FUDMA Journal of Sciences (FJS)
Maiden Edition
Vol. 1 No. 1, November, 2017, pp 69-73

RESPONSE OF RICE VARIETIES TO VARIOUS PLANTING METHODS UNDER IRRIGATION AT TALATA MAFARA IN SUDAN SAVANNA

[1]Mani, H., [2*]Muhammad, A. and. [2]Haruna, F. D.

[1]Department of Agronomy, Institute for Agricultural Research/Faculty of Agriculture,
Ahmadu Bello University, Zaria, Kaduna State, Nigeria
[2]Department of Crop Production and Protection,
Federal University, Dutsin-ma, PMB 5001 Dutsin-ma, Katsina State
Correspondence addresses; e-mail: amuhammad1@fudutsinma.edu.ng & GSM no. 08024776111

Abstract
A field experiment was conducted during the dry seasons of 2012 and 2013 in Irrigation Research Sub-station, Talata Mafara, Zamfara State, Latitude 12°34′00″ N and Longitude 6°04′00″, E 488 m above sea level in the Sudan savanna agro-ecological zone. The objective of the research was to assess the performance of rice varieties under various planting methods under irrigation. The treatment evaluated consisted of three rice varieties (Faro 44, 45 and 57) and three planting methods (transplanting, broadcasting and drilling). Rice varieties were allocated to the main plot while planting methods were allocated to the sub plot, randomized in a Complete Randomize Block Design (CRBD) in split plot arrangement and was replicated three times. The gross and net plot sizes were 5 x 4 and 3 x 3 m, respectively. Results showed that Faro 57 produced taller plants than the other varieties that were statistically at par while Faro 45 took larger days to attain days to 50 % anthesis. Broadcasting rice produced significantly ($p \leq 0.05$) taller plants than drilling and transplanting that were at par. Transplanting rice took larger days to attain days to 50 % anthesis but was at par with drilling in 2012. Faro 57 significantly ($p \leq 0.05$) produced more thrashing % and number of grains panicle^{-1} than Faro 45 and 44. Transplanting had high thrashing % and number of grains panicle^{-1} than broadcasting and drilling. Faro 45 significantly ($p \leq 0.05$) produced high 1000-grain weight and grain yield than Faro 44 and 57 that were at par while transplanting had high 1000-grain weight and grain yield than broadcasting and drilling that were statistically at par. Faro 45 to be established by transplanting is hear by recommended for growing in the ecological zone.

***Keywords**: Rice varieties, planting methods, irrigation*

Introduction

Rice (*Oryza sativa* (L.) is an important food crop for more than half of the world population with Asia as the leading producer and Nigeria the largest producer in Africa (Umar *et al*., 2013). Rice is the sixth major crop in area cultivated in Nigeria after sorghum, millet, cowpea, cassava and yam (Kamara *et al*., 2011; Olaleye *et al*., 2008 and Vange and Obi, 2006). It came second in the world classification of crops accounting for 27 % of the world cereal production, second to wheat with 30 % (Birhane, 2013). Rice is one of the oldest cultivated cereal crops (Hussain *et al*., 2013). It is one of the staple crops in Nigeria that is adapted to both flooded and non-flooded soil conditions in all the agro-ecological zones of Nigeria. Nowadays, increase in food production is the most challenge of the century especially in developing countries due to population explosion and urbanization and hence the demand for the crop is steadily increasing annually (Ereistien *et al*., 2003). Its production rose from 2.4 million metric tons in 1994 to 3.1 million metric tons in 2002 (Kamara *et al*., 2011). According to FAOSTAT (2012), Nigeria produced paddy rice amounting to 4.8 million metric tons valued at $ 1.309 billion, ranked 7th behind millet, vegetables, sorghum, maize, yams and cassava. Goronyo (2017) stated that rice production in Nigeria has increased from 5.5 million tons in 2015 to 5.8 million tons in 2017. According to Umar *et al*. (2013), the potential land area for rice production in Nigeria is estimated to be between 4.6 – 4.9 million hectares that are shared among the upland, rain fed and irrigated lowlands, deep water and mangrove swamp ecologies. With the exception of few countries that have attained self- sufficiency, rice demand in Nigeria exceed its production and large quantities are imported to meet the demand at high costs. In 2008, the country expanded $300 million on the importation of the crop equivalent to 36 % of production. The yield of the crop is still low and averages 1.0 tha^{-1} or less (Singh *et al*., 1997). Rice production is dependent mainly on climatic factors, but the most detrimental is availability of soil moisture. However, production and productivity of the crop is also determined by soil fertility, planting methods, and other biotic and abiotic factors which either directly or indirectly affects its growth and development. There are different rice planting methods, but the most common ones are transplanting and direct sowing (Birhane, 2013). Transplanting of rice seedlings in the traditional way is labourious, time consuming and causes drudgery. Direct sowing of rice may be prone to late moisture stress in Dryland areas where late onset and early withdrawal of rain prevail (Birhane, 2013). Transplanting ensures uniform plant stands and gives the rice crop a head start over emerging weeds. Seedlings are established even if the field is not leveled adequately and has variable waterlevels. There are three principal methods of direct seeding of rice: dry seeding (sowing dry seeds into dry soil), wet seeding (sowing pre-germinated seeds on wet puddle soils) and water seeding (seeds sown into standing water) dry seeding has been the principal method of rice establishment since the 1950s in developing countries (Farooq *et al*., 2011). Water resources both surface and underground are shrinking and thus become a limiting factor in rice production (Birhane (2013). Planting methods depending upon the type of cultivation plays a great role in enhancing growth and yield of the crop. Therefore the urgent need to increase yield per hectare using improved rice varieties and agronomic practices (planting methods) necessitated this research.

Materials and Methods

The experiment was carried out at Irrigation Research Station in Talata Mafara, Zamfara State, Latitude 12°34′00″ N and Longitude 6°04′00″ E 641 m above sea level in the Sudan savanna agro-ecological zone. The experiment consisted of three rice varieties (Faro 44, 45 and 57) and three planting methods (transplanting, broadcasting and drilling). The experiment was laid out in a Randomized Complete Block Design using split plot arrangement. Rice varieties were assigned to the main plot while planting methods were randomized in the sub-plot and was replicated three times. Nursery was prepared for the transplanted treatment, while broadcasting and drilling was done at the same time. Weeds were controlled using Glyphosate (pre-plant) and Butachlor (pre-emergence) and Orizo plus (post-emergence) herbicides and were supplemented with hand pulling at 9 weeks after sowing (WAS). Gross and net plot sizes were 5 x 4 and 3 x 3 m, respectively. NPK fertilizer was applied in 2 split doses. First half of N and whole of P and K were applied at planting and the remaining half of N at 6 WAS using urea (46 % N). Data were collected on growth (days to 50 % anthesis and plant height) and yield parameters (thrashing percentage, number of grains panicle^{-1}, 1000-grain weight and grain yield per hectare) and analyzed using ANOVA. Significant means were separated using Duncan's Multiple Range Test (DMRT) at 5 % level of probability.

Results and Discussion

The result of the effect of rice varieties and planting methods on days to 50 % anthesis and plant hieght during 2012 and 2013 growing seasons is presented in Table 1. The result showed days to 50 % anthesis was not much significantly affected by varieties. Faro 45 significantly ($p \leq 0.05$) recorded the highest days to attain 50 % anthesis (physiological maturity) than Faro 44 and 57 that were statistically similar. This could be due to genetic differences and the variety has high response to applied inputs than the other varieties. The days to 50 % anthesis fluctuates between 116 – 133 days. The effect of variety on plant height showed that Faro 57 significantly ($p \leq 0.05$) recorded highest plant heights during the growing seasons. The highest height of 120cm was attained by Faro 57 during 2013 growing season and the least was 101 cm attained by Faro 44 (Table 1). This difference could be attributed due to their genetic makeup. In a similar study, Garba *et al*. (2013) reported genetic difference as inherent character difference between NERICA-1- rice that is taller than Ex-China. Similar reports were made by Omran *et al*. (1980) and Seaton *et al*. (1992) in groundnut. The result of the effect of planting methods on days to 50 % anthesis showed that rice established by transplanting attained physiological maturity later than the other methods, although statistically similar with drilled rice during 2013 season. The effect of planting methods and varieties on plant height was significantly affected (Table 1). The result on the effect of planting methods on growth parameters showed that rice established by broadcasting significantly ($p \leq 0.05$) attained days to 50 % anthesis earlier (116-121 days) than the other two methods. Plant height was also significantly affected by planting methods. Broadcasting rice was significantly found to result in the tallest rice plants (133.3 and 135.0 cm) during 2012 and 2013 respectively better than the other two methods than establishing rice by transplanting and drilling. The least height attained was by drilling (105 cm) during 2013 season. This showed that rice established by broadcasting responds to applied inputs better. Also the longer days to 50 % anthesis indicated that all assimilates/photosynthates accumulated due to vegetative growth advantage (plant heights) were fully converted in to dry matter components manifested in yield attributes. However, establishing rice by transplanting significantly resulted in higher number of grains per panicle (137.7 and 77.2) and grain yield (267.5 and 154.6) than the two varieties which were statistically at par in all the growing seasons. This finding is in contrast with the result obtained by Hussain *et al*. (2013) who recorded the highest plant heights of 123.7 cm were in transplanted crop in puddled soil whereas the lowest plant height was observed in direct seeded crop in at Pindi Rattan Singh, Kot Nazir and PARC farm Kala Shah Kaku. Also, Maqsood (1998) reported higher plant heights in transplanted rice as compared with direct seeding. The study also contradict the findings of Sekhar (2014) who reported non-significant differences of the effect of planting methods on plant height at Regional Agricultural Research Station, Chintapalli, Visakhapatnam district of Acharya N.G. Ranga Agricultural University. The result on the effect of variety and planting methods on yield parameters showed that thrashing %, number of grains panicle^{-1}, 1000-grain weight and grain yield hectare^{-1} significantly ($p \leq 0.05$) differed. Faro 57 significantly recorded higher trashing % as well as number of grains panicle^{-1} in all the years except during 2013 growing season while Faro 44 recorded the least percentage (Table 2). This could be attributed due to genetic difference of the variety. Faro 45 however significantly ($p \leq 0.05$) recorded higher 1000-grain weight and grain yield hectare^{-1} than Faro 57 and 44 (Table 3). This could be due to the variety took more number of days to attained 50 % anthesis (physiological maturity) and its quick response to applied inputs was high. The effect of variety on grain weight showed that 1000-grain weight was not much significantly affected by rice varieties (Table 3). Faro 45 was found to produce the highest 1000-grain weight better than Faro 44 and Faro 57 which were statistically at par. Similarly, Faro 45 significantly produced the highest yield per hectare followed by Faro 57. The least yield was obtained by Faro 44 (Table 3). This could be due to longer days taken to attained to 50 % anthesis, all photosysnthates accumulated due to vegetative growth advantage were fully converted in to dry matter yield components. The effect of planting methods on yield also significantly differed. Rice established by transplanting was observed to significantly ($p \leq 0.05$) record higher thrashing %, number of grains panicle^{-1}, 1000-grain weight and grain yield better than broadcasting and drilling in all the years of the experiment (Table 2 and 3). This could be attributed due to the less active weed competition for growth resources associated with the planting method as well as proper use of applied inputs. This result obtained was in line with the reports of Birhane (2013); Akhgaril *et al*. (2013) that reported similar trend on the effect of planting methods on yield parameters. The grain yield performance of rice varieties in 2012 was higher than what was obtained in 2013. This could be variation due to different amount of moisture (rainfall) between the years probably because of the steady rainfall in 2012 and hence favorable soil moisture status and availability for rice growth and yields. Umar *et al*. (2013) similarly reported this phenomenon in rice in central Nigeria.

Conclusion

Based on the results obtained from this study, rice variety Faro 45 is recommended for growing in the Sudan savanna ecological zone using transplanting method.

Table 1: Effects of variety and planting methods on plant height and days to 50 % anthesis at Talata Mafara

	Days to 50 % anthesis		**Plant height (cm)**	
Treatments	**2012**	**2013**	**2012**	**2013**
Variety				
Faro 57	116[b]	121[b]	117[a]	120[a]
Faro 45	133[a]	132[a]	114[b]	110[b]
Faro 44	116[b]	116[b]	103[c]	101[c]
SE (±)	0.07	0.08	1.96	2.00
Planting Methods				
Transplanting	122[a]	132[a]	108.3[c]	110[b]
Broadcasting	121[b]	116[c]	133.3[a]	135[a]
Drilling	122[a]	125[b]	115.0[b]	105[c]
SE ±	0.07	0.08	1.96	2.00
Interaction				
V x P	NS	NS	NS	NS

Means followed by unlike letter(s) within the same column are significantly different at 5 % level of probability

Table 2: Effects of variety and planting methods on thrashing percentage and number of grains panicle^{-1} at Talata Mafara

	Thrashing %		**Number of grains panicle^{-1}**	
Treatments	**2012**	**2013**	**2012**	**2013**
Variety				
Faro 57	90[a]	86[a]	143.2[a]	68.9[a]
Faro 45	84[b]	76[b]	130.4[b]	73.3[b]
Faro 44	76[c]	71[c]	126.1[c]	64.5[c]
SE (±)	0.90	0.90	0.80	0.90
Planting Methods				
Transplanting	89[a]	85[a]	137.7[a]	77.2[a]
Broadcasting	82[b]	76[b]	129.7[b]	64.2[c]
Drilling	75[c]	73[c]	137.7[a]	72.2[b]
SE ±	0.09	0.09	0.80	0.90
Interaction				
V x P	NS	NS	NS	NS

Means followed by unlike letter(s) within the same column are significantly different at 5 % level of probability

Table 3: Effect of variety and planting methods on 1000-grain weight and grain yield at Talata Mafara

	1000-grain weight (g)		Grain yield (kg ha^{-1})	
Treatments	**2012**	**2013**	**2012**	**2013**
Variety				
Faro 57	24.0^{b}	23.0^{b}	203.0^{b}	139.7^{b}
Faro 45	25.6^{a}	24.8^{a}	297.3^{a}	150.3^{a}
Faro 44	23.6^{b}	23.2^{b}	176.7^{c}	129.5^{c}
SE (±)	0.08	0.09	2.00	2.12
Planting Methods				
Transplanting	25.8^{a}	24.6^{a}	267.5^{a}	154.6^{a}
Broadcasting	23.8^{b}	23.4^{b}	208.5^{b}	133.1^{b}
Drilling	24.3^{b}	23.2^{b}	200.9^{b}	131.8^{b}
SE ±	0.08	0.09	2.00	2.12
Interaction				
V x P	NS	NS	NS	NS

Means followed by unlike letter(s) within the same column are significantly different at 5 % level of probability

References

Akhgari1 H, Noorhosseini-Niyaki SA, Sadeghi SM **(**2013). Effects of planting methods on yield and yield components of ratoon and main plant of rice (*Oryza sativa* L.) in Rasht, Iran. *Indian Journal of Fundamental and Applied Life Sciences*. **3** (3): 150-157. Online available at http://www.cibtech.org/jls.htm Akhgari et al.

Birhane A. (2013). Effect of Planting Methods on Yield and Yield Components of Rice (*Oryza Sativa* L.) Varieties in Tahtay Koraro Wereda, Northern Ethiopia. *International Journal of Technology Enhancements and Emerging Engineering Research*, **1**(5): 1-5.

Farooq M, Siddique KHM, Rehman H, Aziz T, Lee DJ, Wahid A. (2011)**.** Rice direct seeding: Experiences, challenges and opportunities. *Soil and Tillage Research*, **111**: 87-98.

Garba AA, Mahmoud BA, Adamu Y, Ibrahim U (2013). Effect of variety, seed rate and row spacing on the growth and yield of rice in Bauchi, Nigeria. *African Journal of Food Agriculture, Nutrition and Development.* **13**(4): 8155-8165

Hussain S, Ramzan M, Rana MA, Mann RA Akhter M (2013). Effect of various planting techniques on yield and yield components of rice. Short Communication. *The Journal of Animal and Plant Sciences*, **23**(2): 672-674.

Kamara AY, Ekelem F, Omoigui LO, Chikoye D (2011). Influence of nitrogen fertilization on yield and yield components of rain-fed lowland NERICA® rice in the northern Guinea savanna of Nigeria. *African Journal of Agricultural Research*. **6**(13): 3092-3097. Available online at http://www.academicjournals.org/AJAR. DOI: 10.5897/AJAR10.1058

Goronyo AA (15th May, 2017). Rice production in Nigeria. Leadership Newspaper. Retrieved September 20, 2017, from http://leadership.ng/2017/05/18/rice-production-nigeria-increase-5-8m-tonnes/

Maqsood, M. (1998). Growth and Yield of Rice and
Wheat as Influenced by Different Planting Methods and Nitrogen Levels in Rice Wheat Cropping System. Ph.D. Thesis. Deptertment of Agronomy., University of Agriulture, Faisalabad.

Olaleye AO, Akinbola GE, Marake GE, Molete SF, Mapheshoane B (2008). Soil in suitability evaluation for irrigated lowland rice culture in Southwestern Nigeria: Management implications for sustainability. *Comm. Soil Science, Plant Anal*., **39**: 2920-2938.

Omran AO, Dehera KR, Abdel Al- IH (1980). Flowering and fruiting patterns in prostate and semi prostate types of peanut. *Agricultural Research Review*, **58**(8): 107-116.

Seaton ML, Coffelt TA, Scoyoc SW (1992). Comparison of vegetative and productive traits of 14 peanut cultivars. *Oleagineus*, **47**(7): 471-478.

Sekhar D, Prasad PVN, Tejeswara Rao K, Venugopala Rao N (2014). Productivity of rice as influenced by planting method and nitrogen source. *International Journal of Current Microbiology and Applied Sciences*. **3**(8): 1063-1068. http://www.ijcmas.com

Singh BN, Fagade SO, Ukwungwu MN, Williams JC, Olademeji SS, Okhidievbie AE (1997). Rice Growing Environments and Biophysical. In Agro–ecological zones of Nigeria. *Meteorological Journal*, **2**: 23-41.

Umar A, Ukwungwu MN, David TG (2013). Response of NERICA rice to fertilizer application at Doko, central Nigeria. Short Communication**.** *E3 Journal of Environmental Research* *and Management*. **4**(7): 299-301. Available online http://www.e3journals.org

Vange T, Obi IU (2006). Effect of planting date on some agronomic traits and grain yield of upland rice varieties at Makurdi, Benue State, Nigeria. J. Sustain. Dev. Agric. Environ., **2**: 1-9.