**Original Research Article**

**EFFECT OF DIFFERENT LEVELS OF RECOMMENDED DOSE OF FERTILIZER AND CO-COMPOST ON YIELD AND ECONOMICS OF RICE VAR. ADT 43**

**ABSTRACT**

The experiment was conducted during*Kuruvai* season (June – September, 2023) at the Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalai Nagar – 608002, to evaluate the effect of different levels of RDF with and without co-compost application on the yield and economics of rice. The experiment was laid out in split plot design with three replications by graded levels of recommended dose of fertilizers viz 0, 75, 100 and 125% with and without co-compost of sugarcane trash and water hyacinth @ 1:0, 0:1, 1:2 and 2:1 ratio. The results of the experiment revealed that application of 100% recommended dose of fertilizer (M3) significantly registered higher yield attributes, yield and economic returns. The lower value was observed in unfertilized plot (M1). Among the different co-composts tested, application of co-compost of sugarcane trash : water hyacinth @ 1:1 ratio @ 6.25 t ha­-1 (S4) registered higher yield attributes, yield and economic returns, with the combination of 100% RDF and this co-compost (M3S4) recorded significantly superior yield advantages and economic rewards of rice.

**KEYWORDS:** co-compost, economics, RDF, Rice, sugarcane trash, water hyacinth, yield

**INTRODUCTION**

Nitrogen, phosphorus and potassium (NPK) are essential macronutrients crucial for the growth and development of rice crops. Since, rice is a principal source of food for more than half of the world population (Amudha *et al*., 2009). In 2030 A.D. the global demand for rice would increase by 70 percent, requiring production of 1020 million tonnes of unmilled rice against the present production of 600 million tonnes. It has been repeatedly emphasized that in order to meet the demand, the yield potential of irrigated rice has to be increased from the present yield potential of 4.32 t ha-1 to 8 t ha-1 (GFAR, 2009 and USDA, 2024) In rice, the role of NPK fertilizer is manifested in various ways, *viz*., increased in the number of spikelets, panicles and grains. Its deficiency will contribute to maturity delays and rice vulnerability to diseases increased (Fageria *et al*., 2003). Therefore, combining NPK in fertilizing rice will definitely produce a promising yield. The reduced productivity of rice is attributed to low soil fertility, which impacts overall crop yield. To address the issue of declining rice productivity, it is crucial to investigate the impact of co-compost application with RDF on soil health and crop yield. This research will examine how the use of co-compost influences soil nutrient levels and enhances rice productivity compared to conventional fertilization.

Composting is the best technique, which serves dual purpose of yielding good organic manure with higher nutritional quality for sustainable agriculture and simultaneously reducing weed menace (Geetha, 2009). *Eichhornia crassipes* is a noxious aquatic weed that pollutes aquatic ecosystem. Sustainable management through potential utilization of the most productive weed, water hyacinth is highly promising and found attractive. Decomposed water hyacinth compost enriches the nutrient status of the soil through increasing the microbial population in the soil, hereby improving in soil productivity (Thiruppathi *et al*., 2022). The major research concerns are practical misappropriation of disposal of sugar trash produced during harvest of crop and effects of climate. Thus, the alternative climatically crop trash that is to be recycled is composting (Mathews *et al*., 2016), as a climate green technology of organic fertilizer which is safe disposal (Nakhla *et al*., 2017). The slow rate of decomposition of sugarcane trash is necessary to develop suitable protocol for production of enriched and value added compost to successfully recycle the trash for improved soil health and sustained crop production.

Co-composting is the controlled aerobic degradation of organics, using more than one feedstock. Co-compost prepared from water hyacinth and co-substrates like poultry manure, rice straw, sawdust, and biochar accelerates the composting process and minimizes nutrient losses (Beesigamukama *et al*., 2018a). Utilization of water hyacinth and sugarcane trash by co- compost in an integrated manner not only improves the soil fertility but also thrives the way in refinement of water bodies, suppressing the weed menace and reducing the agricultural residue. Therefore there is an urgent and imperative need to adopt technologies for gainful utilization and safe management of aquatic weeds and agricultural waste along with chemical fertilizers.

Combining fertilizers with compost generally provides a more balanced and sustainable approach to nutrient management compared to using imbalanced or inadequate fertilizers alone to increase crop productivity (Islam and Biswas, 2023). Therefore, it is utmost importance to have combination of inorganic fertilizers and co-compost for sustaining rice productivity. In the present investigation, a comprehensive field investigation was made by imposing different levels of RDF and co-compost application practices to study the productivity, sustainability and economic advantage of rice.

**MATERIALS AND METHOD**

Field experiment was conducted at the Experimental Farm, Department of Agronomy, Annamalai University during the *Kuruvai* season (June – September, 2023). The Experimental Farm is geographically situated at 11024' N latitude, 79044' E longitude and at an altitude of +5.79 m above the mean sea level. The mean annual rainfall received at Annamalai Nagar was 1500 mm, distributed over 60 rainy days. Out of total rainfall, 1000 mm is received during North East monsoon, 400 mm is received during South West monsoon and 100 mm during hot weather period as summer showers. The amount of rainfall received during the cropping period was 387.6 mm in 21 rainy days. The soil of the experimental field was clay loam, with low in available N, medium in available P2O5 and high in available K2O.

The short duration rice variety, ADT 43 was used as test crop and transplanted with a spacing of 15 x 10 cm. The experiment was laid out in split plot design with three replications. The main treatment comprised of graded levels of recommended dose of fertilizer *viz*., M1 - 0% RDF, M2 - 75% RDF (90:30:30 kg N, P2O5 & K2O ha-1), M3 - 100% RDF (120:40:40 kg N, P2O5 & K2O ha-1) and M4­ - 125% RDF (150:50:50 kg N, P2O5 & K2O ha-1) and sub plot treatments treatment comprised of co-composts application such as S1 - control, S2 - sugarcane trash (100%) compost @ 6.25 t ha­-1, S3 - water hyacinth (100%) compost @ 6.25 t ha­-1, S4 - sugarcane trash : water hyacinth (1:1) co-compost @ 6.25 t ha­-1, S5 - sugarcane trash : water hyacinth (2:1) co-compost @ 6.25 t ha­-1 and S6 - sugarcane trash : water hyacinth (1:2) co-compost @ 6.25 t ha­-1). Required quantity of co-composts were prepared and incorporated in the soil as per treatment schedule two weeks before transplanting of rice. The data on number of productive tillers (m-2), effective tiller rate, number of total spikelets panicle-1, number of filled grains panicle-1, fertility percentage, test weight, grain yield, straw yield and economics were observed and the values of each treatment were tabulated. The statistical analysis of the growth characteristics of rice field data was done as per the methodology given by Gomez and Gomez (2010). The critical differences were worked out at 5% probability level by using AGRES Statistical Software Version 3.01(AGRES, 1994), wherever the results were significant.

**RESULT AND DISCUSSION**

**YIELD PARAMETERS**

The data recorded on the number of productive tillers, effective tiller rate, number of total spikelets panicle-1, number of filled grains panicle-1, fertility percentage and test weight of rice at harvest stage are furnished in Table 1. A significant difference in number of productive tillers m-2, effective tiller rate, number of total spikelets panicle-1, number of filled grains panicle-1 and fertility percentage were recorded at harvesting stage as a result of co-compost and different levels of RDF application. However, the test weight of rice was not significantly affected by application of recommended dose of fertilizers and co-compost both in individual as well as in combinations. Among the different levels of recommended dose of fertilizer, the maximum productive tiller number of 337 m-2, effective tiller rate of 84.23 per cent, total spikelets number of 138.39 panicle-1, filled grain number of 116.39 panicle-1 and fertility percentage of 84.01 at harvest stage were registered with the application of 100 % recommended dosage of fertilizer (M3). This was followed by application of 125 % recommended dosage of fertilizer (M4). This might be due to recommended dose of fertilizer level (100% RDF) was found to enhance the process of tissue differentiation, *i.e.* from somatic to reproductive phase leading thereby to increased yield attributes and grain setting as reported by Srivastava *et al*. (2014). The least number of productive tillers (209 m-2), effective tiller rate (78.56 %), total spikelets number (114.49 panicle-1), number of filled grains (89.49 panicle-1) and fertility percentage (78.11) at harvest stage were recorded in 0% recommended dose of fertilizer application (M1).

Among the different composts tested, application of co-compost made from sugarcane trash : water hyacinth @ 1:1 ratio @ 6.25 t ha­-1 (S4) registered significantly higher productive tiller number of 307 m-2, effective tiller rate of 83.04 per cent, total spikelets number of 133.93 panicle-1, number of filled grains of 111.70 panicle-1 and fertility percentage of 83.20 at harvest stage. The higher number of panicles per hill might be due to the greater availability of macro as well as micro plant nutrients with the addition of organic matter into soil (Sivaoshi *et al*., 2011). The least number of productive tillers 226 m-2, effective tiller rate of 78.71 per cent, total spikelets number of 118.10 panicle-1, number of filled grains of 92.73 panicle-1 and fertility percentage of 78.36 at harvest stage were recorded with no composts applied plot (S1).

Interaction between different levels of RDF and co-compost application, application of 100 % recommended dosage of fertilizer and co-compost of sugarcane trash : water hyacinth @ 1:1 ratio @ 6.25 t ha­-1 (M3S4) registered the maximum productive tiller number of 381 m-2, effective tiller rate of 85.62 per cent, total spikelets number of 148 panicle-1, number of filled grains of 127 panicle-1 and fertility percentage of 85.81 at harvest stage. This might be due to combined application of organic and inorganic fertilizer to increase grain yield components since enhanced nutrient availability which improved nitrogen and other macro and micro elements absorption which attributed to higher N mineralization as a result of high cation exchange capacity, slow and gradual release of N could make the soil more productive over a longer period which had the positive effect in better physiological and metabolic functions inside the plant body and laid down the foundation for synthesis of more chlorophyll and sustained the leaf nutrients adequately throughout the cropping period (Gupta *et al*., 2016 and Siddaram *et al*., 2011).The least number of productive tillers 177 m-2, effective tiller rate of 74.68 per cent, total spikelets number of 109.59 panicle-1, number of filled grains of 78.77 panicle-1 and fertility percentage of 71.88 at harvest stage were registered with absolute control (M1S1).

**GRAIN AND STRAW YIELD**

The observed on the grain and straw yield of rice at harvest stage are presented in Table1. Application of graded levels of RDF and co-compost had a significant effect on thegrain and straw yield.

Among the different levels of recommended dose of fertilizers, application of 100 % recommended dose of fertilizer (M3) recorded higher grain and straw yield of 5522 and 7758 kg ha-1, respectively. This was followed by application of 125 % recommended dose of fertilizer (M4). This might be due to application of recommended dose of fertilizer might have resulted in optimum levels of nutrients for crop uptake and translocation to sink thereby expressing superior crop growth and development which positively reflected in significantly superior expression of the various yield attributes and yield of rice reported by Venkateshprasath *et al*. (2017), Rashid (2018), Rafi *et al*. (2024) and Diwedi *et al*. (2024). The lower grain and straw yield of 2433 and 4667 kg ha-1, respectivelyware recorded with the application 0% recommended dose of fertilizer (M1).

Regarding the different composts application, application of co-compost
prepared with sugarcane trash : water hyacinth @ 1:1 ratio @ 6.25 t ha­-1 (S4) significantly registered a higher grain and straw yield of 4831 and 5374 kg ha-1, respectively. This was followed by application of water hyacinth (100%) compost @ 6.25 t ha-1 (S3). This might be due to the enhanced nutrient availability supports more efficient harvesting of light and its conversion into chemical energy through photo assimilation, which ultimately improves yield attributes and increases grain yield and straw yield reported by Saravanane *et al*. (2012) and Mogle *et al*. (2013). The lower grain and straw yield of 2928 and 5374 kg ha-1, respectively was registered with no composts applied plot (S1).

Interaction between different levels of RDF and co-compost application, significantly higher grain and straw yield of 6486 and 8623 kg ha-1, respectivelywere registered with the application of 100 % RDF along with co-compost (sugarcane trash : water hyacinth @ 1:1 ratio) @ 6.25 t ha­-1 (M3S4). This was followed by application of 100 % RDF along with water hyacinth (100%) compost @ 6.25 t ha­-1 (M3S3). This might be due to better utilization of applied nutrients through the activities of soil micro-organisms which involved in nutrient transformation and fixation and also the transport of nutrients from organic sources influences the nutrient availability to the rice crop was earlier reported by Lukman *et al*. (2016) and Paramasivan *et al*. (2016). The lower grain and straw yield 1810 and 4327 kg ha-1, respectively was noticed under with absolute control (M1S1).

**ECONOMICS**

The computed data on total cost of cultivation (₹ ha-1), gross return (₹ ha-1)**,** net return (₹ ha-1) and benefit cost ratio of rice are given in Table 2. The total cost of cultivation varied between Rs. 53,842 to Rs. 62,359.

Regarding the graded levels of RDF application, higher gross return of Rs. 1,33,121 ha-1, net return of Rs. 72,465 ha-1 and benefit cost ratio of 2.18 were resulted by the application of 100% recommended dose of fertilizer (M3). This might be due to enhanced nutrient availability in balanced manner by application of adequate amount of NPK through co-compost with 100% RDF resulting in improvement of yield attributing characters and yield as reported by Banerjee and Pal (2014). The least economics values were recorded in the unfertilized plot (M1).

Among the different composts applied, application of co-compost prepared from sugarcane trash: water hyacinth @ 1:1 ratio @ 6.25 t ha­-1 (S4) recorded higher gross return of Rs. 1,17,109 ha-1, net return of Rs. 56,594 ha-1 and benefit cost ratio of 1.91. Co-compost contain high amount of nutritive value resulting in higher grain yield, which directly reflected on higher gross return, net return and benefit cost ratio (Beesigamukama *et al*., 2018b). The least economics values were noticed with no compost applied plot (S1).

With respect to interaction effect, the maximum gross return of Rs. 1,55,627 ha-1, net return of Rs. 93,409 ha-1 and benefit cost ratio of 2.50 was noticed under application of 100 % RDF along with co-compost of sugarcane trash : water hyacinth @ 1:1 ratio @ 6.25 t ha­-1 (M3S4). This was followed by application of 100 % RDF along with water hyacinth 100% compost @ 6.25 t ha­-1 (M3S3). The minimum gross return of Rs. 46,311 ha-1, net return of Rs. 282 ha-1 and benefit- cost ratio of 1.01 was noticed with the absolute control (M1S1). The results are in line with those of Naveen Kumar *et al*. (2019), Suseendran *et al*. (2020) and Palkar *et al*. (2024).

**Table 1. Effect of graded levels of RDF and co-compost application on the yield parameters of rice at harvest stage**

|  |  |  |
| --- | --- | --- |
|  | **Yield Attributes** | **Yield** |
| **Treatments** | **Number of productive tillers** **(m-2)** | **Effective tiller rate** | **Number of total spikelets panicle-1** | **Number of filled grains panicle-1** | **Fertility percentage (%)** | **Test weight (g)** | **Grain yield** **(kg ha-1)** | **Straw yield****(kg ha-1)** |
| **Level of RDF** |
| **M1** | 209 | 78.56 | 114.49 | 89.49 | 78.11 | 15.52 | 2433 | 4667 |
| **M2** | 269 | 81.43 | 130.02 | 107.61 | 82.72 | 15.92 | 4117 | 6557 |
| **M3** | 337 | 84.23 | 138.39 | 116.39 | 84.01 | 16.01 | 5522 | 7758 |
| **M4** | 307 | 83.05 | 134.64 | 112.36 | 83.41 | 16.03 | 4921 | 7331 |
| **S.Ed** | **2.64** | **0.05** | **0.61** | **0.79** | **0.08** | **0.11** | **46.73** | **62.02** |
| **CD (p=0.05)** | **6.47** | **0.12** | **1.49** | **1.94** | **0.20** | **NS** | **114.34** | **151.77** |
| **Co-Compost Application** |
| **S1** | 226 | 78.71 | 118.1 | 92.73 | 78.36 | 15.87 | 2928 | 5374 |
| **S2** | 284 | 82.13 | 130.67 | 108.07 | 82.59 | 15.86 | 4378 | 6665 |
| **S3** | 293 | 82.55 | 132 | 109.65 | 82.9 | 15.84 | 4519 | 6794 |
| **S4** | 307 | 83.04 | 133.93 | 111.7 | 83.2 | 15.87 | 4831 | 7214 |
| **S5** | 285 | 82.18 | 130.76 | 108.26 | 82.66 | 15.89 | 4405 | 6699 |
| **S6** | 287 | 82.28 | 130.84 | 108.37 | 82.69 | 15.88 | 4428 | 6724 |
| **S.Ed** | **3.96** | **0.07** | **0.91** | **1.19** | **0.12** | **0.17** | **70.09** | **93.03** |
| **CD (p=0.05)** | **8.01** | **0.15** | **1.85** | **2.41** | **0.24** | **NS** | **141.66** | **188.02** |
| **Interaction Effects** |
| **M1S1** | 177 | 74.68 | 109.59 | 78.77 | 71.88 | 16.09 | 1810 | 4327 |
| **M1S2** | 212 | 79.1 | 115.38 | 91.47 | 79.28 | 15.39 | 2482 | 4619 |
| **M1S3** | 217 | 79.49 | 115.53 | 91.72 | 79.39 | 15.37 | 2540 | 4697 |
| **M1S4** | 218 | 79.56 | 115.58 | 91.81 | 79.43 | 15.46 | 2730 | 5013 |
| **M1S5** | 213 | 79.18 | 115.41 | 91.57 | 79.34 | 15.41 | 2511 | 4671 |
| **M1S6** | 215 | 79.34 | 115.45 | 91.62 | 79.36 | 15.39 | 2522 | 4678 |
| **M2S1** | 241 | 78.44 | 120.78 | 96.31 | 79.74 | 15.42 | 3120 | 5434 |
| **M2S2** | 269 | 81.76 | 131.26 | 109.18 | 83.18 | 16.02 | 4204 | 6625 |
| **M2S3** | 273 | 81.98 | 131.87 | 109.92 | 83.35 | 16.09 | 4285 | 6726 |
| **M2S4** | 291 | 82.67 | 132.96 | 111.02 | 83.5 | 15.88 | 4575 | 7166 |
| **M2S5** | 270 | 81.82 | 131.56 | 109.52 | 83.25 | 16.08 | 4240 | 6670 |
| **M2S6** | 272 | 81.93 | 131.69 | 109.73 | 83.32 | 16.05 | 4277 | 6719 |
| **M3S1** | 245 | 81.06 | 121.06 | 97.96 | 80.92 | 15.87 | 3400 | 5878 |
| **M3S2** | 341 | 84.41 | 139.19 | 117.02 | 84.07 | 16.05 | 5702 | 7925 |
| **M3S3** | 366 | 85.31 | 143.6 | 122 | 84.96 | 15.97 | 6076 | 8214 |
| **M3S4** | 381 | 85.62 | 148 | 127 | 85.81 | 16.12 | 6486 | 8623 |
| **M3S5** | 342 | 84.44 | 139.21 | 117.15 | 84.15 | 16.04 | 5722 | 7944 |
| **M3S6** | 344 | 84.52 | 139.25 | 117.2 | 84.17 | 15.99 | 5746 | 7963 |
| **M4S1** | 242 | 80.67 | 120.98 | 97.87 | 80.9 | 16.1 | 3380 | 5857 |
| **M4S2** | 313 | 83.24 | 136.84 | 114.62 | 83.84 | 15.98 | 5125 | 7491 |
| **M4S3** | 317 | 83.42 | 137 | 114.96 | 83.91 | 15.94 | 5176 | 7539 |
| **M4S4** | 339 | 84.33 | 139.16 | 116.96 | 84.05 | 16.02 | 5534 | 8054 |
| **M4S5** | 314 | 83.29 | 136.86 | 114.81 | 83.89 | 16.04 | 5146 | 7511 |
| **M4S6** | 315 | 83.33 | 136.98 | 114.92 | 83.9 | 16.09 | 5167 | 7536 |
| **M at S** |
| **S.Ed** | **7.70** | **0.14** | **1.78** | **2.32** | **0.23** | **0.33** | **136.23** | **180.82** |
| **CD (p=0.05)** | **15.96** | **0.29** | **3.68** | **4.80** | **0.49** | **NS** | **282.17** | **374.52** |
| **S at M** |
| **S.Ed** | **7.93** | **0.14** | **1.83** | **2.38** | **0.24** | **0.34** | **140.18** | **186.06** |
| **CD (p=0.05)** | **16.02** | **0.29** | **3.70** | **4.82** | **0.49** | **NS** | **283.32** | **376.05** |

**Table 2. Effect of graded levels of RDF and co-compost application on the economics of rice cultivation**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatments** | **Total cost of cultivation (₹ ha-1)** | **Gross return****(₹ ha-1)** | **Net return****(₹ ha-1)** | **Return rupees-1****invested** |
| **M1S1** | 46029 | 46311 | 282 | 1.01 |
| **M1S2** | 58529 | 61532 | 3003 | 1.05 |
| **M1S3** | 52279 | 62925 | 10646 | 1.20 |
| **M1S4** | 55404 | 67580 | 12176 | 1.22 |
| **M1S5** | 56446 | 62248 | 5803 | 1.10 |
| **M1S6** | 54362 | 62501 | 8139 | 1.15 |
| **M2S1** | 51140 | 76792 | 25652 | 1.50 |
| **M2S2** | 63640 | 102426 | 38786 | 1.61 |
| **M2S3** | 57390 | 104359 | 46970 | 1.82 |
| **M2S4** | 60515 | 111398 | 50884 | 1.84 |
| **M2S5** | 61556 | 103285 | 41728 | 1.68 |
| **M2S6** | 59473 | 104173 | 44700 | 1.75 |
| **M3S1** | 52843 | 83617 | 30774 | 1.58 |
| **M3S2** | 65343 | 137331 | 71988 | 2.10 |
| **M3S3** | 59093 | 145993 | 86900 | 2.47 |
| **M3S4** | 62218 | 155627 | 93409 | 2.50 |
| **M3S5** | 63260 | 137800 | 74540 | 2.18 |
| **M3S6** | 61176 | 138357 | 77180 | 2.26 |
| **M4S1** | 54547 | 83145 | 28598 | 1.52 |
| **M4S2** | 67047 | 123987 | 56940 | 1.85 |
| **M4S3** | 60797 | 125180 | 64383 | 2.06 |
| **M4S4** | 63922 | 133829 | 69908 | 2.09 |
| **M4S5** | 64963 | 124478 | 59515 | 1.92 |
| **M4S6** | 62880 | 124978 | 62098 | 1.99 |

**CONCLUSION**

From the present investigation it can be concluded that application of 100 % RDF along with co-compost of sugarcane trash : water hyacinth @ 1:1 ratio @ 6.25 t ha­-1 (M3S4) was found to be effective method for maximizing yield parameters, yield and economic returns to the rice farmer during *Kuruvai* season. This practice aligns with future trends towards regenerative agriculture, which focuses on restoring and maintaining soil health to improve the yield characters.

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