Comparison of the Effects of Organic and Inorganic Fertilizers on the Growth of the Paw-San Cultivar

Hnin Wyut Yee [*]

Abstract

The study was conducted to investigate the effects of various organic fertilizers on the growth and yield of the rice (Paw- San) cultivar. The study was conducted during the dry season of November 2018 to April 2019.The site of the study area was Dagon University Campus, Yangon Division. The experiment was arranged in RCBD (Randomized Completely Blocked Design) consisting of four treatments. This was inorganic fertilizer (conventional method) N:P:K of (15:15:15)kg/acre with urea 2:2.5kg/acre was used as inorganic fertilizer :Treatment 1;3tons/ha of cow manure as Treatment 2;3 tons/ha of poultry manure as Treatment 3 and the recommend ratio of effective microorganism (EM) was used for Treatment 4.All organic treatments were also added with 3 tons/ha of rice hull ash respectively.

The highest vegetative growth in this research was observed from inorganic fertilizer Treatment 1 and so from cow manure. The value of growth data from T_1 and T_2 was nearly similar. As a result of this study, cow manure fertilizer was the best among organic fertilizers, and it should be used for organic rice growing. The number of effective tillers showed the highest value of 14.82 from treated with inorganic fertilizer(T_1) and cow manure(T_2) had 13.5.

Key words: ***Oryza sativa*** L., Organic and Inorganic fertilizer, Soil analysis and vegetative growth

Introduction

Rice belongs to the tribe *Oryzeae*, sub-family *Poacoideae* in the grass family *Poaceae*(syn.*Gramineae*).The genus *Oryza* is said to contain six species of which *Oryza sativa* L. is the most important commercially in world rice cultivation. RMRDC(2005).Rice is one of the most important cereal crops in the world followed by wheat and maize. It is indispensable in terms of its important as a food crop because it provides more calories per hectare than any other crop.

Rice is an excellent source of carbohydrates containing approximately 87 % in grain. It contains 7 to 8 % of protein, which has higher digestibility, biological value and is more nutritious, possesses lower crude fibre and lower fat (1 to 2%). The most important and essential plant nutrient is nitrogen (N) and will increase the crop yield positively[19]. N is required for all non-legume crops on all soil types. Nitrogen is supplied by indigenous sources such as soil minerals, soil organic matter, rice straw, manure, and water through rain or irrigation.

Rice (*Oryza sativa* L) is the world's most important stable food for more than two billion people in Asia and hundreds of millions in Africa and Latin America (Ladha *et al.*,1997). Within Southeast Asia, rice provides about 60% of the human food consumption. About 55% of the Asian rice is produced in irrigated areas. The use of chemical fertilizer in rice cultivar could potentially reduce soil fertility.

As a crops nutrient supplier, organic fertilizer can be used in organic rice cultivation. Currently, demand for organic rice in Indonesia is increasing. This was shown by the establishment of organic rice farmer associations in Klaten and Magetan, East Java (Andoko,2010). For consumers, organic rice is believed to be healthier because it does not contain chemical residues. For farmers, organic rice cultivation is more profitable because it can improve soil fertility and its selling price is higher than conventional rice. Poultry manure

[*] Demonstrator, Department of Botany, University of Yangon

is superior to the other farmyard manures as a source of nitrogen supply. To improve the physical, chemical and biological properties of soil, organic fertilizer can be applied.

The aim and objective of the present study were to study the effect of organic and inorganic fertilizers on the vegetative growth of a rice cultivar (Paw-San), to identify the suitable fertilizer for organic rice cultivation.

Materials and Methods

The experiment was carried out in the field area of Dagon University Campus, Yangon Division. During the period of November 2018 to April 2019. The experiment was arranged in a Randomized Completely Block Design (RCBD). There were four blocks and each block had five replication (plots) and 10 plants were randomly selected for data collection. Each block size was 3m x 9m(27 m^2). The seeds of the Paw-San cultivar were used as planting material.

The seedlings of the Paw-San cultivar were treated with four treatments. The treatments were conventional methods of inorganic fertilizer (N:P:K) (15:15:15) and urea with a rate of 2:2.5 (kg/acre) for inorganic fertilizer(Treatment 1). The cow manure fertilizer (Treatment 2) and poultry manure fertilizer (Treatment 3) were used at the rate of 3 tons per hectare respectively and the recommended ratio of the effective microorganism with syrup molasses was used as treatment 4.

Preparation of the seed bed and cultivation area

The seed bed preparation was started one week before sowing the nursery and preparation was done by a mixture of humus, soil and burnt rice husk and one seed was sown in one hole (System of Rice Intensification). The field cultivation area was started one month before sowing.

The soil was disked plough for three time before cultivation and leveling was done. The chemical fertilizer for inorganic fertilizer and the other three organic fertilizers were added. The ten days old seedlings plants were sowed in the field at a distance of 20 cm between plants and rows.

For the next two months of cultivation period, the first data were collected from 21 days after transplanting and every 10 days. The data collection of vegetative growth was plant height, number of tillers per hill, leaf length, leaf width and, number of leaves.

Fig. 1 -Land preparation

Fig.2-Leveling

Fig.3 Setting the water proof plastic between the block

Fig. 4 Transplanting at cultivation area

Measuring leaf area

Only the expanded lamina was considered as a leaf for leaf area measurement. The length and maximum width of five leaves which were tagged for representative treatment were measured every month for calculating leaf area. The leaf area was determined by using the following formula:

Leaf area(cm^2)Leaf Length x Leaf Width x Adjustment factor (K)

The adjustment factor (K) varies with the shape of the leaf which in turn is affected by the variety, nutritional status, and growth stage of the leaf, K value of rice was 0.095 presented by Kemp(1960).

Data Analysis

The data collected were subjected to analysis of Variance (ANOVA) computation was done using IRRST, Philippines and treatment means where significant, were separated using the Duncan's New Multiple Range Test (DNMRT) at 5% level of probability.

Before cultivation, in the field, the prepared soil with various fertilizers was tested in the department of agriculture (LAND USE) soil Interpretation

Division - Yangon
Township - Dagon University

Table 1. Soil sample result of cultivation area

Sr. No	Sample plot	Moisture %	pH Soil water 1:2.5	Organic Carbon %	Humus %	Total N %	Excha-ngeable Cation	Available Nutrients	
							K^+ meq/100gm	P ppm (Bray)	K_2O mg/100 gm
1	Inorganic fertilizer	2.82	6.47	0.98	1.69	0.18	0.43	0.20	20.08
2	Cow manure	2.40	5.61	1.12	1.93	1.16	0.39	2.05	18.44
3	Poultry manure	2.26	5.71	1.08	1.86	0.20	0.42	2.25	19.65
4	Effective Microorganism	2.54	5.87	1.04	1.80	0.16	0.34	0.82	16.00

Results

At the 30 days after sowing the growth rate of plant height was rapid until 130 days after sowing. After 130 days after sowing the growth rate of plant height remains steady until maturity. In all the treatments, cow manure(T_2) was the highest mean plant height at 92.91 cm followed by poultry manure(T_3) was 92.57cm, in inorganic fertilizer(T_1) was 92.24cm and effective microorganism(T_4) was 91.60 cm respectively. Table 2.

Table 2. Mean plant height of rice cultivar (Paw-San) relation with age

Treatment / DAS	**Inorganic Fertilizer(T_1)**	**Cow Manure (T_2)**	**Poultry Manure (T_3)**	**Effective Microorganism (T_4)**
30	37.68	37.92	39	46.01
50	62.05	69.95	70.17	63.99
70	101.11	101.44	103.88	100.25
90	105.45	105.70	105.38	104.27
110	108.93	109.13	107.68	107.41
130	114.82	112.68	110.51	109.18
150	115.63	113.60	111.40	110.10
Mean	92.24	92.91	92.57	91.60

Number of Tillers per hill

The result of the number of tillers per hill was influenced by organic and inorganic fertilizer. The highest number of tillers per hill was observed at their maximum tillering capacity at 130 DAS. The mean maximum number of tillers 19.75 was found in cow manure treated plant(T_2) followed by T_4(16.54),16.35 in poultry manure (T_3) and 16.15in inorganic fertilizer in T_1treated plant. Table 3.

Table 3. Mean number of tiller per hill of rice cultivar (Paw-San) relation with age

Treatment / DAS	Inorganic Fertilizer(T_1)	Cow Manure(T_2)	Poultry Manure(T_3)	Effective Microorganism (T_4)
30	4.94	4.68	3.62	3.78
50	8.64	13	12.02	11.78
70	19.92	23.66	18.72	18.20
90	20.96	25.72	20.88	21.58
110	21.22	25.72	21.44	21.94
130	21.22	25.72	21.44	21.94
Mean	16.15	19.75	16.35	16.54

Leaf Length(cm)

The mean value of leaf length rose slowly until 50 days after sowing. Then it rapidly grows until it reaches a steady state at 110 days after sowing. The highest leaf length of 54.18 cm was recorded at a T_1 (Inorganic fertilizer) treated plant and nearly similar value of 53.89 cm in T_2(cow manure),53.02 in T_4(effective microorganism)and 52.93 in T_3(poultry manure) respectively. Table 4.

Table 4. Mean Leaf Length of rice cultivar(Paw-San)relation with age

Treatment / DAS	Inorganic Fertilizer (T_1)	Cow Manure (T_2)	Poultry Manure (T_3)	Effective Microorganism (T_4)
30	31.71	32.60	34.35	39.20
50	43.34	48.03	41.23	43.32
70	74.72	73.28	76.65	70.47
90	79.24	74.89	78.54	76.27
110	79.75	75.02	68.09	73.60
130	36.32	38.44	36.97	35.26
150	34.18	34.98	34.66	33.02
Mean	54.18	53.89	52.93	53.02

Leaf Width (cm)

In all treatments ,the mean value of leaf width in inorganic fertilizer (T_1) was the highest at 1.04 cm and , cow manure (T_2)treated plant had 1.03 cm, the Poultry manureT_3 treated plant had 1.01cm and effective microorganism treated plant T_4 was 0.99 cm respectively. Table 5.

Table 5. Mean Leaf Width of rice cultivar (Paw-San) relation with age

Treatment / DAS	Inorganic Fertilizer (T_1)	Cow Manure (T_2)	Poultry Manure (T_3)	Effective Microorganism (T_4)
30	0.52	0.51	0.58	0.56
50	0.89	0.87	0.82	0.77
70	1.15	1.12	1.11	1.09
90	1.16	1.16	1.12	1.12
110	1.19	1.17	1.14	1.13
130	1.20	1.19	1.16	1.14
150	1.20	1.20	1.16	1.15
Mean	1.04	1.03	1.01	0.99

Number of Leaves

The leaf number of the plant slowly raise at 90 DAS and then rapidly raise and it reached a steady state at maturity. In all treatments, highest mean number of leaves was 6.93 in cow manure treated plant(T_2) and followed by 6.69 in the poultry manure treated plant (T_3) 6.33 in effective microorganism(T_4) and 6.22 in inorganic fertilizer(T_1). Table 6.

Table 6. Mean number of leaves of rice cultivar(Paw-San)relation with age

Treatment / DAS	Inorganic Fertilizer (T_1)	Cow Manure (T_2)	Poultry Manure (T_3)	Effective Microorganism (T_4)
30	4.12	4.06	4.04	3.92
50	4.86	6.62	5.94	6.18
70	6.12	6.70	6.18	6.44
90	7.02	7.78	7.62	6.74
110	7.12	7.78	7.70	7.02
130	7.16	7.78	7.70	7.02
150	7.16	7.78	7.70	7.02
Mean	6.22	6.93	6.69	6.33

Total Leaf Area(cm^2 $plant^{-1}$)

The harvest time of this research's total leaf area was statically non-significantly different between different fertilizers. The total leaf area of 39.56 cm^2 in cow manure(T_2) was the highest and was followed by 38.37 cm^2 in inorganic fertilizer(T_1),37.86 cm^2 in poultry manure(T_3)and the minimal leaf area 30.34cm^2 was observed from effective microorganism (T_4) respectively.

Table 7. Mean number of total leaf area (Paw-San) cultivar at harvest time

Treatment	Inorganic Fertilizer(T_1)	Cow Manure(T_2)	Poultry Manure(T_3)	Effective Microorganism(T_4)
Total leaf area (cm^2 $plant^{-1}$)	38.37	39.56	37.86	30.34

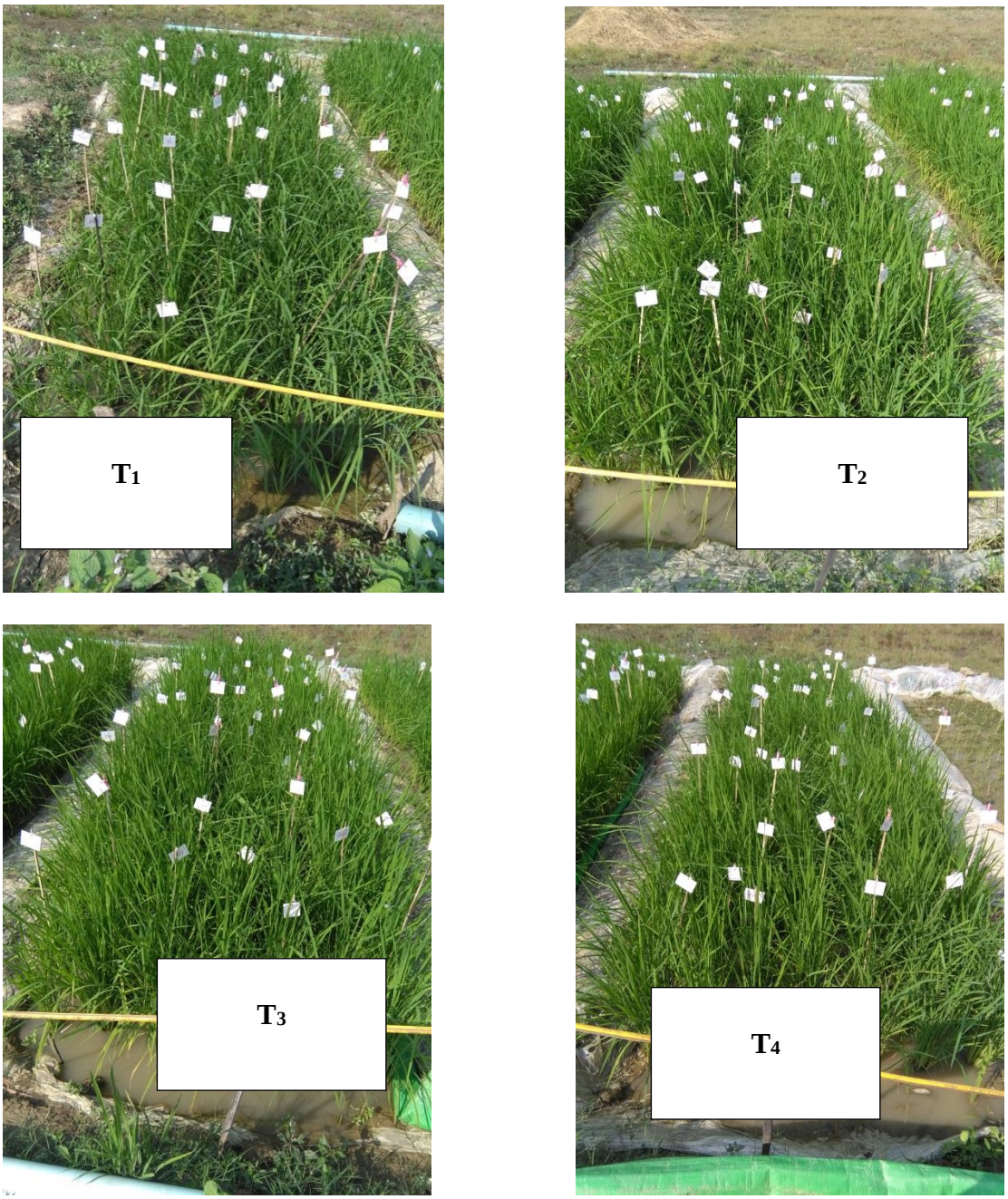

Figure 5. Vegetative growth of Paw-San cultivar

Discussions and Conclusions

The rice cultivation of this experiment according to the result data showed vegetative growth and plant height, number of tillers, leaf length, leaf width and number of leaves within all treatments showed no significant result each other. In this research maximum number of tillers resulted from inorganic fertilizer T_1 and also T_2 cow manure fertilizer gave the second highest tiller number. This result was in agreement with Mirza *et al* 2010)stated that number of tillers per hill in response to application of chemical fertilizer is probably due to enhanced availability of major nutrients.

Whether in the form of chemical fertilizer ,some of the nitrogen is converted to nitrate which is harmful to human health(Preap *et al*., 2002).The result of soil analysis data from four treatments the availability of major nutrients.(N 0.15:P 0.84:K 0.07) more than other treatments. But among the organic fertilizers cow manure T_2 gave the highest vegetative growth.

The vegetative growth from T_3 poultry manure grain weight per panicle, and filled grain per panicle was lower than cow manure fertilizer and inorganic fertilizer. This result was agreeded by Miller 1984,stated that the nutritional value of unprocessed poultry manure deteriorated rapidly, and also stated that deep containing 22% moisture, when stored in the open in air, rapidly lost its N due to high proteolytic activity. In this experiment the field preparation with poultry manure was one week before the cultivation period. Hence Mille states that immediate processing of poultry manure was suggested to prevent rapid decomposition. And then the nutritional value of NPK from prepared land with poultry manure was higher than cow manure and effective microorganism.

But the vegetative growth in all organic fertilizers was nearly similar and did not differ significantly each other. These results were supported by Castellanous and Pratt,1981,they stated that N in poultry litter is present in both organic and inorganic forms that are subject to volatilization, denitrification, immobilization, leaching, and plant uptake. Wolf *et al* 1988 found that 37% of the total N surface applied to poultry manure was volatilized in 11 days.

The recommended ratio of EM used fertilizer also has a minimal value of K^+ P and K_2O. The number of panicle per hill resulting from this fertilizer was the lowest. So the lowest yield and yield component was result from this organic fertilizer(EM).According to the results of this research organic rice cultivation should use cow manure fertilizer.

As a result of the soil test, NPK value was very low. So, it is essential to apply the optimum rate of organic fertilizer application for more efficient use of rice cultivation for better yield to obtain higher yield, cow manure fertilizer should be raised up to 5 tons per hectare for future cultivation.

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