Biological Forum – An International Journal **13(4): 971-974(2021)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Effect of Drip Irrigation and Fertigation Levels on Growth and Yield of Aerobic Rice

Mude Ashok Naik[1]*, K. Vaiyapuri[2], N. Thavaprakaash[3], K. Nagarajan[4] and N. Chandra Sekaran[5]

[1]Ph.D. Scholar, Department of Agronomy,
Tamil Nadu Agricultural University, Coimbatore, (Tamil Nadu), India.
[2]Professor, Department of Agronomy,
Tamil Nadu Agricultural University, Coimbatore, (Tamil Nadu), India.
[3]Associate Professor, Department of Agronomy,
Tamil Nadu Agricultural University, Coimbatore, (Tamil Nadu), India.
[4]Professor & Head, Department of Soil and Water Conservation Engineering,
Tamil Nadu Agricultural University, Coimbatore, (Tamil Nadu), India.
[5]Professor, Department of Soil science & Agricultural Chemistry,
Tamil Nadu Agricultural University, Coimbatore, (Tamil Nadu), India.

(Corresponding author: Mude Ashok Naik)*
(Received 24 September 2021, Accepted 19 November, 2021)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: A field study was conducted at Tamil Nadu Agricultural University, Coimbatore during *rabi* season of 2019-20 to study about the growth and yield of aerobic rice under different drip fertigation and irrigation levels. Thirteen treatments consists of 75 % and 100 % pan evaporation (two irrigation levels) and 75%, 100% and 125% RDF (three fertigation levels), combination with fermented fish waste (FFW) and fermented egg product (FEP), surface irrigation treatment as a check were arranged in randomized block design and replicated thrice. The result showed that significantly higher plant growth, yield attributes and yield during *rabi* season 2019 – 20 were observed in drip fertigation at 125 % RDF, 100 % PE with FFW (3 times) than all other treatments. Which was closely related with drip fertigation at 125 % RDF, 100 % PE with FEP (3 times). The lower growth and yield were noticed in drip fertigation at 75 % RDF, 75 % PE with FEP (3 times). This study concluded that drip fertigation at 125 % RDF, 100 % PE with FFW (3 times) suitable for getting higher growth and yield in aerobic rice.

Keywords: Aerobic rice, Drip fertigation, Fermented fish waste, Fermented egg product, Growth and Yield.

INTRODUCTION

Rice is the most predominant staple food, consumed by more than a half of the world's population. In Asia, rice security is closely related with food security as 90% of rice is consumed in this region. In India the rice is being cultivated in 43.6 M ha with the production of 118.8 m.t and the average productivity is 2.72 t ha^{-1}. In Tamil Nadu rice is cultivated in an area of 1.90 M ha, production of 7.17 m t and the average productivity of 3.76 t ha^{-1} (India stat, 2019-20). One hectare of rice field irrigated by flooding method consumes more than 20,000 m^3 of irrigation water and thereby evapotranspiration consumes 6000 to 8000 m^3 (Kruzhilin *et al.,* 2017). Conventional method of irrigation, which not only consumes huge water, but also causes severe water and nutrient losses under anaerobic condition (Naik *et al*., 2015). Aerobic rice is a production system in which aerobic rice varieties are grown in well drained, unsaturated and unpuddled soils. Drip fertigation is promising technologies have been proved to increase water and nutrient use efficiency of aerobic rice. The current study was planned to evaluate the effect of drip fertigation levels on growth parameters and yield of aerobic rice.

MATERIALS AND METHODS

A field investigation was done during *rabi* season of 2019-20 at Wetland farms, Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore. The farm is situated at 11°N latitude and 77°E longitude, at an altitude of 426.7 metres above mean sea level (MSL), in Tamil Nadu's western agro-climatic zone. Soil of the experimental field is *Typic Haplustalf* and belongs to the Noyyal series. The soil is clay loam in texture with the pH and EC of 8.1 and 0.41 dS m^{-1}, respectively. Organic carbon content of the soil was 0.70 %. Soil was low in available nitrogen (213.0 kg ha^{-1}), medium in available phosphorous (15.0 kg ha^{-1}) and available potassium (608.0 kg ha^{-1}).

During the aerobic rice grown season, the amount of rainfall received during the aerobic rice grown period was 461.5 mm. The rainfall was received in 28 rainy days. The mean maximum and minimum temperatures were 29.84°C and 21.87°C, respectively. The mean relative humidity in the morning and the afternoon was

86.26 per cent and 58.70 per cent, respectively. The mean sunshine hours (5.81) and solar radiation (319.05 Cal. cm^{-2} min^{-1}).

The experiment comprised of thirteen treatments *i.e* T_1: Drip fertigation at 75% RDF, 75% PE with FFW (3 times), T_2: DF @ 75% RDF, 75% PE with FEP (3 times), T_3: DF @ 100% RDF, 75% PE with FFW (3 times), T_4: DF @ 100% RDF, 75% PE with FEP (3 times), T_5: DF @ 125% RDF, 75% PE with FFW (3 times), T_6: DF @ 125% RDF, 75% PE with FEP (3 times), T_7: DF @ 75% RDF, 100% PE with FFW (3 times), T_8: DF @ 75% RDF, 100% PE with FEP (3 times), T_9: DF @ 100% RDF, 100% PE with FFW (3 times), T_{10}: DF @ 100% RDF, 100% PE with FEP (3 times), T_{11}: DF @ 125% RDF, 100% PE with FFW (3 times), T_{12}: DF @ 125% RDF, 100% PE with FEP (3 times), T_{13}: Surface irrigation with 100% RDF were evaluated in randomized block design (RBD), which were replicated thrice. Surface irrigation was scheduled based on IW/CPE ratio of 1.2 with manual method of fertilizer application. Recommended dose of fertilizer (RDF) *viz.,* 150: 50: 50 kg NPK ha^{-1} was adopted. Raised beds were formed with raised bed former the top bed width is 0.9 m and furrows with width of 0.3 m. Aerobic rice variety Anna (R) 4 taken as test variety with spacing of 20 cm × 10 cm. One lateral were laid out on the middle of the raised bed. Spacing between emitter to emitter on a laterals is 0.4 m with a discharge rate of 4 lph at 1 kg cm^{-2}. At the correct time plant protection and weed management practices were carried out.

Fermented fish waste was prepared from fish waste obtained from local fish market. Equal amount of fish waste and jaggery were taken (1 kg of each fish waste and jaggery). The fish waste was taken an air tight plastic container and jaggery was added. The materials were mixed well and stored in a cool dry place. It was kept away from direct sun light. After 30 days, the liquid portion was filtered and used for drip fertigation.

Fermented egg product was prepared by 45 numbers of ripened lemon was squeezed and the juice was taken in a plastic container. Then 15 numbers of eggs kept inside the lemon juice till the eggs were soaked completely and kept for 10 days. After 10 days, eggs were smashed well and for each egg 25 g of jaggery was added and kept for 10 days. The content was filtered after 10 days and the liquid portion was collected and stored in separate container for drip fertigation.

Biometric observations like plant height, number of tillers, dry matter production, productive tillers, number of filled grains, number of chaffy grains, fertility percentage, grain yield and straw yield observations were recorded as per standard methodology given below.

The plant height was measured from the base of the plant to the tip of the panicle. In each plot, five tagged plants were selected and measured by using a scale and expressed in centimetres (cm). Dry matter production was calculated by five plants randomly selected in each plot after drying in hot air oven at 70°C for 24 hours till constant weights were obtained. Mean values were converted into kg ha^{-1}. The total number of tillers in each hill of five tagged plants were counted and mean values is converted into tillers m^{-2}. Fertility percentage is the total number of grains and number of filled grains in a panicle were counted separately in panicles from five tagged hills of each plot and the mean value were recorded as total number of grains $panicle^{-1}$ and number of filled grains $panicle^{-1}$, respectively. The fertility percentage was calculated by the following formula.

$$\text{Fertility percentage} = \frac{\text{No. of filled grains panicle}^{-1}}{\text{Total no. of grains panicle}^{-1}} \times 100$$

The grains from each treatment net plot collected, weighed and expressed in kg ha^{-1}. The paddy straw from each treatment net plot was sun dried, weighed and expressed in kg ha^{-1}.

To evaluate the influence of drip irrigation and fertigation levels on physiological parameters and yield of aerobic rice, the data were statistically analysed. The critical difference at 5% level of significance was calculated to find out the significance of different treatments over each other (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Growth parameters: The results showed (Table 1) that significantly higher plant height, dry matter production and number of tillers were recorded with drip fertigation at 125% RDF, 100% PE with FFW (3 times). This was found to be on par with drip fertigation at 125% RDF, 100% PE with FEP (3 times) and drip fertigation at 100% RDF, 100% PE with FFW (3 times). The lower plant height, dry matter production and number of tillers were recorded with drip fertigation at 75% RDF, 75% PE with FEP (3 times). In general the growth of the plant is based on the availability of moisture and nutrients. The higher plant growth might be due to the fact that availability of moisture is continuous at the root zone and uptake of nutrients by the plant increased resulted in higher cell elongation and division. The experimental results fall in line with the findings of Pushpa *et al.,* (2007), Govindan and Grace (2012), Karthika and Ramanathan (2019). The higher dry matter production may be due to production of higher number of tillers and leaves because of higher uptake of moisture and nutrients due to maintenance of adequate soil moisture and nutrients due to frequent application of irrigation and use of water soluble fertilizers. Similar results were validated by Vijaykumar *et al.,* (2009); Rekha *et al.,* (2015); Ramadass and Ramanatan (2017).

Yield attributes: Higher productive $tillers^{-2}$ (Table 1), Total number of grains $panicle^{-1}$, number of filled grains $panicle^{-1}$ and fertility percentage recorded (Table 2) with drip fertigation at 125% RDF, 100% PE with FFW (3 times). This might be due to continuous supply of moisture and nutrients had helped healthy growth of plant and better accumulation of dry matter and subsequent better grain filling. The lowest fertility percentage observed with drip fertigation at 75% RDF, 75% PE with FEP (3 times).

Table 1: Influence of drip fertigation levels on growth parameters and productive tillers of aerobic rice.

Treatments	Plant height (cm)	DMP (kg ha^{-1})	No. of tillers m^{-2}	No. of Productive tillers m^{-2}
T_1 : DF @ 75% RDF, 75% PE with FFW (3 times)	72.4	7311	319	271
T_2 : DF @ 75% RDF, 75% PE with FEP (3 times)	68.4	7147	314	267
T_3 : DF @ 100% RDF, 75% PE with FFW (3 times)	76.0	7937	346	289
T_4: DF @ 100% RDF, 75% PE with FEP (3 times)	76.2	7891	342	291
T_5 : DF @ 125% RDF, 75% PE with FFW (3 times)	80.9	8694	404	340
T_6 : DF @ 125% RDF, 75% PE with FEP (3 times)	78.5	8314	396	336
T_7 : DF @ 75% RDF, 100% PE with FFW (3 times)	76.2	8130	383	345
T_8 : DF @ 75% RDF, 100% PE with FEP (3 times)	75.9	7946	370	329
T_9 : DF @ 100% RDF, 100% PE with FFW (3 times)	86.5	9984	414	368
T_{10} : DF @ 100% RDF, 100% PE with FEP (3 times)	85.2	9635	409	361
T_{11} :DF @ 125% RDF, 100% PE with FFW (3 times)	93.3	10648	458	412
T_{12} : DF @ 125% RDF, 100% PE with FEP (3 times)	90.5	10223	425	385
T_{13} : Surface irrigation with 100% RDF	74.6	8910	368	313
SEd	3.4	343	21	18
CD (5 %)	7.1	709	44	38

This may be due to lower soil moisture levels at root zone depth leads to inhibition of translocation of assimilates to the grains due to less uptake of nutrients. Similar nature of results too accounted by Dada *et al.,* (2020); Kombali *et al*., (2017). Higher grain yield and straw yield was recorded (Table 3) with drip fertigation at 125% RDF, 100% PE with FFW (3 times), which was on par with DF @ 125% RDF, 100% PE with FEP (3 times). The lower grain yield and straw yield was observed with drip fertigation at 75% RDF, 75% PE with FEP (3 times). Higher grain and straw yield might be due to production of higher number of productive tillers, total number of filled grains per panicle and test weight.

Table 2: Influence of drip fertigation levels on fertility percentage of aerobic rice.

Treatments	Total number of grains panicle^{-1}	Filled grains panicle^{-1}	Unfilled grains panicle^{-1}	Fertility percentage
T_1 : DF @ 75% RDF, 75% PE with FFW (3 times)	82.3	58.3	24.0	70.9
T_2 : DF @ 75% RDF, 75% PE with FEP (3 times)	63.5	42.5	20.9	66.9
T_3 : DF @ 100% RDF, 75% PE with FFW (3 times)	97.2	70.1	27.1	72.1
T_4 : DF @ 100% RDF, 75% PE with FEP (3 times)	89.6	63.1	26.5	70.4
T_5 : DF @ 125% RDF, 75% PE with FFW (3 times)	101.9	75.6	26.4	74.1
T_6 : DF @ 125% RDF, 75% PE with FEP (3 times)	91.1	75.4	15.6	82.8
T_7 : DF @ 75% RDF, 100% PE with FFW (3 times)	92.2	73.4	18.8	79.6
T_8 : DF @ 75% RDF, 100% PE with FEP (3 times)	91.3	72.6	18.6	79.6
T_9 : DF @ 100% RDF, 100% PE with FFW (3 times)	96.0	79.7	16.3	83.0
T_{10} : DF @ 100% RDF, 100% PE with FEP (3 times)	99.9	77.4	22.5	77.4
T_{11} : DF @ 125% RDF, 100% PE with FFW (3 times)	102.7	87.6	15.2	85.2
T_{12} : DF @ 125% RDF, 100% PE with FEP (3 times)	102.2	86.6	15.6	84.7
T_{13} : Surface irrigation with 100% RDF	83.9	59.8	24.2	71.2
SEd	3.1	1.1	3.1	
CD (5%)	6.5	2.3	6.5	

Table 3: Influence of drip fertigation levels on grain yield, straw yield, biological yield and harvest index of aerobic rice.

Treatments	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Biological Yield (kg ha^{-1})	HI
T_1 : DF @ 75% RDF, 75% PE with FFW (3 times)	2783	3831	6614	0.42
T_2 : DF @ 75% RDF, 75% PE with FEP (3 times)	2647	3675	6321	0.42
T_3 : DF @ 100% RDF, 75% PE with FFW (3 times)	3101	4262	7362	0.42
T_4 : DF @ 100% RDF, 75% PE with FEP (3 times)	3098	4125	7224	0.43
T_5 : DF @ 125% RDF, 75% PE with FFW (3 times)	3534	4779	8313	0.43
T_6 : DF @ 125% RDF, 75% PE with FEP (3 times)	3458	4659	8117	0.43
T_7 : DF @ 75% RDF, 100% PE with FFW (3 times)	3205	4455	7659	0.42
T_8 : DF @ 75% RDF, 100% PE with FEP (3 times)	3281	4351	7632	0.43
T_9 : DF @ 100% RDF, 100% PE with FFW (3 times)	4053	5514	9567	0.42
T_{10} : DF @ 100% RDF, 100% PE with FEP (3 times)	3851	5469	9319	0.41
T_{11} : DF @ 125% RDF, 100% PE with FFW (3 times)	4504	6067	10571	0.43
T_{12} : DF @ 125% RDF, 100% PE with FEP (3 times)	4383	5763	10146	0.43
T_{13} : Surface irrigation with 100% RDF	3371	4436	7807	0.43
SEd	186	246	319	0.01
CD (5%)	385	509	659	NS

This might be due to continuous availability of moisture and nutrients throughout the crop growing period. These results are in confirmation with the results of Anusha *et al.*, (2015); Ramadass and Ramanatan (2017); Karthika and Ramanathan (2019); Patnaik, 2020. There is no significant difference in harvest index among the treatments.

CONCLUSION

Based on the field experiment findings we can concluded that drip fertigation at 125% RDF, 100% PE with FFW (3 times) ideal for getting higher growth parameters, fertility percentage, grain yield and straw yield in aerobic rice during *rabi* season.

FUTURE SCOPE

The results of the study revealed that the addition of fermented fish waste and fermented egg product may be considered as a novel liquid bio fertilizer as it promotes growth and yield of aerobic rice and also reduces the environmental pollution by recycling of fish waste.

Acknowledgement. The first author thankful to Ministry of Tribal Affairs, Government of India for providing fellowship to undertake the studies and Tamil Nadu Agriculture University, Coimbatore for providing farm and laboratory facilities to conduct present research trials.
Conflict of Interest. None.

REFERENCES

Anusha, S., Nagaraju, B. S., Sheshadri, T., Channabasavegowda, R., Shankar, A., & Mallikarjuna, G. (2015). Influence of Fertigation Intervals and Fertilizer Combinations on Growth and Yield of Direct Seeded Drip Irrigated Aerobic Rice. *IJSN*, *9*(1&2): 299-303.

Dada, O. A., Okpe, J. A., & Togun, A. O. (2020). Water stress at anthesis and storage temperature affected growth and germinability of rice (*Oryza* spp.). *Journal of Stress Physiology & Biochemistry*, *16*(1).

Gomez, K. A., & Gomez, A. A. (1984). *Statistical procedures for agricultural research*. John Wiley & Sons.

Govindan, R., & Grace, T. M. (2012). Influence of drip fertigation on growth and yield of rice varieties (*Oryza sativa* L.). *Madras Agricultural Journal*, *99*(4/6): 244-247.

Indiastat. 2019-20.http://*www.indiastat.com*.elibrarytnau.remotexs.

Karthika, N., & Ramanathan, S. P. (2019). Effect of drip fertigation on growth, physiological parameters and grain yield of rice grown in Cauvery new delta zone of Tamil Nadu. *International Journal of Chemical Studies*, *7*(3): 2758-2761.

Kombali, G., Nagaraju, T., Sheshadri, M. N., Thimmegowda, & Mallikarjuna, G.B. (2017). Effect of water soluble fertilizers on growth and yield of drip irrigated aerobic rice. *International Journal of Agriculture Science*, *9*(15): 4101-4103.

Kruzhilin, I. P., Ganiev, M. A., Melikhov, V. V., Rodin, K. A., Dubenok, N. N., Ovchinnikov, A. S., & Abdou, N. M. (2017). Mode of rice drip irrigation. *ARPN Journal of Engineering and Applied Sciences*, *12*(24): 7118-7123.

Naik, K. P., Krishnamurthy, N., & Ramachandra, C. (2015). Effect of nutrient sources on grain yield, methane emission and water productivity of rice (Oryza sativa) under different methods of cultivation. *Indian Journal of Agronomy*, *60*(2): 249-254.

Patnaik, G. P. (2020). Effect of moisture stress at critical stages on productivity of transplanted rice (*Oryza sativa* L.). M.Sc. (Agri.) Thesis, Tamil Nadu Agricultural University. Coimbatore.

Pushpa, K., Devakumar, N., Murthy, R. K., Nagaraju, & Krishnamurthy. (2007). Yield and yield attributes of rice genotypes as influenced by methods of irrigation and nitrogen sources. *Environment and Ecology*, *25*(4): 774- 777.

Ramadass, S. & Ramanathan, S. P. (2017). Influence of Drip Fertigation Levels on Physiological Parameters of Aerobic Rice in Western Zone of Tamil Nadu, India. *International Journal of Current Microbiology and Applied Science*, *6*(4): 2609-2613.

Rekha, B., Jayadeva, H. M., Kombali, G., Nagaraju, G. B., Mallikarjuna, A., & Geethakumari (2015). Growth and yield of aerobic rice grown under drip fertigation. *The ecoscan*, *9*(1-2): 435-437.

Vijaykumar, P. (2009). Optimization of water and nutrient requirement for yield maximization in hybrid rice under drip fertigation system. M.Sc. (Agri.) Thesis, Tamil Nadu Agricultural University, Coimbatore.

How to cite this article: Naik, M. A.; Vaiyapuri, K.; Thavaprakaash, N.; Nagarajan, K. and Sekaran, N. C. (2021). Effect of Drip Irrigation and Fertigation Levels on Growth and Yield of Aerobic Rice. *Biological Forum – An International Journal*, *13*(4): 971-974.