TRANSPLANTING RICE(ORYZA SATIVA L) USING DIFFERENT SEEDLING RATES UNDER RAINFED CONDITION IN BAUCHI,NIGERIA

GARBAA. A*

KUBERIJ.R**

ABSTRACT

The study investigates the performance of rice under different transplanting ages and number of seedlings per hill. Four transplanting ages (2, 3, 4 and 5 weeks after removal from the nursery) and four transplanting rates (1, 2, 3 and 4 seedlings per hill) were used. The treatments were factorially combined and laid in a randomized complete block design, replicated three times. Results obtained on growth characterslike plant height, number of tillers and leaves, leaf area index and crop growth rate indicatedthat two weeks old seedlings performed better while five weeks old seedlings were the least in performance among the treatments considered. Number of seedlings per hill had significant (P=0.05) effect on number of tillers, number of leaves and leaf area index. It was noted that one seedling per hill gave higher performance. Similarly, yield and yield components such as number of panicles/m^2, panicle length, number of spikelets, panicle weight, ripening percentage and grain yield exhibited the same trend. Transplanting rice as early as 1 or 2 week(s) after emergence in the nursery using one single seedling per hill seems more promising for higher yield of rice grown during the rainy season.

Keywords: Riceintensificationsystem, transplanting age, transplanting rate, yield

* Department of Crop Production, Faculty of Agriculture and Agricultural Technology,Abubakar Tafawa Balewa University, P.M.B 0248 Bauchi, Nigeria

** Agricultural Science Section, Department of Vocation and Technology, Government Science School Kuru, P. O. Box 59, Bukuru, Jos, Plateau State. Nigeria

INTRODUCTION

Rice (*Oryza sativa L.*) feeds more than half of the world population and among cereals, it is more nutritious where about 40% of world population consume it as their major source of calorie (Banik,1997).It ranks third after wheat and maize in terms of worldwide production. Among the rice growing countries of the world, India has the largest area under cultivation with 448 million hectares followed by China and Indonesia, while Nigeria has approximately 3.7 million hectares under cultivationout of a total arable land of 70 million hectares. In terms of production however, China ranks first with 200 million tones followed by India with 131 million tons annually. In Nigeria, about 77 percentof rice farmed area is rain fed, out of which 47 percent is lowland and 30 percent upland (Bayou, 2009).

Nigeria is the largest rice producing country in West Africa and but unfortunately the second largest importer in the world (FAO, 2012). Theaverage yield per hectare invarious production ecologies are: Rain fed lowland (2.2tones) rain fed upland (1.7tones) irrigated (3.5tones) deep water floating (1.3tones) and mangrove swamp (2.0tones) (Ezedinma, 2008). With expansion of the cultivated land area to rice, there has been steady increase in rice production and consumption in Nigeria. Increase in production however,has not been enough to meet the consumption demand of the rapidly growing population which has much preference for parboiled rice (Singh*et al*., 1997). Despite the population growth, several factors militating against rice production are; lack of improved varieties and better agronomicpractices among a host of others. These deserves urgent research to explore ways of increasing yield of the crop.Rice which is a staple food by more than 60 percent of world population deserves much attention toward research in improving its productivity. In the light of the aforementioned, it became imperative that improved practices in rice production be explored.

Farmers in the study area have been givenextension services on different agronomic practices in rice production especially on the need to dibble or plant rice instead of broadcasting and to raise seedling in the nursery for transplanting under irrigation during the dry season. However, no such knowledge of transplanting the crop under rain fed is known by farmers. The use of over aged seedlings has also been known to retard general performance of rice. Farmers within the study area usually use broadcast method. Moreover,those fewfarmers aware of direct seeding method, only attempt sowing 10-30 seeds per hill not mindful of the quantity of seeds sown. The use of high density seedlings per hill tend to reduce grain yield as competition among plants become severe and consequently making the plants to grow slowly (Miah *et al*. 2004). On the other hand, farmers in the study area who have received extension service on the need to transplant rice by first sowing in the nursery, goes ahead to transplant 4-25 seedlings per hill in the field. This has also been observed by SRI to not only waste seedlings by tenfold or more, but also by reducing seed yield by tenfold under irrigation (Molla, 2001).

MATERIALS AND METHODS

A field experiment was conducted during the rainy seasons of 2013 and 2014at the fadama research site of Abubakar Tafawa Balewa Bauchi, Yelwa Campus. Bauchi is situated at latitude 10^{0}17'N, longitude 9^{0}49'E and 609.3m above sea level in the northern Guinea savannah ecological zone of Nigeria. The treatments consist offour transplanting ages (2, 3, 4 and 5 weeks after removal from the nursery) and number of seedlings per hill(1, 2, 3 and 5 seedlings). The treatments were factorially combined and laid in a randomized complete block design (RCBD), replicated three times.Soil samples were taken randomly prior to land preparation at the depth of 0-15cm and analyzed for texture and nutrient levels (Table 1).

Table 1: Physico-chemical properties of the soil at the experimental site taken in 2009 and 2010 season

	2013	2014
	SOIL DEPTH (cm)	
	0-15	0-15
Mechanical composition (%)		
Clay	33.86	35.94
Silt	18.48	13.45
Sand	47.11	51.08
Textural Class (USDA)	Loamy	Loamy
Chemical Composition		
pH (Water)	6.08	6.23
pH ($CaCl_2$)	5.49	5.52
Organic Carbon %	1.56	1.72
Total N (g/kg)	0.12	0.13
Available P (mg/kg)	12.68	15.65
Exchangeable base bases (Cmol/Kg)		

Ca	4.89	4.12
Mg	0.97	0.18
K	0.28	0.25
Na	0.20	0.21
CEC (Cmol/kg)	9.80	10.95

The field was first ploughed and harrowed twice and later marked in to plots.A plot size of 2.5m x 2.5m was adopted with 0.5mbetween plots and 1.0m between blocks.A raised nursery bedof 8 x 4m by 0.15m high was constructed, fenced properly to protect the emerging seedlings from animals and also close to the experimental site for easy transportation.Variety Ex-China riceseeds were evenly broadcasted on the seedbed of 32m^2 and lightly covered with top soil. The bed waskept moistthroughout the nursing period usingirrigation.

Before the commencement of transplanting, the nursery bed was first watered properly for easy removal of the seedlings after which seedlings were uprooted with some lump of wet soil and taken to the field. Seedlings (1, 2, 3 and 4per hill) were then transplanted at 2, 3, 4 and 5WAS at the depth of 2-4cmeach during the evening time at each of the date of transplanting. Weeding was carried out manually as at when dueand there was no incidence of pests and diseases, hence no pesticide whatsoever was utilized during the experiment.

Growth parameterscarried out at different stages of growthwere plant height; tiller number, leaf number, leaf area index andother growth efficiency indices like crop growth rate and net assimilation rate all observed at 4, 6 and 8 WAT. Ten sampled plants from each plot were used for the data collection.Assessment of yield and yield componentswere determined at harvestwhere panicle number/m^2 andspikeletnumber /panicle were taken and counted manually. Similarly, panicle length was taken using measuring tapewhile panicle weight was taken using a weighing balance. Ripening grain percentage was determined using salt water with specific gravity of 1.03 and 1000 grain weight was also taken at moisture content of 15% using moisture tester.

Data obtained was subjected to analysis of variance (ANOVA) using SPSS package (17.0). Duncan multiple Range test (DMRT) was also used to separate means of the treatments.

RESULTS ANDDISCUSSION

Plant height (cm)

The results in table 2showed that transplanting age significantly (P=0.05) affected plant height at 4, 6 and 8WAT. Twoweeks old seedlings were observed to be taller throughout the sampling dates except at 8WAT, where 2 weeks old seedlings had taller plants. Whilenumber of seedlings per hill showed no significant (P=0.05) difference on plant height except at 4WAT. On the other hand, transplanting1, 3 and 4 seedlings per hill was observed to produce taller plants compared to 2 seedlings.

The significantly (P=0.05) taller plants produced by 2 weeks old seedlings might be due to the vigorous nature in root growth with lesser leaf area, consequent which input lesser transplanting shock during the initial growth stages. Such factors might lead to stimulate increase in cell division, causing stem elongation there by resulting in increased plant height as observed by Kim *et al.* (1999).The result established is also in accordance with the findings of Islam *et al* (2008) and Mirza *et al.* (2009) who reported younger aged transplanted rice produced taller plants among all different treatments.

Number of Tillers

Table 2 indicated, transplantingthat age significantly (P=0.05) affected number of tillers where 2 weeks old seedlings consistently produced higher number of tillers at 4,6 and 8WAT. While 5 weeks old seedlings gave lowest number of tillers.However, thenumber of seedlings per hill and yearindicated significant (P=0.05) difference on tiller number throughout the study period except at 6 and 8WAT. On the number of seedlingstransplanted,1 seedling per hill had the highest number of tillers than the other treatmentswhile four seedlings per hillgave the least tiller number.

Two weeks old seedlings were superior in tiller production, indicating that younger seedlings are healthier and could relieve the transplanting stress in a shorter period of time compared to older seedlings due to the higher nitrogen content in the former (Yamatomo *et al*., 1998) and the plants ability for faster resumption of growth (Anon 2004). Pasaquin*et al*. (2008) reported that tiller production could be optimized by transplanting seedlings at younger age compared to older ones. The results of Prabha*et al.* (2011), Ashraf*et al*. (1999) and Roy &Sattar (1992) also corroborates with the present finding that tiller production in rice decreased with increasing seedling age during transplanting.

The results on number of seedlings per hill also indicated that the lesser the number of seedlings per hill the more the number of tillers produced on the plant. This could be due to less competition for growth factors by less number of plants per hill than when the crop is dibbled with large number of seeds. The result of Prabha*et al*. (2011) and Shrirame *et al*. (2000) revealed that production of tillers inriceincreases as number seedlings per hill decreases from 4 to 1. Contrary to the above findings, Islam. (2008) reported that transplanting 4 seedlings produced more tillers than 3, 2 and 1 seedlings per hill. The variation might be due to varietal difference and possibly soil fertility level in which competition for growth factors in lower number of seedlings per hill could not exceed hills with more seedlings, because of the same number of tillers produce per plant in the treatment involved. The positive performance of rice in terms of tiller production in might be due to higher rainfall recorded in 2014 than 2013 planting season (Table 4).

Table 2: Effect of transplanting age and number of seedlings per hill on plant height and number of tillers per plant of rice (*Oryzasativa L*.) grown at Bauchi, Nigeria

	Height			Tillers		
Treatments	**4**	**6**	**8**	**4**	**6**	**8**
Age of Seedlings (AS)						
2	38.62[a]	56.53[a]	72.85[b]	5.00[a]	6.17[a]	8.54[a]
3	33.63[b]	51.31[b]	107.46[a]	3.58[b]	5.38[b]	7.21[b]
4	26.50[c]	45.88[c]	72.44[b]	2.42[c]	4.25[c]	5.96[c]
5	26.57[c]	44.92[d]	69.83[a]	1.38[d]	3.54[d]	5.04[d]
SE(±)	0.95	0.62	18.85	0.16	0.12	0.21
No. of Seedlings/hill (SH)						
1	32.13[a]	52.03[a]	76.06[b]	3.29[a]	4.88[a]	6.83[a]
2	31.54[ab]	49.23[b]	74.67[b]	3.33[b]	5.13[b]	7.17[ab]
3	31.61[a]	48.84[bc]	70.50[b]	3.04[ab]	4.83[ab]	6.58[ab]
4	30.42[a]	48.55[c]	101.35[a]	2.71[b]	4.50[c]	6.17[b]
SE(±)	0.95	1.21	18.85	0.16	0.12	0.21
Year (Y)						
2009	30.65[b]	48.90[b]	87.58[a]	2.73[a]	4.69[a]	6.65[a]
2010	32.01[a]	50.42[a]	73.71[a]	3.46[a]	4.98[a]	6.72[a]
SE(±)	0.43	0.86	9.43	0.12	0.84	0.15

March 2016 IJESR Volume 4, Issue 3 ISSN: 2347-6532

Means within a column of a set of treatments followed by unlike letter(s) are significantly different using DMRT at 5% level of significance. WAT = Weeks after transplanting; SE (±)-Standard error; NS-Not significant; * Significant at 5% probability level.

Number of Leaves

The results in table 3 showed that transplanting agesignificantly (P=0.05) affectednumber of leaves, number of seedlings per hill and year at all the sampling dates except at 8WAT. Transplanting 2 weeks old seedlings produced higher number of leaves which might be due to the production of secondary and tertiary tillers by low age seedlings.This finding corroborated with the report of Faruk*et al.* (2008), Sansee*et al.* (2011) who reported that higher number of leaves produced by young age seedlings could be mainly due to higher tiller number. Five weeks old seedlings, on the other hand, produced the leastnumber of leaves among othertreatments; this may be due to extended stay of seedlings in the nursery which delay new leaf emergence after transplanting (Pasuquin*et al.,* 2008).

Transplanting 1 seedling produced higher number of leaves as against 2, 3 and 4 seedlings per hill,while 4 seedlings gave the least.During the two year research,higher number of leaves was produced in 2014 compared to 2013 planting season. The result indicated that the fewer the number of seedlings per hill, the more the number of leaves. This might also be due to number of tillers produced when fewer stands are transplanted as opposed to more stands which conforms with the findings of Anitha (2005) who reportedthat transplanting single seedlings encourage the proliferation of micro-organisms that symbiotically enhanced plants capability to produce more tillers with vigorous and healthy root growth and hence more of leaves. Velmesh, (2007) also reported that higher number of leaves produced by lesser number of seedlings may arise as a result of less competition for space and nutrients which enhances physiological activities of the plant.

The positive performance observed on number of leaves in 2014 at 4 and 6 WAT might also be due to rainfall, temperature and humidity recorded at the growth stages as it was observed in the present study (Table 4). The similarities in number of leaves at 8 WAT might be due to full expression of genetic influence on number of leaves and hence masking the effect of environmental condition over the years.

LeafArea Index (LAI)

The results in table 3 showed that transplanting age and number of seedlings per hill significantly (P=0.05) influenced LAI. Two weeks old seedlings significantly (P=0.05) had higher LAI than the other treatments considered. This is because the crophad better root growth which facilitated increased cell division and enlargement due to increased photosynthetic rate and subsequently producing higher leaf area index.The significant (P=0.05) increase in leaf area indexin younger seedling may be due to increase in tiller number by the younger transplanted seedlings (Mohammad *et al*., 2006).

Considering number of seedlings, transplanting 1 seedling produced higher LAI than 2, 3 and 4 while the least LAI was observed with 4 seedlings per hill. Thismay beas a result of more tillers and leaf number recordedas the rate of seedlings decrease.It could also be due to the capability of single seedling to accumulate more photosynthates as decrease in seedling rate enhance less competition (Mirza *et al.*, 2009).

Table 3: Effect of transplanting age and number of seedlings per hill on number of leaves per plant and leaf area index (LAI) of rice (*Oryzasativa L.*) grown at Bauchi, Nigeria.

	Leaves			LAI		
	WAT			WAT		
Treatments	**4**	**6**	**8**	**4**	**6**	**8**
Age of Seedlings(AS) (weeks)						
2	13.42[a]	18.96[a]	28.25	10.49[a]	26.85[a]	46.77[a]
3	10.63[b]	16.13[b]	24.71	6.71[b]	20.85[b]	36.53[b]
4	6.96[c]	12.25[b]	20.83	3.54[c]	14.13[c]	27.11[c]
5	5.29[d]	10.33[d]	17.00	1.93[d]	8.42[d]	17.88[d]
SE(±)	0.19	0.17	0.41	0.11	0.25	0.62
No. of Seedlings/hill (SH)						
1	9.26[a]	15.54[a]	24.71[a]	6.88[a]	19.91[a]	36.86[a]
2	9.38[ab]	14.75[b]	23.00[ab]	5.94[b]	18.11[b]	32.82[b]
3	8.79[c]	14.17[c]	22.13[b]	5.32[c]	17.05[c]	30.58[c]
4	8.17[d]	13.21[d]	20.96[c]	4.53[d]	15.19[d]	28.03[d]
SE(±)	0.19	0.17	0.41	0.11	0.25	0.62
Year(Y)						
2009	8.50[b]	13.85[b]	22.92[a]	5.34[b]	17.08[b]	32.41[a]
2010	9.60[a]	14.98[a]	22.48[a]	6.00[a]	18.05[a]	31.75[a]
SE(±)	0.13	0.12	0.29	0.08	0.18	0.44

Means within a column of a set of treatments followed by unlike letter(s) are significantly different using DMRT at 5% level of significance. WAT = Weeks after transplanting; SE (±)-Standard error; NS-Not significant; * Significant at 5% probability level.

The two year investigation, significantly (P=0.05) influenced leaf area index, where LAI washigher in 2014 in all the sampling dates except at 8WAT than in 2013.The higher LAI produced in 2014 might be due to the higher rainfall recorded (Table 4). Gosh and Singh (1998) reported that optimum leaf growth and tiller production is controlled by the amount of water applied to the crop.

TABLE 4 Metrological Data in 2013 and 2014

	2013			2014		
	Temp. (^{0}c)	RH (%)	Total Rain Fall (mm)	Temp. (^{0}c)	RH (%)	Total Rain Fall (mm)
January	29.00	28.60	0.00	28.90	29.00	0.00
February	33.00	23.40	0.00	31.20	28.50	0.00
March	36.20	26.30	0.00	25.90	28.00	0.00
April	37.04	33.40	18.02	30.10	49.00	94.10
May	34.02	48.60	24.04	27.40	53.00	265.50
June	32.02	71.20	138.08	2.90	79.00	354.10
July	28.09	74.80	142.02	28.20	80.50	218.00
August	29.00	84.20	334.08	29.50	84.00	344.00
September	31.00	74.40	142.02	32.00	76.50	295.00
October	32.00	62.08	82.04	31.00	63.50	123.70
November	34.00	38.03	0.00	34.00	36.50	0.00
December	33.00	33.01	0.00	33.00	34.00	0.00
Total	388.32	598.08	980.56	36430	639.5	1693.80
MEAN	32.36	49.84	140.04	30.35	53.29	241.97

Crop Growth Rate (CGR) (gm^{-2} day^{-1})

The results in table 5 indicates that age of seedling significantly (P=0.05) influenced CGR where transplanting 2weeks old seedlings performed better in growth rate than the other treatments. However, the least CGR was observed with 5week old seedlings. Number of seedlings per hill and year on the other hand, showed no significant effect on crop growth.

Higher crop growth rate observed in 2 weeks old seedlings might be due to the higher leaf area index and number of leaves recorded. Prema (2007) reported a similar trend and reported that younger transplanted seedlings had higher root growth which facilitated increased cell division and enlargement due to increase photosynthetic rate with subsequent increase in crop growth rate. Higher CGR produced by younger seedlings indicated that root activity during the entire growth period enhanced higher content of soluble sugars, non-proteinnitrogen and proline in leaves, higher translocation and conversion of stored matter from vegetative organs in plants under system of rice intensification (SRI) (San-oh *et al.* 2008). The CGR obtainedin the present study, may be due to dependent ability of canopy to intercept photosynthetically active radiation which is a function of leaf area index and crop canopy architecture as observed in an earlier investigation by Vijiyakumar*et al.* (2006).

NetAssimilationRate (NAR) (g/m^{-2} day^{-1})

The results of the studyalso in table 5 revealed that, seedling age significantly (P=0.05) had effect on NAR where 5 weeks old seedlings produced higher NAR. Considering number of seedlings per hill however, no significant effect was observed at 4WAT. Higher NAR was observed for 1, 2, and 4 seedlings per hill than 3seedlings per hill. Similarly, for the two years no significant difference was observed on NAR except at 4WAT. Higher NAR was observed in 2014 than 2013.

The significantly higher NAR exhibited by 5 weeks old seedlings may possibly be due to ability of the rice variety to have stronger and more active root systems at middle growth stage coupled with the higher number of seedlings leading to higher vegetative growth resulting in high dry matter and CGR. In addition, the younger age seedlings at early stage of growth might have not attained the level of physiological activities that could produce higher NAR and hence have the potential of producing similar NAR in later phase of growth. More work is however needed in this to fully establish rate of rice plant photosynthetic surface and the rate of plant growth.

Table 5: Effect of transplanting age and number of seedlings per hill on crop growth rate (CGR) (g/Gm2day) and Net Assimilation Rate (NAR) ($g/cm^2/day$) of rice (*Oryzasativa* L.) at Bauchi, Nigeria

Treatments	CGR WAT 4	CGR WAT 6	CGR WAT 8	NAR WAT 4	NAR WAT 6	NAR WAT 8
Age of Seedlings (AS)						
2	0.46[a]	3.21[a]	1.81[a]	0.043[b]	0.12[b]	0.039[ab]
3	0.28[b]	2.42[b]	0.99[a]	0.043[b]	0.12[b]	0.088[a]
4	0.19[bc]	1.84[bc]	0.60[ab]	0.055[ab]	0.13[b]	0.022[b]
5	0.10[c]	1.31[c]	0.30[b]	0.049[a]	0.16[a]	0.018[b]
SE(±)	0.53	0.27	0.23	0.003	0.007	0.022
No. of Seedlings/hill (SH)						
1	0.30[a]	2.55[a]	1.19[a]	0.049[a]	0.13[a]	0.030[a]
2	0.26[a]	2.21[a]	0.45[a]	0.049[a]	0.13[a]	0.027[a]
3	0.25[ab]	2.11[a]	0.88[a]	0.046[a]	0.13[a]	0.060[a]
4	0.22[a]	1.91[a]	0.70[a]	0.046[a]	0.13[a]	0.050[a]
SE(±)	0.17	0.12	0.90	0.043	0.13	0.059
Year (Y)						
2009	0.22[b]	2.15[a]	1.02[a]	0.043[b]	0.13[a]	0.059[a]
2010	0.30[a]	2.25[a]	0.83[a]	0.052[a]	0.13[a]	0.025[b]
SE(±)	0.04	0.19	0.16	0.002	0.005	0.015

Means within a column of a set of treatments followed by unlike letter(s) are significantly different using DMRT at 5% level of significance. WAT = Weeks after transplanting; SE (±)-Standard error; NS-Not significant; * Significant at 5% probability level.

Number of Panicles /m^2

Effect of transplanting age and number of seedlings per hill on panicle number per square meter(Table 6) revealed significant (P=0.05) difference on transplanting age, where 2 weeks old seedlings had the highest number of panicles than 3, 4 and 5 weekswhile the leastwas produced by 5 weeks old seedlings. Transplanting one seedling per hillwas also observed to producemore panicles than the other treatments considered with4 seedlingshaving the least. A significantly (P=0.05) difference was also observed at the different years under study, where the crop performed better in 2014 than in 2013.

The performance of two weeks age seedlings on higher panicle production might be due to less root damage and minimal transplanting shock as younger seedlings easily establish themselves after being transplanted into the field. This is in conformity with thefindings of Ashrat*et al.* (1999) and Argones& Wada(1989), in the SamewayKhusrul and Aminul (2009) reported more panicles produced by younger seedlings might be due to limitation of older seedlings producing limited panicles.

With regard to number of seedlings per hill, fewer seedlings transplanted produced higher number of panicles indicating that low seedlings have low competition for growth factors and hence seedlings vigor is enhanced (Neem*et al.*, 2011). In addition, number of panicles produced by fewer seedlings per hill could be due to higher number of tillers recorded during the growth stages which corresponded to the number of panicles indicated that higherbelow and above ground competition of older seedlings for growth factors enables the crop have normal physiological activities as reported by Velmesh (2007). Furthermore, the higher number of panicles with single seedlings might be due to the production of tillers and accumulation of photosynthates as recorded in the findings of Mirza *et al*., (2009).

Panicle Length (cm)

Effect of transplantingage and number of seedlings per hill on panicle length revealed significant (P=0.05) difference on transplanting age (Table 6).Where 2 weeks old seedlings had longer paniclescompared to the other treatments, while 5 weeks old seedlings shorter panicles. Considering the number of seedlings, transplanting 1 seedling produced longer panicles than2, 3 and 4 seedlings per hill.Thoughtransplanting 2 and 3 seedlings wereat per with each other buthigher than 4 seedlings per hill. A significant difference was also observed between the two years of investigation, where2014 rainy season produced longer panicles.

Transplanting age which showed significant (P=0.05) difference on panicle length, with2 weeks old seedlings showing superiority over the rest of the treatments indicated that less trauma of younger seedlings in SRI plant ensured to express full potentials of more panicle and better development of panicle with much fertile spikelets as reported by Uphoff (2002) and Tsai & Lai (1987). Furthermore, transplanting of younger seedlings has been known to increase panicle length by 28.2% compared to other conventional practices of transplanting age of seedlings (Prabha*et al*., 2011). This finding lend support to that ofKhusrul andAminul (2009) who reported that older transplanting seedlings have the tendency of producing shorter panicles than younger seedlings.

Panicle Weight (g)

Statistical analysis carried out on panicle weight revealed significant (P=0.05) difference among the different seedling ages (Table 6) in which 2 weeks old seedlings had heavier panicles than the other treatments. On the other hand, 5 weeks old seedlings were the least on panicleweight. Number of seedlings per hill also exhibited significant (P=0.05) difference, where 1 and 2 seedlings per hillwere observed to produce heavier panicles than the other treatments considered, though the results were statistically the same. The years under investigation were observed to be significantly different in terms of panicle weight where rice grown in 2014was heavier than those of 2013 rainy season.

The heavier panicles observedwith 2 weeks transplanted seedlings may be attributed to higher panicle length and spikelet number recorded. Salem (2011) observed a significant correlation betweenpanicle weight and its spikelet number.

Based on number of seedlings per hill, heavier panicles observed from the application of 1 and 2 seedlings per hill might probably be due to proper utilization of all terrestrial growth resources which may be better on translocation of photosynthates from source to sink which could result in panicle weight under lower number of seedlings per hill. Mishra and Salokhe (2005) reported that higher panicle weight might be due to the healthy and vigorous start of the crop during the growing season as there willbe less seedling competition with sufficient nutrients.

The significant (P=0.05) influence of 2014 over 2013 rainy seasons could be due tothe optimum environmental conditionssuited for the crops performance. Oteng., (2012) and Diouf*et al.,*(2000) found out that high rainfall with optimum temperaturesfavor yield related characters such as panicle weight, panicle length and spikelet number.

Number of Spikeletsper panicle

Effect of transplanting age and number of seedlings per hill on spikelet number revealed also a significant (P=0.05) influence on transplanting age (Table 6). Twoweeks old seedlingshad the highestspikelet numberthan 3 and 4 weeks, while 5 weeks old seedlings gave the lowest spikelet number. With regard to number of seedlings per hill, transplanting 1 seedling per hill had more spikelets than other treatmentsconsidered, while 4 seedlings gave the least.

Production of more spike letsby younger aged seedlings may again be due to lesstrauma experienced during transplantingwhich ensures full potential for more spikelets (Uphoff 2002). In corroboration with the present observations, Mishra and Salokhe (2005) reported that higher number of spikelet by younger aged seedlings might be due to production of higher yield attributes with consistently reduced spikelets number by older seedlings is associated with lower yield attributes.

Higher number of spikelets produced by single transplanted seedling indicates it's both aerial and underground efficiency in the utilization of solar radiation, water and nutrients (Miah *et al*., 2004). The trend in the production of spikelet also explains its production potential to produce morespikelets which is as a result of higher growth rate which eventually leads to healthy seedlings. Mirza*.,* (2009) reported that higher number of spikelets produced by lower rateseedlings might be due to accumulation of more photosynthates as the number of transplant seedlings decrease due to less competition for assimilates.

Percentage Filled Grains

Percentagefilled grains was observed to be significantly (P=0.05) influenced by age of seedlings and number of seedlings per hill (Table 6). Two weeks old seedlings had more filled grains while 5 weeks old seedlings had the least. One seedling per hill had higher percentage filled grains than 2, 3and 4 seedlings while 4 seedlings had the least. The two years investigation significantly (P=0.05) influenced percentagefilled grainswhere 2014rainy season recorded higher percentage filled grains than 2013 season.

The higher percentage filled grains observed could be due to increase in shoot dry matter accumulation as a result of early transplanting as reported by Pasuquin*et al*., (2008). The more filled grains noted with younger seedlings in the present investigation as against older seedling may also be due to production of tillers at slow rate by older seedlings and hence leading to late production of panicles which did not mature along with the earlier formed panicles thereby becoming unproductive (Vergara,1979).

Straw Yield (kg/ha)

Effect of transplanting age and number of seedlings per hill on straw weight is presented in table 6. Age of transplanted seedlings was significantly (P=0.05) influenced straw weight while number of seedlings per hill did not significantly (P=0.05) affect straw yield. 2 weeks old seedlings recorded the highest straw yield while the lowest was observed with 4 weeks old seedlings. Except with 4 seedlings per hill where it was the least on straw yield, higher straw yield through at per with each other was realized with1, 2 and3 seedlings per hill. . The two years under study revealed significant (P=0.05) influence on straw yield. Higher straw yield was produced in 2014 planting season than in2013.

The significantly (P=0.05) higher straw yield produced by younger seedlings as was observed in the present investigation may be due to higher number of tillers produced by the younger seedlings and physiological limitation of older transplanted seedlings producing limited tillers (Khusrul andAminul, 2009). Singh *et al*. (2005) also reported that younger seedlings at transplanting showed less transplanting shock and mortality rate which gave an improved start off, leading to heavier biomass. Transplanting seedlings at younger stage provides sufficient nutrients for vegetative growth and also reproductive phase which ultimately might have led to increased grain and straw yield (Krishnna, 2000).

1000Grain Weight (g)

The results of the investigation showed in table 6 revealed a significant (P=0.05) influence on age of seedlings and number of seedlings.Two weeks old seedlings had heavier weight than the rest of the treatments .However, 5 weeks old seedlings gave the least 1000grain weight.Based on number of seedlings per hill, 1 seedling produced heavier grains whilelighter grains were observed with 4 seedlings per hill. Years of the research did not significantly (P=0.05) affected 1000 weight.

Statistical analysis carried out revealed that age of transplanted seedlings significantly (P=0.05) influenced 1000 grain weight, where younger seedlings were observed to be heavier than the older ones. This might be due to ability of the younger seedlings to recover from transplanted stress easily and faster, hence quicker transportation of assimilates to the panicles which enhance more grain weight than the older seedlings (Ashraf *et al*., 1999).

With regard to number of seedlings per hill, there was also a significant (P=0.05) difference on grain weight where grain weight decreases with increase in number of seedlings per hill. This might be due to less competition with transplanted seedling which enhances more nutrient translocation, invariably leading to higher grain weight as corroborated by Mirza *et al,* (2009).

Grain Yield (kg/ha)

The results in table 6 showed that grain yieldsignificantly (P=0.05) affected transplanting age and number of seedlings per hill. Two weeks old seedlingshad the highest grain yield among the treatments considered, whilefive weeks oldseedlings gavethe least.Younger aged seedlings also revealed higher grain yield than older seedlings. This may be due to the significant increase in all yield attributes associated with age of seedlings.

Number of seedling per hill also indicated that transplanting 1 seedling produced higher grain yield while the least yield was obtained with 4 seedlings per hill.This could be explained by the fact that single seedling transplant tend to consume more nutrients than 2, 3 and 4 seedlings. It might also have taken the advantage of low vegetative biomass in the initial growth stage which conforms with the findingsof Mirza*et al*.(2009) and Mohammad *et al*.(2006) that higher grain yield produced by single seedlings as against 2, 3 and 4 seedlings per hill might be due to greater competition and the lower production of yield components from the high number of transplanted seedlings per hill. In contrast to the result, Rahman*et al*. (2006) reported that 3 seedlings per hill produced more grain yield when compared to 1, 2 and 4 seedlings per hill. More work is however, needed in this area to substantially establish the causefor yield differential from 1 to 3 seedlings per hill.

The two year investigation also showed significant (P=0.05) influence on grain yield. The result which revealed higher grain yield production in 2014 might be due the higher rainfall recorded compared to 2013 rainy season (Table 6).

Table 6: Effects of transplanting age and number of seedlings on yield and yield components of rice *(Oryzasativa L.)* at Bauchi, Nigeria

Treatment(s)	Panicle no./m^{2}	Panicle length(cm)	Panicle wt. (g)	Spikelet no./panicle	Ripeninggra in (%)	Straw Yield (kg/ha)	1000grain weight(g)	Grain Yield (kg/ha)
Age of Seedlings(AS)								
2	452.54^{a}	21.94^{a}	3.32^{a}	328.52^{a}	95.35^{a}	2200.67^{a}	28.48^{a}	5360.00^{a}
3	391.08^{b}	20.71^{a}	2.82^{b}	344.38^{b}	89.46^{b}	2006.00^{b}	27.85^{b}	4268.33^{b}
4	342.54^{c}	18.25^{b}	2.74^{cb}	268.04^{c}	86.09^{c}	197667^{b}	27.46^{c}	3713.33^{c}
5	269.04^{d}	15.12^{b}	2.42^{c}	205.48^{d}	78.33^{d}	1711.33^{c}	26.94^{d}	2933.33^{d}
SE(±)	9.82	0.43	0.07	6.29	0.59	68.50	0.08	68.78
No. of Seedlings/hill(SH)								
1	291.75^{a}	19.89^{a}	3.05^{a}	350.68^{a}	90.55^{a}	2064.00^{a}	27.95^{a}	4540.00^{a}
2	374.67^{ab}	18.89^{ab}	2.93^{a}	316.02^{b}	88.72^{b}	1978.67^{a}	27.82^{ab}	4148.33^{b}
3	363.46^{ab}	18.80^{ab}	2.68^{b}	301.83^{c}	87.07^{b}	1992.00^{a}	27.65^{b}	3613.33^{c}
4	352.33^{b}	18.43^{b}	2.65^{b}	277.88^{d}	82.89^{c}	1860.00^{b}	27.32^{c}	3613.33^{c}
SE(±)	9.82	0.43	0.07	6.29	0.59	66.56	0.08	65.42
Years (Y)								
2009	361.92^{b}	18.68^{b}	2.75^{b}	313.85^{a}	86.39^{b}	1927.67^{a}	27.72^{a}	3473.33^{b}
2010	379.19^{a}	19.32^{a}	2.91^{a}	309.35^{a}	88.23^{a}	2019.67^{b}	27.64^{a}	4664.17^{a}
SE(±)	6.94	0.31	0.05	4.45	0.42	48.43	0.58	48.64
Interaction								
AS x SH	*	NS	NS	*	**	NS	NSNS	
AS x Y	NS	**	NS	NS	NS	NS	NS**	
SH x Y	NS	NS	NS	NS	NS	NS	NSNS	
AS x SH x Y	NS	NS	NS	NS	NS	NS	NSNS	

Means within a column of a set of treatments followed by unlike letter(s) are significantly different using DMRT at 5% level of significance. WAT = Weeks after transplanting; SE (±)-Standard error; NS-Not significant; * Significant at 5% probability level.

Conclusion

From the results obtained, it became clear that the recommendations of SRI where 12 day old rice seedlings are transplanted under irrigation can also be applied under rain fed. However, higher yield could be obtained best when higher rain fall is achieved within the season. Similar to SRI recommendations, transplanting a seedling per hill was confirmed to perform in yield than higher number of seedlings.

Recommendation

From the investigation carried out, it can be recommended that farmers shouldbe advised to first raise their seedlings in the nursery and then transplant in the field, two weeks later. Moreover, during transplanting, farmers should apply only one seedling per hill for optimum yield.

REFERENCE

Abdulaziz, K., Masaaki, S., Mohammed, Z., Mohammed, S. B., Khalid, N., and Inayatullah, A. (2005). Effect of Seedling age and water depth on morphological and Physiological aspect of transplanted rice under high temperature.*Journal of Zhejiaringuniversity Science* ***6(***5) 389-395

Abha, M., and Salokhe, V. M. (2008).Seedling characteristics and the early growth of transplanted rice under different waterregimes.Cambridge University press volume (44) 19 PP

Anitha, S. (2005). System of Rice intensification. Kissan World., Pp.41.

Aragones, D.V., Wada, G. (1989). Effect of seedling and plant density on growth and yield of rice varieties.*Philippians Journal of crops Science* **14**(1):47.

Arnon, I. (1972) crop production in dry Region first Edition.Published by Cox and Wyman 188 PP

Ashraf, A., Khalid, A. and Ali, K. (1999). Effect of seedling age and density on growth and yield of rice in saline soil *Pakistan Journal of Biological Science***2**(30): 860-862.

Banik, P., Sarkar, B., Samal, T. Ghosal, P. K.andBagohi D. K. (1997). Effect of different number and age of seedlings on rice.*Indian Journal of Agronomy***42**(2): 265-270.

Bayou, F.(2009).Rice value chain Development plan, Kaduna Rice Industry supply chain Development Programme, submitted to MSME Nigeria.

Diuof M., Nonguierma A., Abou A., Royer A.,and Some, B. (2000). Fight against drought in Sahel Achievements and perspective Agrhmet Regional centre. Drought 4:257-2666.

Ezedinma, C. (2008). Impact of trade on Domestic Rice Production and the challenges of self-sufficient in Nigeria. International Institute for Tropical Agriculture (IITA).

FAO (2010). Food and Agricultural Organization Sustainable Rice-base production and people's livelihood.International Rice Commission, FAORome Italy**In**: International Rice Commission news letter (special edition) Vol.52.

Faruk, M. O., Rahman, M. A. and Hasan M.A.(2009).Effect of seedling age and number of seedling per hill on the yield and yield contributing character of rice.*International journal of sustainable crop production***4**(1): 58-61.

Gosh D.C., Singh, B. P.(1998).Crop growth modeling for wetland rice management environment and ecology **16**(2):446-449.

Islam, M. S., Akhter, M. M., Rahman, M. S. Banu, M. B.andKhalequzszaman, K. M. (2008).Effect of Nitrogen and number of seedlings per hill on the yield and yield components of Tman Rice (BRRI Shan 33).*International Journal for sustainable of crop production***3**(3): 61-65.

Kewat, M. L.,Agrawal, S. B., Agrawal, K. K., and Sharma, R.S. (2002). Effect of divergent plant spacings and age of seedlings on yield and economics of hybrid rice (oryza sativa).Indian Journal of Agronomy 47: 367-371

Khusrul, A.andAminul, H. (2009). Seedling age influence rice (OryzaSativa L.) Performance, *Philipine Journal of Science***138**(2): 219-226.

Kim S. S.Kim B. K., Choi, M.G. Back, N. H. and Choi-Wy,L. S. (1999). Effect of seedling age on growth and yield on transplanted rice in Southern plain region.*Korean Journal of crop science***44**(2):122-128.

Krishna,A.(2000).Effect of ageof seedlings on performance of rice(*Oryza Sativa L.)*Under late planted condition.*Journal Research*. ANGRAU **28**:73-74.

Latif, M. A., Islam, M. R., Ali, M. YandSaleque, M. A. (2005). Validation of the system of rice intensification (SRI) in Bangladesh.Bangladesh Rice Research Institute (BRRI) Field crop research **93**:281-292. www.elseviercom/locafe/fcr.

Miah, M. N. H., Talukder, S., Sarker, M. A. R. and Ansari, T.H. (2004).Effect of number of seedlings per hill and urea supergranules on growth and yield of rice.*Journal of Biological Science***4** (2): 122-129.

Mirza, H., Rahman, M. L., Roy, T. S., Ahmed, J. U. and Zobaer, A. S. M, (2009).Plant characters, yield components and yield of late transplanting Aman rice as affected by plant spacing and number of seedling per hill. Advances in Biological Research.**3** (5-6):201-207.

Mishra, A. and Salokye, V. M (2008). Seedling characteristics and the early growth of transplanted rice under different water regimes. *Experimental Agriculture* 44, 1-19

Mohammad, S. B., Inayaf U. A. and Gul H. (2006).Growth and yield of rice as affected by transplanting dates and seedlings per hill under high temperature of Ismail Khan. *Pakistan Journalof Zhjiang University of Science* **7**(7):572-579.

Molla, M. A. H. (2001).Influence of seedling age and number of seedlings on yield attributes and yield of hybrid rice in the Wet season. IRRN, **26** (2): 73-74.

Neem S., Muhammad M., Syed A., and Muhammad A. (2011) Impact of nursery seedling Density, Nitrogen and seedling. Age on yield attributes of fine rice Children Journal of Agricultural Research. 71(3).

Obulamma, U. and Reddeppa, R. (2004).Effect of Spacing and seedling number on growth and yield of hybrid rice. *Journal Research ANGRAU*. **30** (1):76-78.

Oteng-Darko, P., Kyei-Baffour N. and Ofori, E.(2012). Yield of rice as affected by transplanting dates and plant spacing under climate change simulations. Wudpeker Journal of Agricultural Research **12**(12):55-69pp

Pasuquin, E., Lafarge, TandTubuna, B. (2007). Transplanting young seedlings in irrigated rice field early and high tiller production enhance grain yield. Field crop research 105, 141-155

Prabha, S. C.A., Thiyagarajan, T. M., Senthivelu, M. (2011).System of rice intensification principles on growth parameters, yields attributes and yield of rice (*Oryza Sativa L.*). *Journal of Agronomy* 10(1): 27-33.

Prema,S.(2007). Studies on crop establishment techniques and nitrogen levels on transplanted (oryza sativa L) M.Sc (Ag) thesis submitted to and approved by Tamid Nadu Agriculture University, Coimbatore,T. Tamil Nad.

Rahman,S.,Sharma. M. P. and Sahai, S. (2006).Nutritional and medicinal value of some indigenous rice varieties.*Indian journal of Traditional Knowledge* **6**:454-458.

Roy,B. C., and Sattar, S. A. (1992).Tilleringdynamic of transplanted rice as influence by seedling's age. *Tropical Agricultural journal***69**(4):351-356.

SalemA.K.M., Elkhoby, W. M., Abou-Khalifa, A. B. and Ceesa, Y. (2011).Effect of Nitrogen fertilizer and seedling's age on inbred and Hybrid Rice varieties. *American-AsianJournal of Agricultural and Environmental Sciences* **11**(5):640-646.

San-oh.Y. K.M., Ookawa, Tand Hirasawa,T. (2008)Ecophysiological Analysis on effect of planting pattern on Biomass production and Grain yield in rice. Japan Agricultural Research (JARQ), http://www.Jircas.affrc.go.jp, 42,(2), 79-89.

SanseeG. A. wanie, G and Ranamukhaarachchi, S. L. (2011).Study of age of seedlings at transplanting on growth dynamics and yield of rice under alternating flooding and suspension of water management.Recent research in Science and Technology. Asian Institute of Technology, Thailand **3** (3) 76-88.

Shrirame, M. D., Rajgire H. J.andRajgire, A. H (2000). Effect of spacing and seedling's Number per hill on growth attributes and yield of rice hybrid under lowland condition *journal of soils crops***10**:109-113.

Singh, K, K., Yadav, S. K., Tomar, B. S., Singh, J.N. and Singh P.K. (2005) Effect of seedlings age on seed yield and seed quality attributes in rice CV. Pusa Basmati – 1 Seed research 32:5-8.

Singh, B. N., Fagade,s., Ukwungwu, M. N., William, C., Jagtap, S. S., Oladimeji, O., Effisue, A. and Okhidievbie, O. (1997). Rice growingenvironment and biophysical constraints in different agro-ecological Zones of Nigeria. *Meteorological Journal***2**(1): 35-44.

Tsai, Y. Z. and Lai, K. L. (1987).Effect of seedling age on the growth and development of rice in different cropping seasons.*Journal of Agricultural Science association china***11**:138-198.

Uphoff, N. (2002). System of Rice intensification for enhancing the productivity of land labour, and water.*Journal of Agriculture resource manage***1**:43-49.

Velmesh, K. Y. (2007). Studies on the effect of dates of planting, plant Geometry and number of seedlings per hill in Hybrid rice (*Oryza sativa L*.)Unpublished Ph.D theses Chandra Shekhar Azad University of Agriculture and Technology KanPur (U.P)

Vergara, B. S. (1979). Farmer's primer on growing rice. International Rice Research Institute (IRR), Los BanosPhillipines.

Vijayakumar,M. S. R., Probhakaran, N. K., Subbian, P. and Chandrasekaran, B. (2006). Influence of rice intensification (SRI) practices on growth characters, Days to flowering, growth analysis and labour productivity of rice. *Journal of plant Sciences***5**:984-989.

Yamamoto, Y., Ikejiri, A. and Nitta, Y. (1998). Characteristics of taking root of rice nursery seedling in relation to the changes of some inorganic and organic constituents after transplanting. *Japanese Journal of Crop Science*67, (20-25)

Zhong, X., Peny, S., Sheehy, J. E.,Visperas, R. M. L. and Liu, H. (2002).Relationship betweentillering and leaf area index.Quantifying critical leaf area index for tillering in rice.*Journal of Agricultural Science.***138** (3):269-279.