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Performance of Lowland Rice (Oryza sativa L.) as Influenced by Combine Effect of Season and Sowing Pattern in Zigau

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Abstract

A Field experiment was conducted at Zigau, Shira Local Government Area of Bauchi State to study the performance of lowland rice as influenced by combine effect of season and sowing pattern. Lowland rice variety FARO 44 (Sippi 692033) was used during the study. The treatments consisted of two seasons (dry and wet) and four different sowing patterns (Transplanting, Dibbling, Drilling and Broadcasting). This gave eight treatments combination which were factorially combined and laid in Randomized Complete Block Design (RCBD) replicated four times. The result indicated a significant interaction of season and sowing pattern on both the growth and yield parameters studied. Transplanting rice during dry season produced significantly ($P \leq 0.01$) more tiller counts than all other treatment combinations for both years. However, irrespective of season transplanted and dibbled rice significantly ($P \leq 0.01$) had higher number of spikelets than drilled and broadcasted rice only in 2015. The result further revealed that, in 2015 transplanting rice during dry season was found to be significantly ($P \leq 0.05$) better in terms of grain yield (kg/ha) than all other treatments studied. Based on the present findings, it is clear that transplanting rice in dry season gave higher grain yield. However, the use of transplanting in either dry or wet season should be adopted by farmers in the study area

Keywords

Performance, Dibbling, Drilling, Combine effect, Lowland rice, Sowing pattern

Introduction

Rice (*Oryza sativa* L) is a cereal crop belonging to the family *Poecae*. Asian rice (*Oryza sativa* L) and African rice (*Oryza glaberrima*Steud) are the two most important species being cultivated. Rice is one of the most important food commodities in West Africa. In Nigeria, it is the fourth major cereal crop following maize, sorghum and millet particularly in terms land area under cultivation [1]. It has become an important economic crop and a major staple food for millions of people in Sub-Saharan Africa [2] and particularly in Nigeria farmers seem to be willing to grow the crop at whatever cost and constrain they may face during it production.Studies conducted in Nigeria reveal that rice constitutes over 20% of total food expenditure among urban and rural households. The demand for rice has grown significantly over the last 40 years due to changing consumer dietary patterns and population growth [3].

In Nigeria the demand for rice has been at the increase and at a much faster rate than any other West African countries since the mid-1970s [4], which may probably be attributed to the geometric progression in population growth. Estimated annual rice demand and production in Nigeria is said to be 5 and 2.21 million tons respectively. The national rice supply-demand gap of 2.79 million tones is expected to be bridged by importation [5] which has constituted serious drain on the nation's foreign exchange.

Rice production in Nigeria, is constrained by a number of factors which may include among others, the use of poor agronomic practices (such as planting pattern or seeding method), drought, use of local varieties, and inconsistency of government policy instruments and interventions to boost local production such as import restriction, tariff restriction and inauguration of presidential task force on rice. It is believed that with proper awareness, sensitization and

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training on rice production under irrigation during dry season particularly on improved planting techniques and water management like Alternate Wetting and Drying (ADW), the quantum leap in the production level may be bridged.

Rice being a tropical crop can be grown during the two distinct seasons (dry and wet) of the year provided that moisture is made available to the crop. Therefore, in addition to traditional wet season rice production, Nigeria has abundant land and water resources to embark on dry season rice production through irrigation to ensure all year round production.Dry season is the season of the year with no rainfall and moisture requirement for crop production is primarily depend on irrigation water. The season is prolonged, spanning from October to May, particular in northern parts of the country. Additional yield to annual rice production through dry season production could set Nigeria on a pathway to rice self-sufficiency thereby bringing the demand and supply gap of the crop.However, despite its high yield potential, less emphasis has been directed toward dry season or irrigated rice production which accounts for 10-16% of the total rice area in the country [6,7] and it is mostly found in the northern parts of the country.

Among various agronomic practices limiting yield, planting pattern and/or planting method are considered to be of great importance, asincrease in yield can be ensured by maintaining appropriate plant population through different planting pattern. In rice production, planting methods like broadcasting, drilling, dibbling and transplanting have impact on the growth and yield of the crop besides cultivation cost and labour requirement. The method of stand establishment in rice culture can be classified into direct seeding and transplanting. Like other cereal crops, rice can be grown directly into the field instead of first raising the seedlings in the nursery and later transplanting them into the main field. Though transplanting method seems to be more laborious from raising nursery, uprooting and transporting the seedlings, however, it has been shown to be a better practice than direct method of seeding [8]. According to Hayat, et al. [9] and Ali, et al. [10] direct seeded rice when managed properly can yield as high as the transplanted one. This research was therefore carried to investigate on the performance of lowland rice as influenced by combined effect of season and sowing method.

Materials and Methods

Field experiment was conducted at in Zigau, Shira Local Government Area of Bauchi State to study the productivity of rice as influenced by season and sowing method. The experimental site is located on Latitude11° 25'N and Longitude 9° 57'E and at an altitude of 410m above sea level. The warmest month of the year in the study area is April, with an average temperature of 34.5 °C and lowest average temperature of 26.5 °C in the month of January, while the mean annual rainfall of the area Is about 600-780mm. The wet season in and around Shira area commences in around June and ends in October while dry season lasts for about seven months that is between November and May.

Lowland rice variety FARO 44 otherwise known as Sippi 692033 was used for the study. The treatments consisted of four different sowing methods (Transplanting, Dibbling, Drilling and Broadcasting) tested in two different seasons (Wet and Dry). This gave eight treatment combination which were factorially combined and laid in Randomized Complete Block Design (RCBD) replicated four times. For direct method of sowing (dibbling, drilling and broadcasting) the seeds were sown directly on the field. However, in transplanting method of sowing seedlings were first raised in the nursery before transplanted. The seeds were sown the same day for both direct seeding and nursery. Uniform inter and intra row spacing of 20 cm was used for dibbling and transplanting method. In drilling method of seeding the seeds were sown in a groove of 2-3 cm deep spaced at 20 cm. In Broadcasting the seeds were manually spread using hand and covered lightly with soil for effective germination. Seed rates used were; transplanting (40 kg/ha), dibbling (60 kg/ha), drilling (120 kg/ha) and Broadcasting (150 kg/ha).

Weeding was done manually at 3, 8 and 12 weeks after sowing. Compound fertilizer NPK 20:10:10 was first applied as basal using broadcast method at the rate of 60 kgN/ha, 30 kgP_2O_5 and 30 kh/haK_2O. The remaining nitrogen dose was then applied in two split doses as top dress at 7 weeks after sowing and at booting stage. Under the dry season experiment, surface irrigation method was used to convey water from wash bore through hose pipe to constructed channels between blocks or replicate to each plot. The irrigation water was applied to the treatment plots through ridge that linked each plot to the constructed channels.

Intermittent irrigation with alternate wetting and drying of 3 days interval. However, during the rainfed experiment, the field was left under the natural rainy season for water supply.Data were collected on plant height, tiller count and yield characters from 20 randomly selected sampled hills/stands from the net plot size of 4m^2. The data collected for all the sampled stands and for all the characters observed. The data collected were subjected to Analysis of Variance (ANOVA) as described by Snedecor and Cochran (1967) using SPSS version 22 package. This was carried out to study the effect of all the treatments. However, where the treatments were observed to be significant, Duncan Multiple Range Test (DMRT) was used to separate the means.

Results and Discussion

Data on rainfall, temperature and relative humidity of the study area, during the period of the experiment was recorded and obtained from Bauchi State Agricultural Development Programme (BSADP), Azare meteorological station (Table 1). For both years the warmest month of the year in the study area is April, with an average temperature of 34.5 °C and lowest average temperature of 26.5 °C in the month of January. Total annual rainfall in 2016 was higher (788.6 mm) than that of 2015 (549.2 mm). Similarly, the onset of the rainfall was earlier in 2016 (May) than 2015 (June).

Interaction of season and sowing pattern (Table 2**)** indicated that transplanting rice during the dry season in both years had higher tiller count than the other treatments studied. However, irrespective of season on the other hand, drilling and broadcasting methods produced the least tiller

Table 1: Total rainfall, mean temperature and relative humidity of the experimental area for 2015 and 2016.

	Rainfall (mm)		Mean Temperature (C)		Relative Humidity (%)	
Months	2015	2016	2015	2016	2015	2016
January	Nill	Nill	27.5	27	71	71
February	Nill	Nill	27.5	26.5	69	72
March	Nill	Nill	30	31.5	72	75
April	Nill	Nill	34	35	73	76
May	Nill	44.3	34	35	75	77
June	57.3	99.2	32	34	73	76.1
July	133.7	217.9	30.5	28.5	72	73
August	282.6	281.6	29.5	27	70	72
September	56	134.4	28.5	27.5	69	73
October	19.6	11.2	30	32	70	74
November	Nill	Nill	30	27.5	71	70
December	Nill	Nill	27.5	25.5	74	68

Source: BSADP, Azare Meteorological Station

Table 2: Interaction between season and sowing pattern on tiller count per plant of rice grown during dry and rainy season of 2015 and 2016 at Zigau Bauchi State, Nigeria.

	Season			
	2015		2016	
Treatments	Dry	Wet	Dry	Wet
Sowing method				
Transplanting	21.06a	18.36b	22.00a	19.13b
Dibbling	10.44c	7.10d	11.00c	7.40d
Drilling	1.00e	0.90e	1.10e	1.10e
Broadcasting	0.80e	0.90e	1.00e	0.95e
LS	**		**	
LSD	0.9		1.365	

LS = Level of significance ** = Significant at 1% level of probability

Table 3: Interaction of season and sowingpattern on spikelet number per spike grown during 2016 at Zigau Bauchi State, Nigeria.

	Season	
Treatments	Dry	Wet
Sowing method		
Transplanting	11.75a	11.68a
Dibbling	11.75a	11.05ab
Drilling	10.50b	9.14c
Broadcasting	10.55b	8.33c
LS	*	
LSD	1.1	

LS = Level of significance * = Significant at 5% level of probability

number. From the interaction between season and sowing pattern, transplanting rice during dry season produced higher tiller count than other treatment. This was not surprising as the optimum performance of transplanted rice can be achieved when favourable environmental conditions such as abundant sunlight and proper water management especially during active tillering are available. The present study is in agreement with the early reports of IRRI (2008) that transplanting enables optimal spacing which may probably increase tillers over poor spacing particularly when coincides with favourable condition of high temperatures and solar radiation during the months of March and April in the dry season when rice is known to tiller profusely [12,13].

Interaction of season and sowing pattern presented in Table 3**, s**howedthat irrespective of the two seasons, **t**ransplanting and dibbling had more number of spikelets than other treatments studied. The increase in number of spikelets per spike under the transplanted and dibbled rice as against the other methods of sowing may not be unconnected to more space, sunlight and nutrients availability in transplanted crop than higherdensities of drilled and broadcasted crop which might have been translated into increased in competition between the adjacent plants. This hinders the development of yield attributes including number of spikelet per spike. The result of present findings agrees with the report of Hay and Walker (1989) that increase in plant population by different sowing methods may lead to increase in competition between adjacent plants which may subsequently affect yield and yield components of rice.

Interaction between season and sowing pattern on grain yield is shown on Table 4 and only in 2015 indicated that transplanting method had the highest grain yield. The least grain yield on the other hand was observed under broadcasting during wet season in 2015.The significant performance of transplanting over the other sowing pattern could be attributed to optimum plant population by planting the seedlings at specific distance which may allow for more radiation to be intercepted by the canopy due to reduced mutual leaf shading for more efficient photosynthesis, therefore the highest yield. Increase inplant population of different sowing methods, may increase competition between adjacent plants (Hay andWalker, 1989) which may subsequently affect yield.

Table 4: Interaction of season and sowing pattern on grain yield of rice in 2015 at Zigau Bauchi State, Nigeria.

	Season	
Treatments	Dry	Wet
Sowing method		
Transplanting	6629.50a	5811.58b
Dibbling	6028.13b	4981.63c
Drilling	3866.50d	3676.53d
Broadcasting	3626.38d	2945.43e
LS	*	
LSD	423.252	

LS = Level of significance * = Significant at 1% level of probability

Table 5: Simple Correlation between yield and some characters of rice grown during dry and wet seasons of 2016 and 2017 in Zigau, Bauchi State, Nigeria.

	Correlation Coefficients	
Characters	2016	2017
Yield		
Number of tillers per plant	0.922**	0.815**
Number of spikes per hill	0.893**	0.684**
Number of seeds per spike	0.674**	0.297NS
Number of spikelets per spike	0.692**	0.413*
Spike weight	0.769**	0.604**
Seed weight per spike	0.801**	0.587**
Spike length	0.471**	0.299NS
Weight of 1000 grain	0.511**	0.696**
Shelling percentage	-0.661**	-0.530**
Harvest index (HI)	0.560**	0.747**

**Significant correlation at 0.01 level

*Significant correlation at 0.05 level

Table 5 shows simple correlation between yield and other parameters of rice grown during the dry and wet seasons of and 2017. It can be observed that, except for number of seeds per spike and spike length only in 2017 all other parameters were significantly ($P \leq 0.01$) correlated with grain yield for both years. Similarly, with the exception of shelling percentage which had negative correlation, all other parameters were positively correlated with grain yield. The result indicated that number of tillers per plant, number of spike per hill, number of seeds per spike, number of spikelets per spike, spike weight, spike length, 1000 grain weight, seed weight spike and harvest index are functions of total yield, as they increase the total yield also increases and vice-versa. However, increase in shelling percentage might lead to decrease in total grain yield per land area and vice-versa. It is clear from the result of this investigation, that dry season and transplanting method of sowing which have higher values these parameters, significantly ($P \leq 0.01$) produced higher grain yield. The results further revealed that the relationship between these characters with yield signifies their vital role to final grain yield. The present findings therefore, corroborates with the work of Muhammad, et al. (2007) that among other yield components number of seed per panicle, grain yield per hill significantly influenced grain yield in rice production

Conclusion and Recommendation

Based on the present findings, it is observed that the interaction of season and sowing pattern had influenced on the growth and yield attributes of rice. Transplanting rice in dry season which produced higher yield (6629.50 kg/ha) performed better than all other treatment combinations. However, the use of transplanting in either dry or wet season should be adopted by farmers in the study area. The results further indicated positive correlation between grain yieldand most parameters measured.

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