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RESPONSE OF IRRIGATION METHODS AND FREQUENCIES ON GROWTH AND YIELD OF RICE IN SEMI-ARID REGION OF BORNO STATE, NIGERIA

Galadima Umar Idris[a*], Kahinde Raheef Adebayo[b], Raheed Amao Busari[c], Kahinde Peter Alabi[d]

[1]Department of Agricultural and Bio-Environmental Engineering, Federal Polytechnic Monguno, Borno State, Nigeria

[2, 3 and 4]Department of Food and Agricultural Engineering, Kwara State University Malete, Nigeria

Corresponding author*

Abstract: *Rice is becoming staple food in most part of Nigeria, but the production quantity is still very far for the need of over 200,000,000 million populations. The increasing scarcity of freshwater is threatening the sustainability of irrigated rice. Supplementary irrigation couple with irrigation frequency can be an alternative means to sustain rice crop production. The study was conducted at teaching and research farm Ramat Polytechnic Maiduguri, Borno State Nigeria. This study focus on rice crop growth and yield at different irrigation schemes under supplementary irrigation. Three (3) irrigation frequencies were set up to two (2) different irrigation methods: namely Border and Basin Irrigation methods. The irrigation frequencies were 2, 4 and 6 days respectively. A rice variety named Faro44 was assigned to the treatments in complete randomized design (CRD). Filled grain percentage was recorded higher in 2 days' irrigation frequency at border Irrigation method having 86% followed by border irrigation of the same frequency with 72%. Grain yield was recorded higher in basin irrigation at 2 days' irrigation frequency 7.83 tonne/hectare and the least yield was recorded as 1.30 tonne/hectare in border irrigation at 6 days' irrigation frequency. The study concludes that basin irrigation produces the highest crop yield with decrease in both growth and yield as the frequency increases.*

Key words: *Freshwater, Irrigation, Response, Sustainability, Quality, Yield.*

1 INRODUCTION

The increasing scarcity of fresh water for rice production is alarming couple with the population growth is a threat to food security (Hanson and May, 2004). Alternative means for rice production is therefore necessary to meet up with the challenges so as to ensure food security in Nigeria. Rice is recognized as one of the most important staple food crop, accounting for more than half of human caloric intake globally (Ainsworth, 2008). It is generally valued for its high

nutritional benefits apart from being rich in calories, it is high in fiber, vitamins and minerals but low in cholesterol and sodium, suggesting it is a healthy source of energy (Ekeleme *et al*., 2008). In 2009, Nigeria was ranked 12th in the world's list of rice consuming countries, while it is ranked 17th globally (FAO, 2011). However, Nigerian rice production has not meet the demand or have the capacity to cope with an expanding population growth. Production is also suggested to be declining due to effects of climate change particularly through drought, heat, flooding and pests and diseases. Drought is recognized as a major abiotic stress that limits rice productivity and adversely affects grain quality in rain-fed and upland ecosystems (Farooq *et al*., 2012).

Rice is most sensitive to drought stress during reproductive development at which time moderate water shortages can result in a significant reduction in grain yield (Farooq et al., 2009). The extent to which drought affects yields depends on the intensity and the time of occurrence of the stress within the crop growth cycle. Yield losses ranging from 15 to 50% have been reported (Huang et al., 2016). Hence, alternative means through irrigation application and methods is necessary to sustain rice production (Materu *et al.,* 2018). Careful variety selection with appropriate irrigation methods to prevent soil moisture deficit can ensure positive rice production (Fleury *et al.*, 2010). The challenge for sustainable rice production is to select the appropriate frequency of irrigation so as to increase grain yields to meet the demands of an ever-growing population (Pascual and Wang, 2017). Supplemented irrigation frequencies and method can serve as a better option for growing rice in semi-arid zone of Maiduguri Borno State, Nigeria. This study focus on growth and yield of rice under different irrigation methods and frequencies.

2 METHODOLOGY

The study was conducted at Ramat Teaching and Research farms Maiduguri, Borno State from August to November 2022. Three irrigation frequencies in an interval of 2, 4 and 6 days were used in two different irrigation methods namely basin and border irrigation methods. The irrigation water was applied using a watering can to all plots, Border irrigation received twice volume of water applied to Basin Irrigation plots. However, if there was rainfall. Irrigation application for the said frequencies was suspended and irrigation application continued during the off rain days. The plots dimensions were 5 m^2 and 10 m^2, that is: (2.5 × 2) m for basin Irrigation and (2 × 5) m for Border irrigation respectively. Rice variety Faro44 was planted directly at a spacing of 22.5 × 22.5 cm. Weeding was done periodically by hand based on the weed density at the plots. Data on growth parameters such as plant height, tiller number and number of leaves per plant were collected at an interval of 30 and 70 days after planting. Hence, yield and yield components data were collected during harvest in accordance with the guidelines provided by IRRI (2002).

2.1 Experimental design and layout

The design used in the experiment was Complete Randomized Design (CRD). Six plots of different sizes were used making 6 treatments which were replicated 3 times having 18 plots in total.

Irrigation Frequencies (days)	Irrigation Methods	
2	Border	Basin
4	Basin	Border
6	Border	Basin

3 RESULTS AND DISCUSSION

Growth and yield response of rice to different irrigation methods under different irrigation frequencies

The growth parameters, and yield components differ among treatment during harvest. The highest plant height 134 cm was recorded under basin Irrigation at 2 days' frequency. However, there is no significant difference at $P < 0.05$ among border and basin irrigation at 2 and 4 days' frequency, but there is statically difference among at $P < 0.05$ in both border and basin irrigation at 6 days' frequency. Tiller number was recorded higher in border irrigation at 4 days' irrigation frequency with no significance difference in basin and border at 4 days' irrigation frequency, but statistically differs at $P < 0.05$ at 2 and 6 days' frequency in both border and basin irrigation methods. Filled grain percentage was recorded higher in basin irrigation at 2 days' irrigation frequency with 86% followed by 72% in border irrigation of the same frequency and the least was recorded in border Irrigation at 6 days' frequency with 23%. Statistically there is significance difference among treatments at $P<0.05$ where the highest was recorded in Basin Irrigation and followed by Border Irrigation with decrease in filled grain percentage as the frequency increases. The highest yield was recorded in basin irrigation method at 2 days' irrigation frequency with 7.83 t^{-ha} followed by border irrigation of the same frequency and it decreases with increase in frequency where the least yield was in recorded in border irrigation at 6 days' frequency.

Statistically, there is significant difference among treatments in all the parameters and this could be due to difference in response to interactions in rice to different irrigation methods and frequencies. Consequently, the higher coefficient of variance (CV) recorded under yield could be due to response to drought stress under different irrigation methods and frequencies as reported by (Ashraf, 2010).

This study is in accordance with finding of (Idris et al., 2020), whose conducted a pot experiment in a greenhouse reported among different rice verities and moisture content and concludes rice produce higher yield in higher moisture content compared to low moisture content. Similarly, (Zhou *et al.*, 2017) reported that at both field and pot experiment yield and above ground biomass of rice plant decreases with decrease in moisture content. However, this finding is contrary to (Sokoto and Muhammad, 2014) whose reported a high yield response to drought in Faro44, this could be due drought stress severity of this experiment.

Table 2.2: Growth and yield response of rice to different irrigation methods under different irrigation frequencies

Irrigation Method	Frequency (Days)	Plant Height (cm)	Tiller Number (no.)	Filled grain (%)	Yield (t/ha)
Border	2	133.00^{a}	7.67^{b}	72.00^{b}	6.33^{ab}
Basin		134.00^{a}	9.00^{b}	85.67^{a}	7.83^{a}
Border	4	129.00^{a}	15.67^{a}	57.33^{bc}	2.77^{c}
Basin		130.67^{a}	14.67^{a}	687.33^{c}	5.03^{b}
Border	6	85.333^{c}	6.67^{b}	23.00^{d}	1.30^{c}
Basin		118.00^{b}	8.33^{b}	24.00^{d}	4.80^{b}
CV		3.7	21.52	11.65	20.32
LSD		*	*	*	*

4 CONCLUSION

These conclusions were made on study made on: Response of irrigation methods and frequencies on growth and yield of rice in semi-arid region of Borno state, Nigeria. as stated below:

- Rice (Faro 44) produces higher length and tiller number under flooded water content in Basin Irrigation method
- Rice above ground biomass both height and tiller number decreases with decrease in water content within the surrounding of the rice plant.
- Yield and all yield component with the exception of tiller number are higher under flooded water content
- Rice produces higher yield if the method of irrigation used conserved water (basin Irrigation).

REFERENCES

Ainsworth, E. A. (2008). Rice Production In A Changing Climate: A Meta-Analysis Of Responses To Elevated Carbon Dioxide And Elevated Ozone Concentration. *Global Change Biology,* 14**,** 1642-1650.

Ashraf, M. (2010). Inducing Drought Tolerance In Plants: Recent Advances. *Biotechnology Advances,* 28**,** 169-183.

Ekeleme, F., Kamara, A., Omoigui, L., Tegbaru, A., Mshelia, J. & Onyibe, J.(2008). Guide To Rice Production In Borno State, Nigeria.

Farooq, M., Hussain, M., Wahid, A. & Siddique, K. H. M. (2012). Drought Stress In Plants: An Overview. *In:* Aroca, R. (Ed.) *Plant Responses To Drought Stress: From Morphological To Molecular Features.* Berlin, Heidelberg: Springer Berlin Heidelberg.

Farooq, M., Wahid, A., Lee, D.-J., Ito, O. & Siddique, K. H. M. (2009). Advances In Drought Resistance Of Rice. *Critical Reviews In Plant Sciences,* 28**,** 199-217.

Fleury, D., Jefferies, S., Kuchel, H. & Langridge, P. (2010). Genetic And Genomic Tools To Improve Drought Tolerance In Wheat. *Journal Of Experimental Botany,* 61**,** 3211-3222.

Hanson, B. & May, D. (2004). Effect Of Subsurface Drip Irrigation On Processing Tomato Yield, Water Table Depth, Soil Salinity, And Profitability. *Agricultural Water Management,* 68**,** 1-17.

Huang, J., Wang, B., Yang, X., Zhao, F., Chen, S., Li, Y. & Cheng, J.(2016). Advance Of Rice Drought Resistance, Water Saving Cultivation And Genetic Breeding. *Agricultural Science & Technology,* 17**,** 1115-1119.

Idris, G. U., Kaewrueng, S., Sreewongchai, T. & Tawornpruek, S. (2020). Effects Of Irrigation Scheduling At Different Managed Allowable Depletion In Saline Soil On Three Rice Varieties. *International Transaction Journal Of Engineering Management & Applied Sciences & Technologies,* 11.

International Rice Research Institute. (2002). Standard Evaluation System For Rice. Http://Www.Knowledgebank.Irri.Org./Image/Docs/Rice-Standard-Evaluation-System.Pdf.

Materu, S., Shukla, S., Sishodia, R., Tarimo, A. & Tumbo, S. (2018). Water Use And Rice Productivity For Irrigation Management Alternatives In Tanzania. *Water,* 10.

Pascual, V. & Wang, Y.-M. 2017. Impact Of Water Management On Rice Varieties, Yield, And Water Productivity Under The System Of Rice Intensification In Southern Taiwan. *Water,* 9**,** 3.

Sokoto, M. B. & Muhammad, A. (2014). Response Of Rice Varieties To Water Stress In Sokoto, Sudan Savannah, Nigeria. *Journal Of Biosciences And Medicines,* 02**,** 68-74.

Zhou, Q., Ju, C.-X., Wang, Z.-Q., Zhang, H., Liu, L.-J., Yang, J.-C. & Zhang, J.-H. (2017). Grain Yield And Water Use Efficiency Of Super Rice Under Soil Water Deficit And Alternate Wetting And Drying Irrigation. *Journal Of Integrative Agriculture,* 16**,** 1028-1043.