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PERFORMANCE OF KALINGA'S HEIRLOOM RICE CULTIVARS UNDER DIFFERENT LEVELS OF VERMICOMPOST

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Abstract

The study was conducted under wetland culture at Tabuk City, Kalinga using a two-factor experiment laid in Randomized Complete Block Design with three replications and with the following treatments: - Heirloom rice cultivars included a_1-Chong-ak and a_2-Ulikan Red; and Organic fertilizer included b_1-No fertilizer (control), b_2-100% of the recommended rate of fertilizer, b_3-75% of the recommended rate of fertilizer, b_4-50% of the recommended rate of fertilizer and b_5-25% of the recommended rate of fertilizer. The study aimed to determine which of the different fertilizer treatments would give the best in terms of agronomic characteristics and highest yield of the cultivars and to provide benchmark data on the profitability of producing the two cultivars. Results revealed that different levels of organic fertilizer as a single factor did not produce a significant effect on the yield of the two heirloom rice cultivars tested. A significant interaction effect between the two factors tested is obtained in terms of the mean number of tillers, the mean number of days to maturity, percent filled and unfilled grains. Ulikan Red obtained significantly the highest mean on the following parameters: number of days to flowering, height at maturity, number of tillers, days to maturity, and computed yield in tons per hectare.

Keywords: Heirloom rice cultivars, Chong-ak, Ulikan, agronomic characteristics, benchmark.

Introduction

Traditional rice is mostly found in upland areas in the province of Kalinga, Cordillera Administrative Region (CAR) particularly in the Municipality of Pasil, Tanudan, Lubuagan, Tinglayan, and Balbalan. These varieties are grown in the highland areas for 6-7 months, leaving one cropping a year. It has low tillering performance, awned grains, and tall stalks which characterize these rice cultivars. Aside from this, they can be grown organically and free from synthetic pesticides and fertilizer.

The Chong-ak cultivars are more flavorful than Ulikan cultivars hence, Chong-ak is more susceptible to insect pests because of its aromatic character. Also, the Ulikan is taller than Chong-ak and in terms of yield, it is comparable. Besides, they also have characteristics that help farmers make a better income from their crops. Moreover, traditional rice varieties have been a tangible example of the culture being preserved by the indigenous people's (Cuevas et al., 2018)

Vermicompost has been shown to have several positive impacts on plant growth and health. This organic fertilizer is therefore increasingly considered in agriculture and horticulture as a promising alternative to inorganic fertilizers. However, the effects of vermicompost on plant-soil systems are not fully understood (Lazcano & Domínguez, 2011). Vermicompost is rich in microbial population particularly fungi, bacteria, and actinomycetes (S.H.S. Senarathne, 2018).

The study was conducted to know the agronomic characters of these cultivars and assess their productivity using levels of Vermicompost. This study was the basis of future researches, faculty, students, and research institution.

Methodology

Heirloom Rice Cultivar Selection

The Heirloom Rice seeds were collected from the farmers who are planting them at Pasil, Kalinga. These Heirloom rice cultivars are popular and have been planted by farmers for many years now.

Selection of Experimental Site

The experiment was conducted in a puddled irrigated area at Barangay Agbannawag, Tabuk City, Kalinga. The experimental site is 1.5 Km away from the residential area and near the sub-irrigation canal and accessible to any transportation

Pre-germination of Seeds

Heirloom Rice seeds were pre-germinated by soaking the seeds in a drum with clean water overnight. Seeds were taken out from the drum and then incubated for 24 hours or until a white dot appears, which is the emerging root. Adequate aeration was provided during incubation by placing the seeds on top of a slotted pallet and covered with rice straw.

Seedbed Preparation

The seedbed was prepared by plowing once and harrowing twice at a one-week interval. Just after the final harrowing, seedbed plots were set up measuring 1 m wide and 6 m long. Application of vermicompost was done before sowing of seeds to supply the nutrient needed by the seedlings and at the same time to facilitate pulling of seedlings. The seedbed surface was leveled with the use of a wooden plank to ensure a uniform water level in the paddy field.

Care of Seedlings

The seedbed was set up far from fields infected with tungro, grassy stunt, and other diseases. The seedbed was established away from sources of light to avoid attracting adult stemborers, brown planthoppers, and green leafhoppers. The seedbed was provided with good soil condition and good drainage. Seedlings were watered 3 days after sowing (DAS), gradually increased to 2 cm depending on the height of the seedlings.

Land Preparation

The wetland tillage method was used to prepare the rice fields for planting. The following steps were done before wetland tillage.

a. The dike was repaired to minimize seepage.
b. Primary tillage was done with the use of a rotavator mounted on a four-wheeled tractor;
c. The field was submerged for 7 days to soften the clods and to decompose organic materials and then the field was drained to allow volunteer/drop seeds and weed seeds to germinate;

d. Harrowing was done 3 times at 7 days intervals with the use of a combed-tooth harrow mounted on a hand tractor. The first harrowing was done along the plowing pattern of the rotavator to further break the soil clods. The second harrowing was done crosswise to incorporate crop residues and to eradicate newly emerged weeds. Third and final harrowing were done 21 days before transplanting which aims to protect seedlings from negative effects of high concentration of harmful substances generated by decomposing organic matter as well as final incorporation of crop residues and to provide proper soil tilth for crop growth;
e. Leveling was done manually with the use of a wooden plank.

Experimental Design

The experimental area was laid out following the principles and procedures of Randomized Complete Block Design in Two Factor Experiment. Each of the following treatment combinations was replicated three times. Heirloom rice cultivars included a_1-Chong-ak and a_2-Ulikan Red; and Organic fertilizer included b_1-No fertilizer (control), b_2-100% of the recommended rate of fertilizer, b_3-75% of the recommended rate of fertilizer, b_4-50% of the recommended rate of fertilizer, and b_5-25% of the recommended rate of fertilizer.

Transplanting of Seedlings

The seedlings were transplanted manually approximately one month after sowing following the planting distance of 20 x 20 centimeters using the straight-row method.

Irrigation

Within one week after transplanting, soil saturation was maintained to control snail infestation and established better soil-root contact. During tillering stage up to the flowering stage the water level was maintained to 6 cm depth to stimulates deeper root growth, tiller production, firm root anchorage, correction of micronutrient imbalances, and removal of toxic substances from the soil. During the ripening period, irrigation was stopped to facilitate uniform grain maturity.

Fertilizer Application

The computed amount of vermicompost applied was based on the result of the nutrient analysis of the vermicompost sample at the Bureau of Soils and Water Management. Fertilizer treatments were all applied as basal fertilizer.

Cultural Management Practices

Monitoring of insect pests and disease occurrence in the experimental area was done every three days to avoid possible serious damage.

Controlling Golden Kuhol was done by handpicking before and after final harrowing to avoid serious damage to the seedlings. Attractants like leaves of gabi were also used after transplanting to facilitate hand-picking of Kuhol.

Hand weeding was done every fifteen days to ensure that the experimental field is free from weeds and to minimize competition for light, moisture, and nutrient. No herbicide was used to control weeds in the experimental area.

Application of insecticide like Chix was used to control white aphids, rice yellow beetle, and black rice bug following the recommended dosage.

Also, the application of fungicide like Fuguran was used to control the occurrence of False Smut in Ulikan Red cultivars during the beginning of the maturity stage.

Harvesting, Threshing, and Drying

Chong-ak (a_1) was harvested 107 days after transplanting while Ulikan Red (a_2) was harvested 122 days after transplanting. The Heirloom rice cultivars manifested yellowish-brown during harvesting. Harvesting was done manually with the use of sickle (gapas). The representative sample plants were the first to be harvested. Threshing and drying were done manually to ensure no grains losses most especially from the sample plants.

Results and Discussion

Number of Days to Flowering

Data shown in Figure 1 presents the cultivar response on a mean number of days at flowering to different levels of vermicompost. Results revealed that Chong-ak (a_1) was the earlier to flower with a mean of 96.07 days and then Ulikan Red (a_2) with a mean of 106 days. Analysis of variance revealed a highly significant difference between the heirloom rice cultivars tested.

The effect of different levels of vermicompost on the cultivars' number of days at flowering is presented in Figure 2. The plants produced flowers sporadically regardless of varying levels of vermicompost with a mean ranging from 100.33-101.83 days after sowing (DAS) with highly significant differences as revealed in the analysis of variance.

Plants under b_3- (75% of the recommended rate of fertilizer) are significantly different from b_1-(no fertilizer-control). This result is supported by Tisdale and Nelson (1984), who found that an adequate supply of nitrogen to the crop plants during their growth period is very important for the initiation of leaves and florets' primordial development.

The interaction effect of two heirloom rice cultivars and different levels of vermicompost is shown in Figure 3. Results show that interaction between different treatments obtained a range of 96.33 – 96.67 and 104.33 – 105.33 days of flowering for Chong-ak and Ulikan Red, respectively. Analysis of variance revealed a highly significant difference between the treatments tested.

Number of Tillers per Hill

As shown in Figure 4, Ulikan Red (a_2) obtained the higher number of tillers with a mean of 9.07, and Chong-ak (a_1) had the lower mean of 7.67. Analysis of variance of the data revealed a significant difference between the two heirloom rice cultivars tested.

Data in Figure 5 presents the effect of different levels of vermicompost on the cultivars' mean number of tillers per hill. Results revealed that plants fertilized with b_5-(25% of the recommended rate of fertilizer) significantly produced more number of tillers over all other treatments with a mean of 9.83,

followed by b_1, b_4, b_3, and b_2 with corresponding means of 9.17, 8.17, 7.33 and 7.33. Analysis of variance revealed significant differences among the treatment tested.

Number of Days to Maturity

In terms of the mean number of days to maturity, Chong-ak (a_1) cultivar was the earlier to mature with a mean of 137.8 days after sowing (DAS), and Ulikan (a_2) was later to mature at 152 days. Statistical analysis revealed that there is a highly significant difference between the two heirloom rice cultivar tested as shown in figure 6.

The effect of different levels of vermicompost on the cultivars' mean number of days of maturity is shown in Figure 7. Data shows a different response among the treatments tested. Statistical analysis revealed a significant difference noted. This means that the different rates of fertilizer applied produced a significant effect on the number of days of maturity. Besides, Chong-ak responded to organic fertilizer sporadically with a range of 135-143 days maturity while Ulikan uniformly matured at 152 days despite differences in the level of fertilizer application.

The interaction effect of two heirloom rice cultivars and different levels of organic fertilizer is shown in Figure 8. The result shows that the mean maturity of Chong-ak differs significantly in T_4, T_1, T_2, T_3, and T_5. This implies that the response of different treatments in Chong-ak (a1) is sporadic. Also, Ulikan Red (a_2) responded uniformly as shown by the uniform days to maturity. Analysis of variance revealed a significant difference among the treatments tested.

Percent Filled Grains (%)

Figure 9 shows that Ulikan Red (a_2) obtained the higher percent filled grains with a mean of 74.87% and Chong-ak (a_1) had a mean of 68.5%filled grains. Analysis of variance revealed a significant difference between the cultivars tested.

This finding is the claim of Walker et al.(2008) that proper application of fertilizer to rice leads to an increased number of filled spikelets per panicle. Supposed to be, b1 (100% of the recommended rate of fertilizer) should have the higher percent filled with grains.

The interaction effect of the two heirloom rice cultivars and different levels of organic fertilizer on the number of filled grains per sample is shown in Figure 10. Results show a significant interaction among the two heirloom rice cultivars exposed to vermicompost treatments.

Percent Unfilled Grains/Sample (%)

Figure 11 presents the cultivars' response on mean percent unfilled grains to different levels of vermicompost. Results revealed that the higher percentage of unfilled grains was obtained in Chong-ak (a1) with a mean of 31.5%while Ulikan Red (a2) obtained a mean of 25.13%. Analysis of variance indicates a significant difference between the two cultivars tested.

The interaction effect of heirloom rice cultivars and different levels of vermicompost is shown in Figure 13. Results revealed that T_5 is significantly different from T_1, T_9, and T_{10}. This means that 25% of the recommended rate of fertilizer under Chong-ak (a_1) produced more unfilled grains. Analysis of variance revealed a significant interaction of the two factors involved.

Computed Yield (tons/ha)

The cultivars' response on computed yield in tons per hectare to different levels of vermicompost is shown in Figure 12. Results show that Ulikan Red (a_2) obtained the highest computed yield with a mean of 2.84 t/ha while Chong-ak (a_1) has a mean of 1.91t/ha. Analysis of variance revealed a highly significant difference between the two cultivars tested (Appendix Table 9c). The disparities in yield may be accounted to the percent unfilled grains wherein Chong-ak (a_1) produced 31.5% unfilled grains significantly higher than Ulikan Red (a_2) with 25.13% unfilled grains. Moreover, Ulikan Red produced a higher filled grain with 74.87%, while Chong-ak obtained a lower filled grain of 68.50%.

Accordingly, too (PhilRice, n.d.) the longer maturing varieties generally have higher yield potential, which means that longer maturing plants have more time to absorb nutrients from the soil compared to shorter maturing plants. This statement was manifested in Figure 5a that Ulikan Red (a_2) obtained a longer mean maturity of 152 days (DAS).

Moreover, tillering in rice is one of the most important agronomic characters for grain production (Smith, n.d.) because the number of tillers per plant determines the panicle number, key components of grain yield (Yan et al., 1998) (Yan et. al. 1998). Miller et al. (1991) reported that tillering is a major determinant for the production of rice.

The statement above is similar to the result that Ulikan Red (a_2) produced more tillers with a mean of 9.07 compare to Chong-ak which only has a mean of 7.67 (Figure 13).

Fig. 1 Cultivar response on a mean number of days to flowering to different levels of vermicompost.

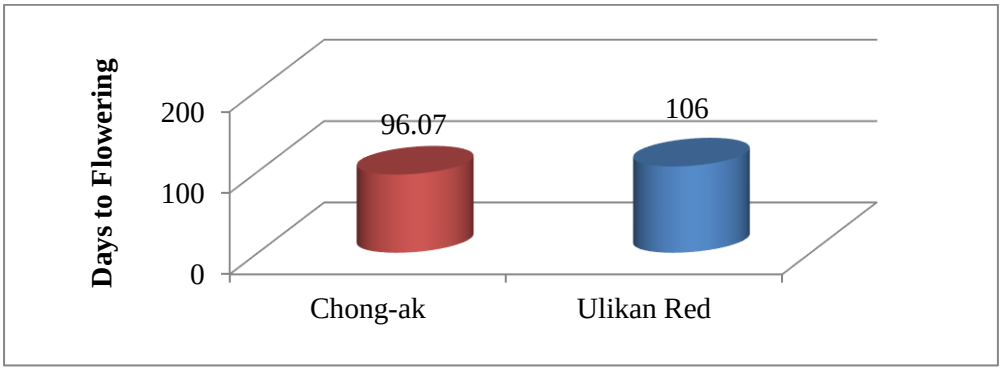

Fig. 2 Effect of different levels of vermicompost on the cultivars' mean number of days to flowering.

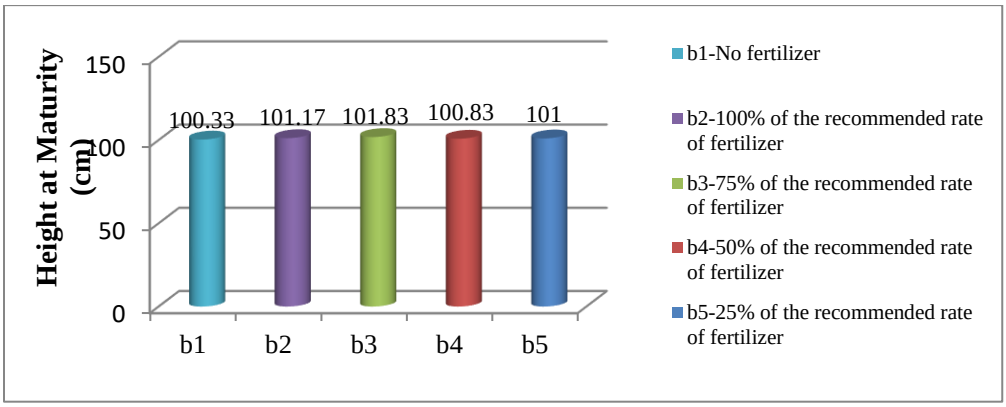

Fig. 3 Interaction effect of heirloom rice cultivars and different levels of vermicompost as to the mean number of flowering

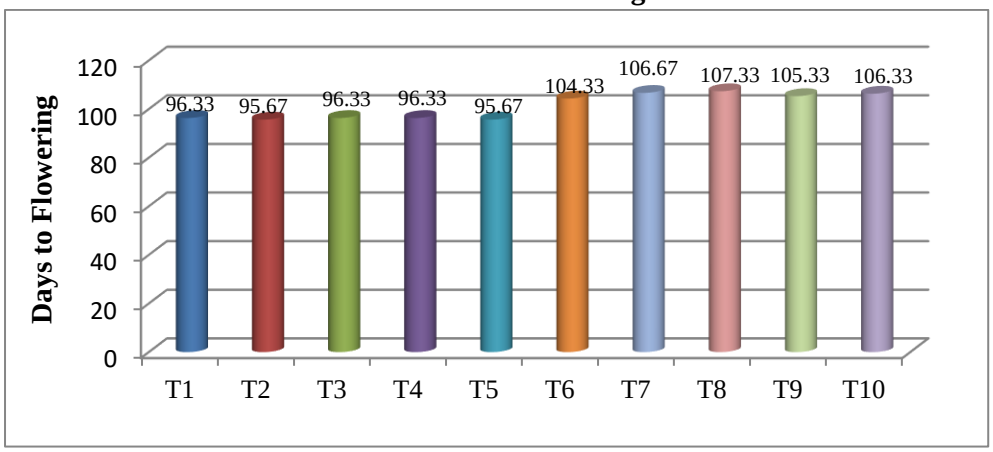

Fig. 4 Cultivar response on the mean number of tillers per hill to different levels of vermicompost

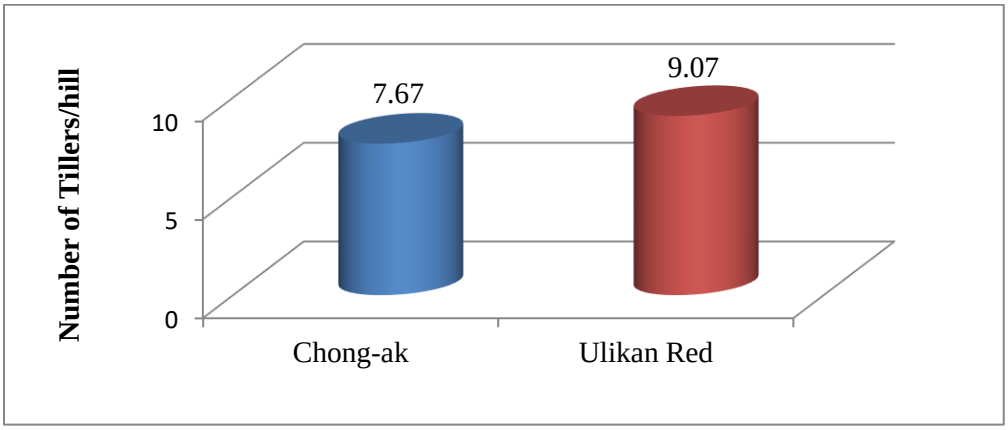

Fig. 5 Effect of different levels of vermicompost on the cultivars' mean number of tillers per hill

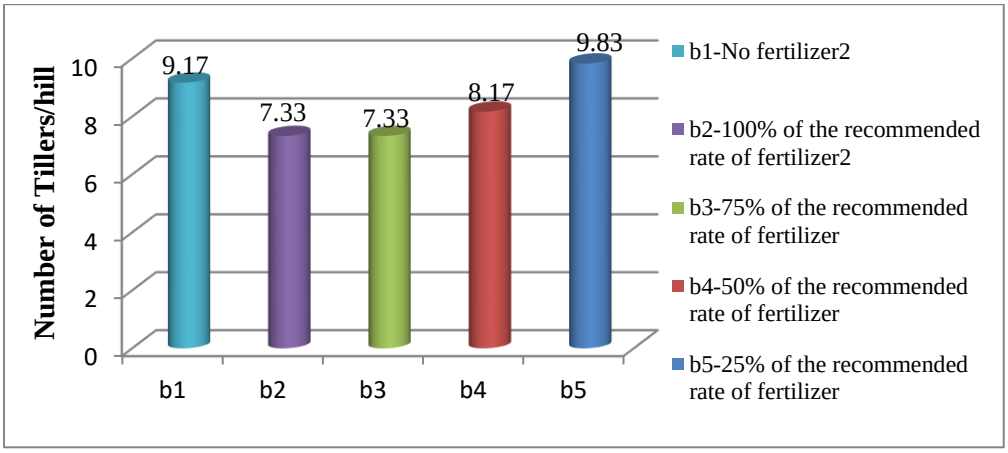

Fig. 6 Cultivar response on the mean number of days to maturity to different levels of vermicompost

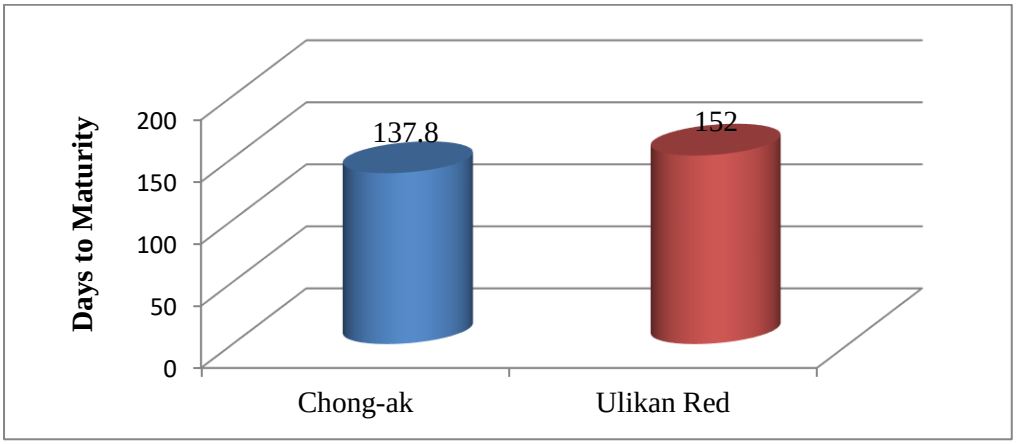

Fig. 7 Effect of different levels of vermicompost on the cultivars' mean number of days to maturity

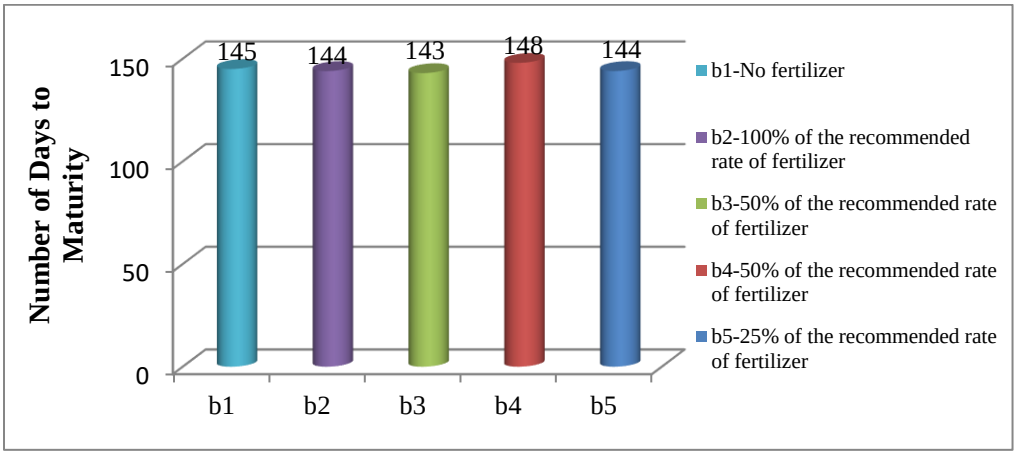

Fig. 8 Interaction effect of heirloom rice cultivars and different levels of vermicompost on the mean number of days to maturity

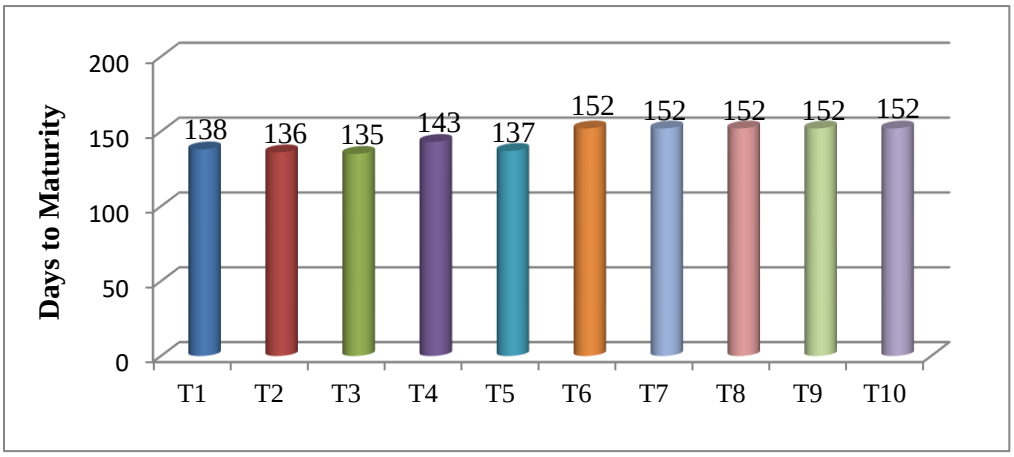

Fig. 9 Cultivar response on the mean percent of filled grains to different levels of vermicompost

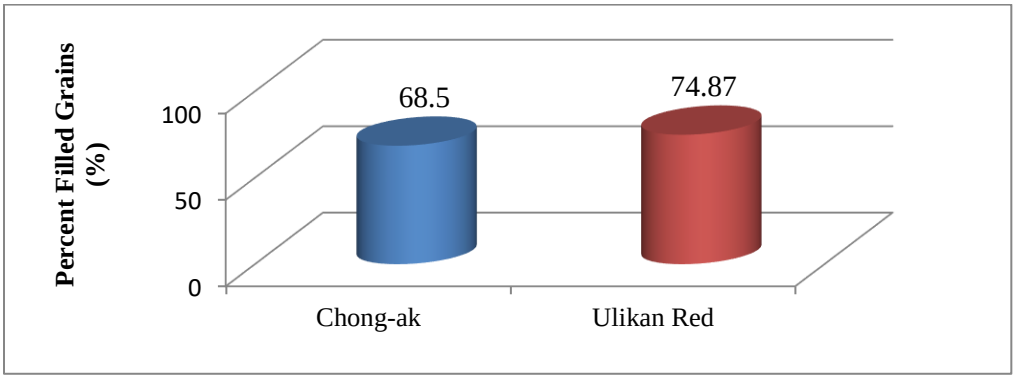

Fig. 10 Interaction effect of heirloom rice cultivars and different levels of vermicompost on percent filled grains

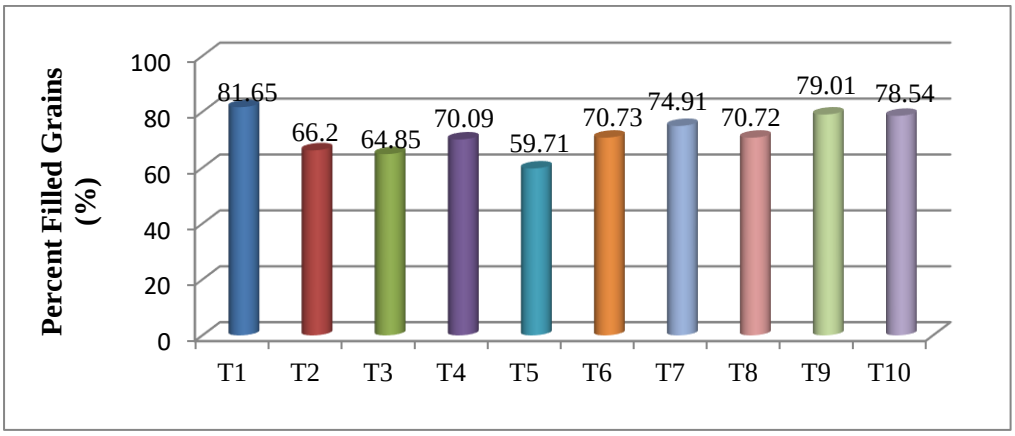

Fig. 11 Cultivar response on percent unfilled grains to different levels of vermicompost

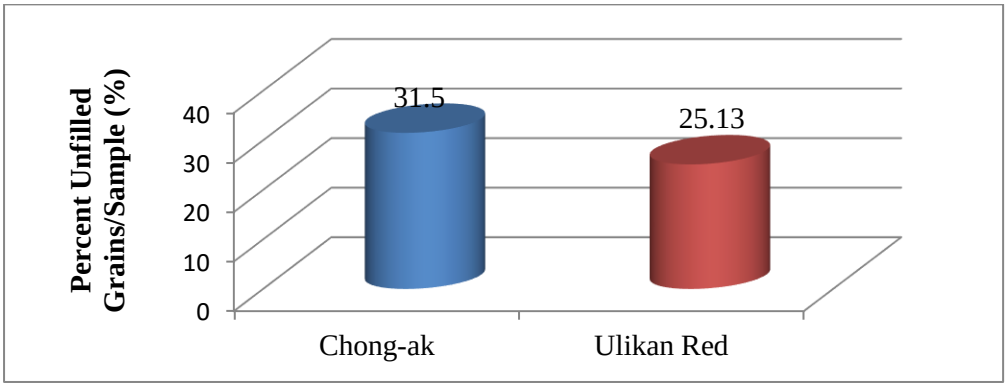

Fig. 12 Interaction effect of heirloom rice cultivars and different levels of vermicompost on percent unfilled grains/sample.

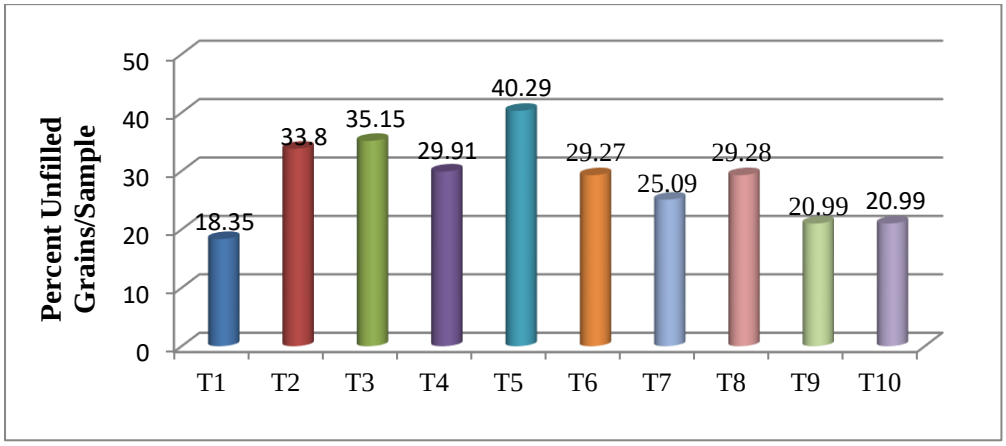

Fig. 13 Cultivar response on mean computed yield (tons/hectare) to different levels of vermicompost

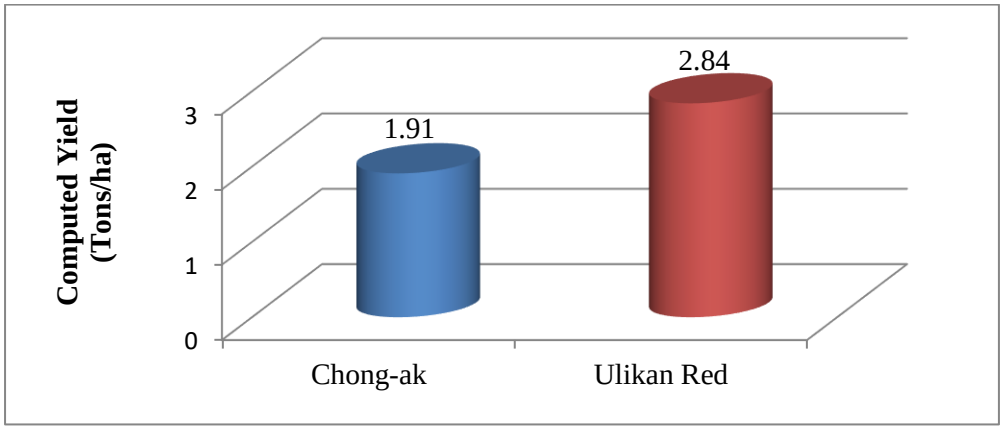

Table. 1 Profitability analysis of Chong-ak (a_1) under the different rate of fertilizer

Description	b_1	b_2	b_3	b_4	b_5
Total Cost of Production (Php)	25,685.00	25,685.00	25,685.00	25,685.00	25,685.00
Gross Sales (Php)	91,000.00	85,500.00	112,000.00	99,500.00	89,500.00
Net Income (Php)	65,315.00	18,785.00	27,515.00	34,515.00	44,315.00
Return on Investment (Php)	254.29	18.01	32.57	53.11	98.07
Net Return Peso Invested	2.54	0.18	32.57	0.53	0.98

Table. 2 Profitability analysis of Ulikan Red (a_2) under the different rate of fertilizer

Description	b_1	b_2	b_3	b_4	b_5
Total Cost of Production (Php)	25,685.00	104,285.00	84,485.00	64,985.00	45,185.00
Gross Sales (Php)	141,500.00	143,000.00	134,500.00	151,500.00	139,500.00
Net Income (Php)	115,815.00	38,715.00	50,015.00	86,515.00	94,315.00

Return on Investment (Php)	450.91	37.12	59.2	133.13	208.73
Net Return Peso Invested	4.50	0.37	0.59	1.33	2.08

Conclusions

Based on the result of the study, the following conclusions were drawn:

1. Ulikan Red cultivar significantly performed better than Chong-ak in terms of growth parameters such as the number of days to the flowering, mean height at maturity, the mean number of tillers, and several days to maturity.

2. There is no significant difference between Ulikan Red and Chong-ak cultivars concerning percent filled and unfilled grains, the weight of 1000 grains, and dry matter yield when applied to different levels of vermicompost.

3. Ulikan Red cultivar has a significantly higher computed yield per hectare compared to Chong-ak cultivar.

4. The different levels of organic fertilizer applied as a single factor produced a significant effect on the growth of the two heirloom rice cultivar tested under wetland culture specifically on the mean number of days of the flowering, mean number of tillers, and mean a number of days of maturity.

5. The different levels of organic fertilizer applied as a single factor did not produce a significant effect on the yield of the two heirloom rice cultivars tested under wetland culture.

6. Ulikan Red cultivar under the control treatment (no fertilizer applied) is more profitable compared to Chong-ak.

Recommendations

Based on the result of the study, the following are recommended:

1. The use of the Ulikan Red heirloom cultivar is recommended since it has a significantly higher yield compared to Chong-ak under wetland culture.

2. No organic fertilizer is recommended for Ulikan Red cultivar production under wetland culture. However, application of 25% of the recommended rate of fertilizer may be applied to enhance a higher number of tillers since tillering is a major determinant of yield in rice production.

3. Follow-up studies are recommended on the following:

a. Heirloom rice cultivars of Kalinga as affected by different balanced fertilization strategies;

b. Growth and yield performance of heirloom rice cultivars under different planting distances;

c. Further evaluation of the performance of heirloom rice cultivar of Kalinga across different location and cropping time;

d. Sensory evaluation on the eating quality and nutritional content of organically produce heirloom rice cultivar;

e. Different and nutritional management of heirloom rice cultivar of Kalinga; and

f. Performance of heirloom rice cultivars on the timing of fertilizer application.

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