizer use efficiency and improving paddy crop productivity (Wang *et al*., 2019; Liu *et al*., 2021).

The urea combined with liquid organic fertilizer (LOF) is an integrated fertilization (Shahid *et al*., 2017). Using LOF is an alternative to reduce the negative impact of using inorganic fertilizers. LOF contains macro- and micro-nutrients, healing nutrient deficiencies effectively and preventing nutrient leaching problems and damage to the crop and soil when frequently used (Qaswar *et al*., 2020). The correct dosage combination can quickly improve rice growth and production (Liu *et al*., 2021).

The highest proportion of organic substitution treatment significantly enhanced carbon-related functional groups (Qaswar *et al*., 2020). The organic fertilizer can better structure the soil microbial community (Ikoyi *et al*., 2020). On the other hand, the excessive use of inorganic fertilizers can cause pollution and reduce soil quality (Xiao *et al*., 2021). Therefore, the best combination of urea and LOF fertilizer can hasten the growth and production of lowland rice. Past studies also showed that combining organic fertilizer with inorganic fertilizer continuously boosts crop yield and soil fertility (Wang *et al*., 2019).

For lowland rice cultivation, the intermittent irrigation system is one of the irrigation methods with practical measuring (Yassi *et al*., 2020). Also called wet-dry irrigation, the water regulation on land is alternately in stagnant and dry conditions. Mekongga rice was the sample in this research because it has high productivity and resistance to pests. The novelty of this research is finding the optimum combination doses of organic and inorganic fertilizers for superior rice production and improving rice field conditions. The presented experiment determined the effect of various combinations of urea and liquid organic fertilizer on the growth and production of lowland rice with intermittent irrigation.

MATERIALS AND METHODS

Experimental site and procedure

The latest research commenced from June to December 2022 at the Kalosi Alau Village, District Dua Pitue, Sidrap Regency, South Sulawesi Province, Indonesia (Figure 1) (-3°9’03.1306”, 120°01’77.78”). The experiment proceeded in a split-plot design with three replications. The urea (U) comprising four doses, i.e., control 0 kg/ha (U0), and 50, 100, and 150 kg/ha (U1–U3, respectively), were treatments in the main plots. The liquid organic fertilizer (LOF) (P) also comprised four levels, i.e., control 0 cc/L (P0), and 2, 4, and 6 cc/L of water (P1–P3, respectively) and fertilized the sub-plots.

Tools and materials

The equipment used in this research included a tractor, a sprayer, a scale, a measuring tape, a

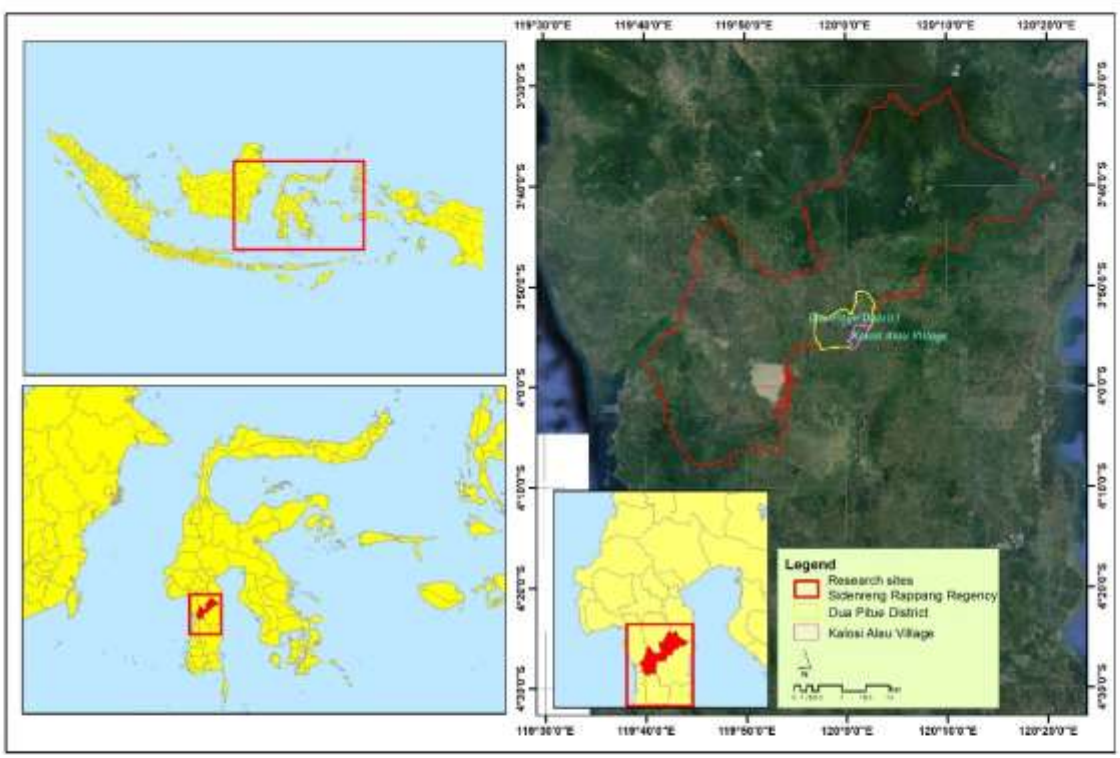

Figure 1. Research Location Map at Kalosi Alau Village, Dua Pitue District, Sidrap Regency, South Sulawesi Province, Indonesia.

ruler, a camera, a laptop, writing tools, a Chlorophyll Content Meter (CCM 200), a Digital Grain Moisture Meter, a solarimeter, mat, sickle, stakes, machete, hoe, and bucket. The sample materials in this research were rice cultivar 'Mekongga' seeds, urea fertilizer, Liquid Organic Fertilizer (LOF) CAM Plus, compost, NPK fertilizer, bags, envelopes, label paper, plastic bags, saltwater solution, eggs, and a raffia string.

Crop husbandry

Land preparation began by plowing with a tractor and leveling it with a harrow, followed by developing treatment plots measuring 4.25 m × 5.25 m with mud partitions for planting area demarcation. Before land preparation, soil analysis ensued by collecting field samples for evaluation. The assessment included soil texture, total nitrogen (Kjeldahl), available phosphorus (Bray-1), available potassium (Bray-1), organic carbon (Walkley and Black), and soil pH. The harvesting of rice cultivar Mekongga transpired at 99-104 days after transplanting (DAT). Harvesting the plants when the grains have reached the physiological maturity stage had the criteria that 80% of the plants have turned yellow and the rice grains at the base of the panicle have hardened.

Data recorded

The recorded data continued on the growth and morphological and physiological parameters. Plant height (cm) measuring began from the base of the stem to the tip of the highest leaf and the topmost panicle at 30, 50, 70, and 90 days after transplanting (DAT). The number of tillers reached counting as tillers per clump, counted at 30, 50, 70, and 90 DAT. The number of productive tillers counts as tillers that produce panicles when the panicles have emerged. Flag leaf length (cm) measurement from the base of the leaf to the leaf tip had all measurements made before crop harvest. Randomly selecting 100 grains and weighing them calculated the 100-grain weight (g). Grain samples from each treatment combination in each replication had their dried milled rice (kg) weight measured after the drying process in each treatment plot. The grain yield (t/ha) calculation came from the conversion of dried harvested rice per plot using the following formula:

$$Grain\ yield\ \left(\frac{ton}{ha}\right) = \frac{hectare\ area\ (m^2)}{plot\ area\ (m^2)} x\ yield\ per\ plot\ (kg)$$

The computation for leaf chlorophyll index used a Chlorophyll Content Meter. It involves clipping the leaf from the base to the tip of the third leaf ten times. Observations ensued for the various chlorophyll contents, i.e., chlorophyll a and b, and total chlorophyll in the leaf. Chlorophyll a, b, and total chlorophyll ($\mu mol/m^2$) calculations employed the following formula (Table 1).

$$Y = a + b\ (CCI)^c,$$

Statistical analysis

All the recorded data underwent analysis of variance (ANOVA), with the means further compared and separated with a Tukey's HSD Test. The data obtained proceeded with correlation analysis using the Pearson product-moment equation. The correlation values fall within the range of $-1 \leq r \leq 1$. The minus (-) plus (+) signs indicate the direction of the relationship. The correlation values

Table 1. Leaf chlorophyll index.

Parameters	Formula: $y = a + b\ (CCI)^c$		
	A	B	C
Chlorophyll A	-421.35	375.02	0.1863
Chlorophyll B	38.23	4.03	0.88
Chlorophyll Total	-283.20	269.96	0.277

Source: Goncalves, Junior, and Silva (2008).

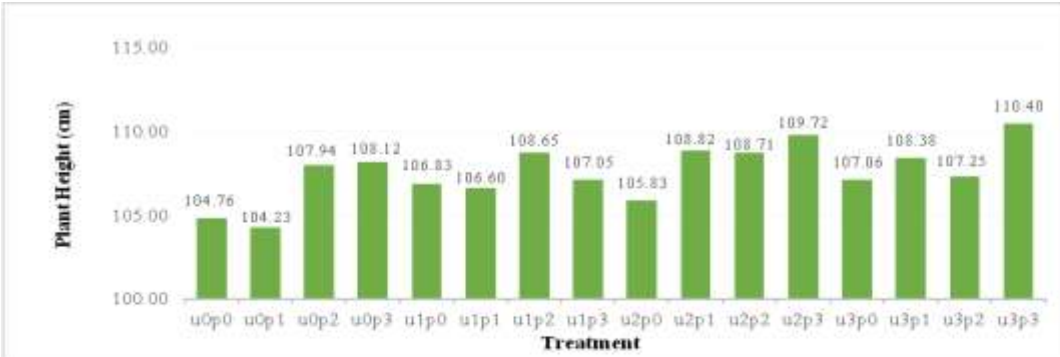

Figure 2. Average plant height (cm) in urea and LOF treatments.

classification was as follows: 0.70 to 1.00 indicates a high degree of association, 0.40 to 0.70 - a substantial relationship, and 0.20 to 0.40 reveals a low correlation (Kozak *et al*., 2012).

RESULTS AND DISCUSSION

The results showed significant variations due to the influence of various treatments developed by combining organic and inorganic fertilizers on the observed parameters. The research conducted by mixing organic and inorganic fertilizers in a water management system has positively affected rice plants' growth and productivity traits. Similar findings also appeared in the past study of Yassi *et al*. (2020), where fertilizer combinations and water management systems significantly influenced parameters, such as the number of productive tillers, grain dry weight at harvest, and milled dry grains of rice plants.

Based on the results, the analysis of variance exhibited that urea treatment, LOF, and their interactions had nonsignificant effects on plant stature (Figure 2). However, the highest plant height (110.4 cm) emerged when applying urea (150 kg/ha) and LOF (6 cc/L), with the lowest plant height (104.23 cm) recorded when treated with urea (0 kg/ha) and LOF (2 cc/L). Light competition influenced plant height, and the two parameters positively correlated. Plant height variations bore most influences from the ability to absorb light, so taller plants can better perform physiological and biochemical processes because of having a larger light-absorbing area than shorter plants. In this study, the optimal urea dosage was the 100 kg/ha application for increasing the 100-grain weight. The effective secondary characteristics for rice cultivation and evaluation are the number of filled grains (Yassi *et al*., 2023). The 100-grain weight represents a yield component that affects the plant height and production quantity, indirectly indicating the size of grains in the tested rice genotypes. The higher the weight of the grains, the larger the size of the grains, and vice versa. The application of N fertilizer significantly affects the plant height. It was presumably because the N fertilizer supported improving growth and productivity. In addition, rice plants that lack nitrogen have fewer tillers and stunted growth (Phares and Akaba, 2022).

Rice requires more nitrogen than other nutrients, and it is the most critical limiting factor affecting the grain yield (Wang *et al*., 2017; Sitaresmi *et al*., 2019; Olzhabayeva *et al*., 2024). Nitrogen fertilization affects the vegetative growth phase, where the first 50% of urea stimulates plant growth, and the second 50%, just before the primordial phase, further promotes the development of growth components in preparation for the generative phase, resulting in an optimal number of rice panicles.

Currently, many variations of irrigation methods exist aside from flooding. Land flooding results in a disruption of aerobic microorganism activity due to less oxygen entering the soil slowing the decomposition rate of organic material. Intermittent irrigation allows oxygen to enter the soil, aiding the activity of aerobic microorganisms, which enhances organic matter availability (nutrients) to crop plants (Hu *et al*., 2023). Intermittent irrigation affects the vegetative growth, which is crucial for rice production (Stöber *et al*., 2020). The studied parameters depend on the genetic traits and the strong influence of environmental factors. The observed parameters also gained effects from land conditions on the efficiency of light use and plants' competition in using water and nutrients, which ultimately affect plant growth and yield-related traits (Janus *et al*., 2023). Therefore, each parameter variations depended on the adaptation of rice cultivars to the growing conditions.

Urea

The analysis of variance indicated that the urea treatment highly affected the number of productive tillers and production per hectare. In this case, the availability of N nutrients increases, providing more uptake by the crop plants (Nabayi *et al*., 2023). Applying urea fertilization at 0–20 days after transplanting (DAT) significantly influenced rice plants' vegetative development.

The available macronutrients for the rice plants facilitated the plant's metabolic processes. Yassi *et al*. (2020) reported that rice growth and production traits attained considerable influences from the available water and macronutrients, such as N. Nutrient availability helps the plant to conduct its metabolism and generate energy for further growth and development. Nitrogen fertilizers play a crucial role in chlorophyll formation. With sufficient nitrogen, chlorophyll production increases, and the chlorophyll itself is essential in photosynthesis. In rice cultivation, the grain quantity and quality traits correlate with plant production. Providing sufficient essential N nutrients grows longer panicles, producing more grains per plant (Nabayi *et al*., 2023). The number of grains and seed weight formed in a single panicle depends on the photosynthetic activity of the plant and the genetic potential of the cultivated rice genotypes. The grain weight refers to the dry matter content in seeds from photosynthesis.

Liquid organic fertilizer

The LOF treatments, viz., 4 cc/L (p2) and 6 cc/L (p3), showed the best performances for each studied parameter. It indicates applying LOF to rice plants positively affected rice growth and production. Rice plants treated with POC increased the soil pH and nutrients, boosting the augmentation of high-quality rice compared with the control treatment (Jin *et al*., 2023; Liao *et al*., 2023). Rice plants treated with liquid organic fertilizer result in better tiller growth. Applying LOF can accelerate plant growth without harmful side effects on plants and the environment (Tuhuteru *et al*., 2021).

Observations on the chlorophyll index showed that applying LOF affects chlorophyll a significantly (Table 2), chlorophyll b (Table 3), and total chlorophyll (Table 4). The highest content of chlorophyll a (239.38 and 236.43 $\mu mol/m^2$) was notable in urea (100 kg/ha) (u2) and LOF (6 cc/L) (p3), respectively. The utmost chlorophyll b content (98.2 and 95.83 $\mu mol/m^2$) emerged in urea (150 kg/ha) (u3) and LOF (6 cc/L) (p3), respectively. The maximum total chlorophyll content (342.9 and 339.64 $\mu mol/m^2$) was evident in urea (150 kg/ha) (u3) and LOF (6 cc/L) (p3), respectively. In LOF, the nitrogen content helps form chlorophyll, which is crucial in plant photosynthesis (Phares and Akaba, 2022). Chlorophyll a and chlorophyll b in rice plants are the main photosynthetic pigments, absorbing purple, blue, and red light and reflecting green light. The LOF treatment (6 cc/L) has the most chlorophyll content, so chlorophyll b and chlorophyll a synthesis occurs in large quantities. The results of photosynthesis helped form vegetative organs. Chlorophyll a and b contents enhanced the metabolic activities, optimizing nutrient absorption from the soil and promoting plant growth and development. Nitrogen is an integral part of chlorophyll, influencing photosynthesis, and most photosynthetic results occur in seeds (grains). Nitrogen fertilizer is crucial in the chlorophyll formation.

Table 2. Average chlorophyll a levels (μmol/m^2) in urea and LOF treatments.

Urea	LOF				Means	NP (U) BNT 0,05
	P0 (control)	P1 (2 cc/L)	P2 (4 cc/L)	P3 (6 cc/L)		
U0 (control)	204.74	217.05	224.63	233.96	220.10^{b}	11.72
U1 (50 kg/ha)	222.81	227.31	224.71	229.01	225.96^{b}	
U2 (100 kg/ha)	234.80	238.57	239.41	244.74	239.38^{a}	
U3 (150 kg/ha)	230.76	227.73	233.92	238.02	232.61^{ab}	
Means	223.28^{q}	227.67^{pq}	230.66^{pq}	236.43^{p}		
NP (P) BNT 0,05	9.14					

Table 3. Average chlorophyll b levels (μmol/m^2) in urea and LOF treatments.

Urea	LOF				Means	NP (U) BNT 0.05
	P0 (control)	P1 (2 cc/L)	P2 (4 cc/L)	P3 (6 cc/L)		
U0 (control)	83.83	86.34	90.85	92.94	88.49^{b}	5.98
U1 (50 kg/ha)	90.33	93.28	91.03	92.79	91.86^{b}	
U2 (100 kg/ha)	94.05	94.16	98.72	98.09	96.25^{ab}	
U3 (150 kg/ha)	98.26	96.48	98.54	99.51	98.20^{a}	
Means	91.62^{q}	92.57^{q}	94.78^{pq}	95.83^{p}		
NP (P) BNT 0,05	3.08					

Table 4. Average total chlorophyll content (μmol/m^2) in urea and LOF treatments.

Urea	LOF				Means	NP (U) BNT 0,05
	P0 (control)	P1 (2 cc/L)	P2 (4 cc/L)	P3 (6 cc/L)		
U0 (control)	295.55	312.44	322.97	336.07	316.76^{b}	17.61
U1 (50 kg/ha)	317.19	328.08	323.15	329.21	324.41^{b}	
U2 (100 kg/ha)	345.63	330.84	350.08	341.84	342.10^{a}	
U3 (150 kg/ha)	337.23	339.21	343.74	351.42	342.90^{a}	
Means	323.90^{q}	327.64^{q}	334.98^{pq}	339.64^{p}		
NP (P) BNT 0,05	10.29					

The higher weight of milled dry grains was generally due to better metabolism than other treatments. Phosphorus (P) positively affected increasing rice grain production. Additionally, sufficient phosphorus will enhance the efficiency of nitrogen. As earlier mentioned, nitrogen is vital to chlorophyll, which is crucial in photosynthesis for storing most photosynthates in the grains.

The intensity of sunlight measured helped determine the amount of light absorbed and penetrated by the rice plants (Table 5). The results showed that rice plants treated with urea (150 kg/ha) and LOF (4 cc/L) (u3p2) received the lowest amount of light (8%) in the pregnant phase compared with other treatment combinations. Rice plants with urea (50 kg/ha) and LOF (2 cc/L) (u1p1) and urea (50 kg/ha) and LOF (4 cc/L) (u1p2) received less light (12%) in the period before harvest compared with other treatment combinations. Sunlight affects plant growth and production because it is the chief energy source. Solar radiation enhances growth and transpiration rates and is crucial for crop plants (Shi *et al*., 2022).

During the latest research, light intensity measurements showed the highest density of canopy cover at rice plant pregnancy and ripening phases. It was evident that the urea (0 kg/ha) treatment (u0) was the treatment that transmitted the most light, and the urea (100 kg/ha) treatment (u2)

Table 5. Percentage of light intensity transmitted after passing through the canopy of plant.

Treatments	Transmitted Light Intensity (%)	
	Pregnancy Phase	Before Harvest
u0p0	13%	15%
u0p1	19%	21%
u0p2	18%	19%
u0p3	12%	13%
u1p0	11%	13%
u1p1	11%	12%
u1p2	11%	12%
u1p3	17%	19%
u2p0	10%	17%
u2p1	10%	16%
u2p2	10%	19%
u2p3	13%	17%
u3p0	13%	18%
u3p1	12%	18%
u3p2	9%	15%
u3p3	18%	21%

Table 6. Average number of productive tillers in the treatment with urea and LOF.

Urea	LOF				Means	NP (U) BNT 0.05
	P0 (control)	P1 (2 cc/L)	P2 (4 cc/L)	P3 (6 cc/L)		
U0 (control)	12.87	12.60	14.20	12.40	13.02[b]	1.85
U1 (50 kg/ha)	12.47	14.47	14.87	15.40	14.30[b]	
U2 (100 kg/ha)	15.53	18.07	16.40	17.20	16.80[a]	
U3 (150 kg/ha)	14.60	16.27	17.93	16.73	16.38[a]	
Means	13.87[q]	15.35[p]	15.85[p]	15.43[p]		
NP (P) BNT 0.05	1.22					

Description: Numbers followed by the same letter in columns (a, b) and rows (p, q) which is the same means that it is not different in the BNT test α = 0.05.

transmitted the least light to rice plants, which eventually affected plant metabolism. Insufficient absorption of sunlight will affect the rice plant's growth and production and disrupt its metabolic processes (Yao *et al*., 2017). Low yields correlate to low photosynthesis and biomass production. The rate of photosynthesis was relevant to the capture of sunlight by the leaves, and the amount of light transmitted to the land surface decreases the plant's age.

Urea and liquid organic fertilizers interaction

Urea and LOF treatments seemed to have separate effects. Past studies concluded that the treatment factors act independently (Tarigan and Harifah, 2018). Various factors influenced plant growth, such as environmental (climate change, rainfall, and land degradation), genetic makeup of the genotypes, and the plants' cultivation techniques (Badiane *et al*., 2023; Nazir *et al*., 2023; Wang *et al*., 2023).

However, urea and LOF treatments can be applicable together in rice cultivation to achieve the highest growth and production. The analysis of variance showed that the combination of urea and LOF significantly affected the number of productive tillers (Table 6). The results indicated that urea and LOF treatments had a significant effect. However, the interaction had a nonsignificant effect on

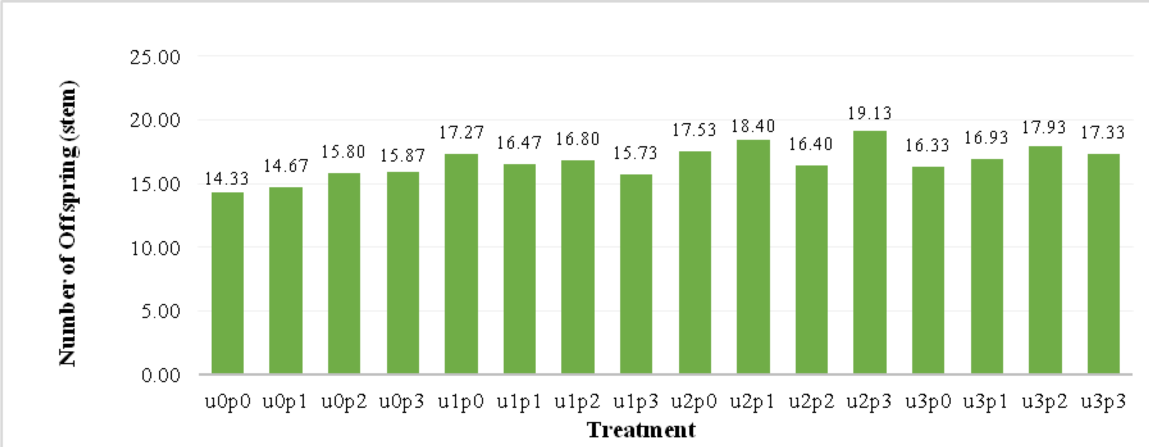

Figure 3. Average number of tillers (stems) in the urea and LOF treatments.

the number of productive tillers. The highest average number of productive tillers (16.8) resulted in the urea (100 kg/ha), which was significantly different from the urea (0 kg/ha). Nitrogen plays a crucial role in the vegetative growth of plants and stimulates the rice tiller growth. The availability of sufficient nitrogen during tiller formation affects the number of tillers in rice crops. The number of tillers formed was always directly proportional to the nitrogen available in the soil during tiller formation (Wang *et al*., 2017).

Production per hectare showed a significant ($P \leq 0.05$ and $P \leq 0.01$) correlation with the number of tillers (Figure 3). The maximum average number of tillers (19.13) manifested in the urea (100 kg/ha) and LOF (6 cc/L) (u2p3). The minimum number of tillers (14.33) was visible in the urea (0 kg/ha) and LOF (0 cc/L) (u0p0). This positive correlation refers to the combined function of the treatments used in the research, where applying urea and LOF together on the leaves allowed both vegetative and generative development optimally. Significant positive correlation values indicate that the higher the plant's characteristics, the higher the production per hectare. Characteristics that exhibited substantial positive correlation were also vital for further selection of the genotypes. The correlation coefficient provides insight into the relationships between features and information on the level and direction of selection (Bechere *et al*., 2014).

The use of fertilizer can overcome nutrient deficiencies that occur to meet plant needs. Among all the applied treatment combinations, the best combination was the treatment of urea (100 kg) and LOF (6 cc/L) (u2p3). It was relative to the increased availability of nitrogen and other nutrients. The N, P, and K were the nutrients that emerged as essential nutrients for crop plants, which also improved the soil quality, and the interaction of these three nutrients supports better rice growth and yield (Phares and Akaba, 2022; Nabayi *et al*., 2023). Determining the given dose of fertilizer is vital because it affects the rate of plant growth and more optimal productivity results. Fertilization requires the correct or balanced dose. Fertilization with the right dose can increase soil fertility, meet plant needs, and achieve maximum productivity. Additionally, providing appropriate fertilizer will impact the stability of increasing crop production, plant resistance to disease attacks, and adaptation to unfavorable climate changes.

Observations on the harvested grains per plot and the production per hectare showed that the maximum average appeared in the combination of urea (150 kg/ha) and LOF (6 cc/L) (u3p3) (Table 7). The analysis of variance showed that urea and LOF treatments had a highly significant effect. The topmost

Table 7. Average production per hectare (t/ha) in urea and LOF treatments.

Urea	LOF				Means	NP (U) BNT 0.05
	P0 (control)	P1 (2 cc/L)	P2 (4 cc/L)	P3 (6 cc/L)		
U0 (control)	4.68	5.11	4.96	5.05	4.95[c]	
U1 (50 kg/ha)	5.15	5.34	5.32	5.47	5.32[b]	0.22
U2 (100 kg/ha)	5.47	5.24	5.38	6.13	5.55[a]	
U3 (150 kg/ha)	5.01	5.44	5.75	6.26	5.61[a]	
Means	5.07[q]	5.28[q]	5.35[pq]	5.73[p]		
NP (P) BNT 0.05	0.39					

Table 8. Correlation matrix among the recorded parameters.

Traits	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1	0.10tn	0.30*	0.33*	0.04tn	0.39**	0.35*	0.18tn	0.17tn	0.14tn	0.36*	0.38**	0.40**	0.38**
2		1	0.58**	0.27tn	-0.04tn	0.42**	0.42**	0.34*	0.34*	0.37**	0.21tn	0.23tn	0.42**	0.31*
3			1	0.39**	0.01tn	0.48**	0.60**	0.39**	0.52**	0.52**	0.39**	0.54**	0.43**	0.34*
4				1	0.35*	0.38**	0.47**	0.45**	0.42**	0.30*	0.25tn	0.29*	0.38**	0.43**
5					1	0.32*	0.37**	0.38**	0.28tn	-0.18tn	-0.11tn	0.12tn	0.22tn	0.29*
6						1	0.75**	0.68**	0.47**	0.47**	0.26tn	0.61**	0.35*	0.32*
7							1	0.75**	0.64**	0.52**	0.38**	0.50**	0.43**	0.40**
8								1	0.52**	0.45**	0.33*	0.51**	0.47**	0.43**
9									1	0.89**	-0.02tn	0.45**	0.37**	0.41**
10										1	0.03tn	0.40**	0.28tn	0.28tn
11											1	0.23tn	0.31*	0.27tn
12												1	0.37**	0.32*
13													1	0.96**
14														1

** = Very Closely Related, * = Closely Related, tn = Not Relevant, 1. Plant Height, 2. Number of Puppies; 3. Number of Productive Offspring; 4. Length of Flag Leaf; 5. Panicle Length; 6. Chlorophyll Levels a; 7. Chlorophyll Levels b; 8. Total Chlorophyll Levels; 9. Number of Grains per Panicle; 10. Panicle Density; 11. Percentage of Grain Content per Panicle; 12. Grain Weight of 100 Seeds; 13. Weight of Milled Dry Grain; 14. Production per Hectare.

average production (5.61 t/ha) was prominent in the treatment of urea (150 kg/ha) (u3), which was remarkably different from urea (0 kg/ha) (u0) and urea (50 kg/ha) (u1). However, it was nonsignificantly different from the urea (100 kg/ha) (u2). The highest average production (5.73 t/ha) was notable in the LOF (6 cc/L) (p3), which was also significantly different from the LOF (0 cc/L) (p0) and LOF (2 cc/L) (p1) and was nonsignificantly different from LOF (4 cc/L) (p2). Table 8 shows the correlation analysis of all parameters. The main correlation in this research is production per hectare. The results of the correlation analysis show the parameters of plant height (r = 0.38), length of flag leaf (r = 0.43), chlorophyll levels b (r = 0.40), total chlorophyll levels (0.43), number of grains per panicle (r = 0.41) and weight of milled dry grain (r = 0.96) give a very significant correlation on productivity.

CONCLUSIONS

An improved rice productivity can result from combining urea and liquid organic fertilizer. The combination of urea and LOF yielded the best results, with the combination of urea (150 kg/ha) and LOF (6 cc/L) and urea (100 kg/ha) and LOF (6 cc/L) resulting in the highest rice grain yield (6.13 and 6.26 t/ha, respectively). The urea fertilizer (100 kg/ha) and LOF (6 cc/L) resulted in the highest average number of productive tillers (16.8), the percentage of filled grains (84.47%), and the dried milled rice (11.64 kg). The combination carried out with the correct dosage and concentration (urea fertilizer (100 kg/ha) and LOF (6 cc/L) can result in better rice growth and production and improve the rice field soil conditions.

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