Original Research Article

RESPONSE OF LOWLAND RICE AS AFFECTED BY SEEDLING AGE AND TIME OF WEED CONTROL IN SUDAN SAVANA OF NIGERIA

ABSTRACT

An experiment was conducted at the Research and Training Farm of Federal College of Horticulture Gombe State (10020'N and 10030'E) during the 2021 rainy season in the Sudan Savanah agro-ecological zone of Nigeria. The aim of the research is to evaluate the effect of seedling age and time of application of post-emergence herbicide on the growth and yield of lowland rice (Faro 44). The experiment consisted of two factors, namely:- seedling age (3, 4, and 5-week-old seedlings) and time of weed control by post-emergence herbicide at 2, 3, and 4 weeks after transplanting. Farmer's practice hoes weeding, 7 weeks after transplanting as check and controls i.e. no weeding). These treatments were factorial combined (3 x 5) to give 15 treatment combinations of treatment and replicated thrice. The seedling was allocated to the main plot while weed control was to the sub-plot. Data gathered on weed, growth, yield, and yield attributes were subjected to analysis of variance, and mean differences were separated using Student Newman keuls (SNK) at $p< 0.05$. The result revealed significant differences due to seedling age and time of weeding in most characters measured. Generally, the 3-week-old seedling (3WOS) performed better but at par with 4WOS, while earlier application of herbicides at 2 weeks after transplanting (WAT) gave excellent weed control. The highest yield of paddy rice 8849.4 and 9517.2 kg/ha, was obtained from 2WOS and herbicide application at 2WAT. It can be concluded that 3-4WOS seedlings of Faro 44 variety of rice and early application of herbicide at 2wat can be suggested to the rice farmers in the study area.

Keywords: Seedling age, yield, application, time

Introduction

Rice (Oryza saliva L) belongs to the family Poaceae. It is the most important world cereal and a major food crop in the tropics, particularly in Asia and Africa. Rice is the leading stable food crop in Nigeria. It is cultivated and consumed in virtually all the agroecological zones (Ayanwale et al., 2011). The demand for rice in Nigeria has soared over the years. It is consumed across all income groups and consumption is reported to have increased by 5% per year between 1961-2006. Production had, however, not kept pace with consumption. Nigeria consumes more rice than it produces, leading to significant imports over the years. Nigeria's rice consumption is expected to increase to 35million metric tons by 2050. The widening domestic rice deficit is being met by importation. Nigeria is both the largest producer and consumer of rice in the West African sub-region and is currently one of the world's top-ranked importers of rice. Seedling age at transplanting is an important factor for a uniform stand of rice and regulating its growth and yield (Bassi et.al., 1994). Tillering is an important agronomic trait that determines the number of panicles and grain yield per unit and its dynamics greatly depend on the age of the seedling at transplanting (Pasuquin et al., 2008). The occurrence of weeds has become a serious problem and they limit the yield and quality of rice crops. It is often stated that some weeds cause total crop failure and that weeding practices are absolutely essential. Estimations of yield losses

caused by competition from weeds range from 30-100% (Dohermann and Fairhurst, 2000). As weeds and rice emerge simultaneously in rice fields, the proper time and method of weed control remain a complex phenomenon. (Khaliq and Matloob, 2011). In rice, the conventional method of weed control (hand hoe weeding) is very laborious, expensive, and inefficient. Chemical weed control can be considered a better alternative (Singh and Singh, 1993). Post-emergence herbicides are a major tool used to control weeds. Hence, determining the appropriate seedling age of transplanted rice and timing of weed control will help toward boosting the productivity of the crop as not much is not reported on these crucial factors in the study area. Therefore, this research aims to evaluate the effect of seedling age and the critical period of post-emergence herbicide weed control to enhance the productivity of rice crops in the study area.

Material and Method.

An experiment was conducted at the Research and Training Farm of Federal College of Horticulture Gombe State ($10^0$20'N and $10^0$30'E) during the 2021 rainy season in the Sudan Savanah agro-ecological zone of Nigeria. The experiment consisted of two factors namely:- Seedling age (3, 4, and 5 weeks old seedlings) and Time of weed control (post-emergence herbicide at 2, 3, and 4 weeks after transplanting, farmers practice hoe weeding at 7weeks after transplanting as check and control i.e. no weeding). These treatments were factorially combined (3 x 5) to give 15 treatments combination and replicated three times. The seedling was allocated to the main plot while weed control was to the sub-plot. Prior to transplanting seedlings were raised in the nursery at week intervals to obtain different seedling ages using the most popular variety (Faro 44) used by the farmers in the locality which is medium maturing. The land was cleared, harrowed to fine tilth and gross plots were constructed 2m long and spaced 2m wide given a total area of $4m^2$, six inner rows were reserved as the net plot for collection of data. An alley of 50cm was left between plots and 1m between the replication. The seedlings were planted in the plots at 20x20cm inter and intra- row spacing. Fertilizer was applied at the rate of 96:40:40 NPK. 40kg NPK was applied as basal while the remaining N was applied at 2 split doses using urea (46%). Weeding was done as per treatments. The post-emergence herbicide used was Solito which is broad-spectrum with pretilachlor (28.65%) +pyribenzoxim (1.9%) active ingredient at a rate of 2l/ha at 2 and 3 and 4 weeks after transplanting (WAT). No serious incidence of pests and diseases were observed. Harvesting was carried out at the physiological maturity stage when the panicle becomes golden brown color. Data were collected on growth characters taken in 6 and 8 WAT from the randomly tagged plants in the net plot. The number of leaves per plant was obtained by counting and the mean was recorded. Leaf area per plant was determined using a portable Leaf Area Meter (YMJ-A) their means were recorded. LAI was determined using the relation LAI= $\frac{LA}{GA}$ Where LA = Leaf area and GA Ground area covered by plant. Data collected on weed parameters include weed cover scores which were assessed at physiological maturity. Weeds within the quadrant area were scored according to the scale 0 = not weedy, 1 = Fairly covered by weed, 2 = Moderately covered by weed, 3 = highly covered by weedy and 5= Completely covered by weed (Komboik *et al.,* (2003): The weeds within the quadrant in each plot were harvested and then oven-dried at 70°C to a constant weight then weighed and recorded

as weed dry weight. scale. Weed control efficiency (WCE) was determined at harvest using equation

$$WCE = \frac{\text{Weed dry weight Control} - \text{Weed dry weight in weed treatment}}{\text{Dry weight of control}} \; x\; 100$$ (Audu, 2018).

Data on yield and yield attributes were obtained from the following. The number of productive tillers were counted from 10 randomly selected stand at harvest and the average was recorded. The number of spikelets per panicle of rice was counted from 10 randomly selected panicles and the average was recorded. The length of the panicle was determined from 10 randomly selected panicles and the average was recorded for each treatment. The no of grains per rice panicle was counted from 10 randomly selected panicles and the average was recorded for each treatment. One thousand grains were counted using a seed counter and a sensitive weighing scale was used for weighing. Paddy yield per hectare was calculated by harvesting all the panicles in the net plot and then dried, threshed, and winnowed to separate the grains from the chaff. The resulted grains were weighed to get the grain weight of each plot in kg and then extrapolated the grain yield per ha using the expression below.

$$Paddy\ yield\ kg/ha = \frac{\text{weight of paddy in Net plot}}{Area\ of\ Net\ plot} \; x\; 10{,}000$$

The biological yield was calculated using the following relation:-

$$= \frac{\text{Yield of paddy rice+Stalk in Net plot}}{\text{Area of Net plot}(m2)} \; x\; 100$$ (Rana and Kurnar 2018).

Data generated were subjected to analysis of variance using Genstat statistical package and differences between means were separated using Student Newman Keuls (SNK) at P< 0.05. Prior to the experiment soil samples were collected from the experimental fields using a soil auger at depth of (0-30cm) and were analyzed for physico-chemical properties using standard procedure. The meteorological data on climatic variables were obtained from the metrological station of Upper Benue River Basin Development Authority Dadin-Kowa sub-station Gombe state Nigeria.

RESULT AND DISCUSSION

Weed Parameters

The result of weed parameters is presented in table 1. Weed cover scores differed ($p<0.05$) due to seedling age, where 5WOS recorded the highest weed cover but at par with 4WOS while 3WOS had the lowest weed cover but at par with 4WOS. The lower weed cover score of 3WOS could be attributed to the ability of younger seedlings to compete with weeds due to quick establishment and active growth. Shukla et al. (2015) also reported that younger and tender seedlings had the potential to significantly suppress weeds due to enough coverage of leaves

and tiller production than older seedlings. There were no significant differences in weed dry weight and weed control efficiency due to seedling age (Table1). As indicated in Table 1, weed cover scores differed ($p<0.01$) due to the time of weed control where control (no weeding) had significantly higher weed cover while hoe weeding at 5WAT recorded the lowest weed cover, but, at par with herbicide application at 2WAT which in turn is statistically similar with herbicide application at 3and 5WAT. Similarly, control recorded significant ($p<0.01$) higher weed dry weight, while non-significant differences were observed due to other times of weed control. The significant higher weed dry weight and weed cover score observed in the control were probably due to the severe uncontrolled weed growth, which is similar to the result obtained by Atangs, 1997, herbicide, who reported that the weed-treated plots, especially in herbicide-treated plots of maize and rice had significantly lower weed dry matter and weed infestation the weedy check. However, control had significantly lower weed control efficiency while non-significant differences were observed due to other times of weed control management. Control (unweeded) generally recorded the highest weed cover score due to high weed intensity, long periods of infestation, and the inability of the crop to compete with weeds.

Growth Parameters

The number of leaves due to seedling age and time of weeding was not significant (Table2). The number of tillers differed significantly ($p<0.05$) due to seedling age, where 3WOS produced a significantly higher number of tillers while a non-significant difference was observed between 4WOS and 5WOS in the number of tillers. A highly significant difference was observed due to the time of weed management on the number of tillers where control was significantly lower, while non-significant differences were observed on other times of weeding management (Table 2). Leaf area and leaf area index do not differ due to seedling age and time of weeding (Table2). The significant performance of 3WOS on the number of tillers confirmed the findings of Pasuquin et al., 2008 that rice seedlings transplanted at an early stage had a high number of tillers than those transplanted at old age. This is because tillering dynamics of the rice plants greatly depend on the age of the seedling at transplanting. Mobasser et al. (2007) observed that when seedlings stay for a longer period of time in the nursery beds, primary tiller buds on the lower nodes of the main culm become degenerated, leading to reduced tillering ability.

Yield and Yield Parameters

The result of panicle length as indicated in Table 3, there was no significant difference due to seedling age but the time of weeding differed ($p<0.05$) where the control had a significantly shorter panicle, while non-significant differences were observed in other times of weeding. The number of grains per panicle differed by $p<0.01$ and $p<0.05$ due to seedling age and time of weeding respectively, where 3WOS recorded the highest number of grains per panicle, but, at par with 4WOS, while 5WOS had the lowest number, grains per panicle but at par with 4WOS, and control, was significantly lower in the number of grains per panicles while all other timings of weeding are statistically similar in this parameter observed. There was a significant difference in 1000 grains of rice due to the age of the seedlings (Table3). The 3WOS had the highest grain weight (1000) but at par, with 4WOS, while 5WOS was significantly lower in 1000 grain weight. During the time of weed management, trends were observed in the number of grains per panicle. The number of spikes per panicle also differed ($p<0.01$) due to seedling age, where 3WOS had the highest number of spikes per panicle but at par with 5WOS. Control was significantly lower in the number of spikes per panicle. Hoe weeding at 5WAT recorded the highest number of spikes per panicle but at par with herbicides 2 and 3WAT. The significantly higher performance of 3 and 4WOS on these yield characters observed could be due to good establishment with higher tillering ability and accumulation of dry matter. This confirmed the submission of Hussain et al. (2005) and Shah (2001) who reported that the maximum number of panicles was produced by lines transplanted at an early age. 3,

The result of the biological and paddy yields of rice is depicted in Table 4. The result showed that the biological yield was significantly ($p<0.01$) due to seedling age where 5WOS produced significantly lower biological yield, while a non-significant difference was observed between 3 and 4WOS. Time of weeding also differed at $p<0.01$. Herbicide application at 2WAT gave the highest biological yield but was at par with hoe weeding at 5WAT. Rice transplanted at 3 weeks old had the highest yield of paddy rice but at par with 4WOS. Hand hoe weeding at 5WAT recorded the highest paddy rice but at par with herbicide application at 2WAT followed by 3 and 4WOS accordingly. The control had significantly lower paddy rice. The significant differences observed in seedling age indicate that it plays a vital role in the productivity of rice. Seedlings planted at a younger age (3 and 4 weeks) in this research produce a significantly higher yield of rice than those planted at an older age (5 weeks). Many researchers have reported that a better yield of rice can be achieved by transplanting younger seedlings (Himeda, 2004; Nandini and Singh, 2000; Thanunathan and Sivasubramanian, 2002). Early weed control appeared to have a significant effect on the yield and yield attributes of rice. This is because the productivity of rice is believed to be largely dependent on effective and timely weed control. This result is in agreement with Rekha et al. 2002, who stated that early weed control is more important to the achievement of high yields of rice than late weeding. Thapa and Jha, 2002 also reported that weed-free conditions at the early stage of growth were found more important than at later stages for getting higher yields of rice. Grain yields in weeded plots were significantly higher than those of unweeded. This indicates that heavy weed infestation has caused a substantial reduction in the yield of paddy rice.

Conclusion and Recommendation

A significant effect was observed due to seedling age and time of weed control in productivity of rice where seedling of 3-4weeks old and early herbicide weed control at 2weeks after transplanting and manual hoe weeding at 5 weeks after transplanting performed significantly higher than other treatments. Therefore, it can be concluded that 3-4WOS seedlings of Faro 44 variety of rice and early application of herbicide at 2WAT can be suggested to the rice farmers in the study area.

Table 1: Effect of seedling age and weed management on Weed Cover Score, Weed Dry Matter Yield and Weed Control Efficiency of Rice.

Treatment	Weed Cover Score	Weed Dry Weight (g)	Weed Control Efficiency (%)
Seedling Age (S)			
3WOS	2.7b	223.4	61.7
4WOS	2.9ab	223.7	63.2
5WOS	3.0a	238.2	60.5
SE±	0.16	35.90	3.86
p<F	*	NS	NS

Time of Weeding (T)			
2WAT	1.5bc	185.8b	63.7a
3WAT	1.9b	129.1b	72.2a
4WAT	2.1b	260.9b	58.2a
Hoe Weeding at5WAT	1.1c	106.2b	80.2a
Control (No weeding)	4.1a	768.5a	00.00b
S.E+	0.3064	174.9	8.32
p<F	**	*	**
INTERACTION			
S x T	NS	NS	NS

Means followed with the same letter are not significantly different at 5% level of probability using Student Newman Kauls. NS= Not significant, *=Significant, **=Highly Significant, WOS= weeks Old Seedling and WAT= Weeks after Transplanting.

Table 2: Effect of seedling age and weed management on the number of leaves and tillers of rice at 8WOS

Treatment	No. of Leaves	No. of Tillers	Leaf Area	Leaf Area Index
Seedling Age (S)				
3WOS	99.0	16.3a	5.2	1.0
4WOS	93.0	14.2b	4.9	1.1
5WOS	99.4	14.4b	4.9	1.2
SE±	5.96	0.66	4.9	1.19
Pro-level	NS	*	NS	NS
Time of Weeding (T)				
2WAT	118.46	16.9a	5.3	1.3
3WAT	95.39	15.3a	4.8	1.2
4WAT	98.42	14.3a	4.4	1.0
Hoe Weeding at 5WAT	98.84	14.9a	5.2	1.1
Control (No weeding)	74.04	9.5b	4.3	0.9
SE±	13.34	0.99	0.39	0.20
p<F	NS	**	NS	NS
Interaction (S X T)	NS	NS	NS	NS

Means followed with the same letter are not significantly different at 5% level of probability using Student Newman Kauls. NS= Not significant, *=Significant, **=Highly Significant, WOS= weeks Old Seedling and WAT= Weeks after Transplanting.

Table 3: Effect of seedling age and weed management on the length of panicle, 1000 Grain weight number of spike per panicle and number of grains per panicle of rice.

Treatment	Length of Panicle (cm)	Number of Grains/Panicle	1000Grain Weight (g)	Number of Spike/panicle
Seedling Age (S)				
3	25.83	79.6a	38.4a	9.0a
4	25.02	77.1ab	37.6a	8.2b
5	25.13	75.b	35.9b	8.8a
SE±	0.650	3.00	1.173	0.222
p<f	NS	**	*	**
Time of Weeding (T)				
2WAT	62.9a	22.6a	38.1a	8.7ab
3WAT	62.7a	23.2a	38.6a	8.7ab
4WAT	61.0a	22.6a	37.2a	8.1b
Hoe Weeding	61.5a	22.6a	41.0a	8.8a
Control (No weeding)	51.9b	20.9b	27.0b	7.3c
SE±	3.90	0.80	2.72	0.45
P<F	*	*	**	*
Interaction (SX T)	NS	NS	NS	NS

Means followed with the same letter are not significantly different at 5% level of probability using Student Newman Kauls. NS= Not significant, *=Significant, **=Highly Significant, WOS= weeks Old Seedling and WAT= Weeks after Transplanting.

Table4. Effect of seedling age and weed management on the biological yield and yield of paddy rice in both locations

Treatment	Biological Yield of Rice ($kgha^{-1}$)	Yield of Paddy Rice $kgha^{-1}$
Seedling Age (S)		
3WOS	64.6a	8849.4a
4WOS	58.9a	8810.8a
5WOS	49.5b	79883.2b
SE±	4.78	451.8
Pro-level	**	*
Time of Weeding (T)		
2WAT	80.6a	9517.2a
3WAT	65.6b	7320,7b
4WAT	39.3c	6433.1c
Hoe Weeding	69.9ab	9255,6a
Control(No weeding)	28.8d	324.9.8d
SE±	10.00	228.6
p<F	**	**
Interaction(		
S x T	NS	NS

Means followed with the same letter are not significantly different at 5% level of probability using Student Newman Kauls. WOS= weeks old seedling and WAT= weeks after transplanting.

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