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INFLUENCE OF WEED CONTROL ON GROWTH AND YIELD OF RICE (*Oryza sativa* L.) IN SUDAN SAVANNAH OF KEBBI STATE, NIGERIA

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ABSTRACTS

Weeds are unwanted plants that cause reduction growth and yield on rice production through competition for light, nutrient, water and space. Rice is one of the most important staple cereal crop in Africa. A field trial was conducted at the Teaching and Research Fadama Farm of Abdullahi Fodio University of Science and Technology Aleiro, Nigeria, to evaluate the effect of weed control treatments on growth and yield of rice. The experiment consisted of five weed control treatments which included three rates of Patriac herbicide (0.2L/ha at 10DAT, 0.3L/ha at 20DAT, and 0.2 + 0.3L/ha at 10 and 20 DAT), manual weeding and weedy check. The treatments were laid out in a Randomized Complete Block Design (RCBD) with three replications. Data were collected on Plant Height (cm), Number of Leaf, Leaf Length (cm), Flag Leaf Length (cm), Tiller Count, Weed Density, Number of Days to 50% Flowering, Panicle Length (cm), Number of Seed/Spike, Total Grain Weight (Kg), Fresh Straw Yield (g) and 100 Grain Weight (g). Data obtained were subjected to Analysis of Variance (ANOVA) and significant means were separated using Least Significance Difference at 5% Probability level. The results showed that there is a statistical difference among treatments at 0.05% probability level except for the 20DAT and Number of Days to 50% flowering. Application of Partriac at 0.2l/ha + 0.3l/ha at 10 and 20DAT tallest plant with (39.13^{a}), (46.80a), (55.47^{a}) (84.67^{a}), (99.80^{a}) at 20, 30, 40, 50 and 60DAT respectively. It could be concluded that the combine application of Patriarc herbicide dosages (0.2 and 0.3L/ha at 10 and 20 DAT) gave better performance on weed control, as it's enhances the growth and yield of rice than the single dose application and therefore recommended for usage by farmers.

Keywords**:** Application, Herbicide, Patriarc Rice, weed

Introduction

Rice (*Oryza sativa* L.) is one of the most important cereals crop that constitute a dominant portion of a world standard diet. It is the major staple food in Nigeria that is consumed across all the geopolitical zones. Rice consumption is increasing rapidly in Nigeria because of the shift in consumers' preference toward it, increasing population growth, increased income levels and rapid urbanization (Oyewole *et al.*, 2021; Akinbode *et al.*, 2022). Despite its production, weed control is the major constraint and labor consuming activity in rice producing regions across the country that resulted to low productivity in rice production (Akobundo, 2011). Most of the farmers know different chemical weed killers but have little knowledge on different rate of herbicide

application that is economical and effectives in weed control.

The demand for rice in Nigeria has assumed a steady rise in the last decades compared to other cereal crops such as sorghum and millet (Onwalu, 2012). In Nigeria the estimated annual rice demand is about 5 million metric tons, while local production is about 2.21 million metric tons (Adekule, 2013). The annual importation takes a considerable share of the Nigeria's foreign exchange. For instance, the country spends an average of N360 billion annually on rice importation (Adekule, 2013) contributing to dwindling foreign exchange. Most rice farmers in Nigeria depend on traditional technologies with utilization of productivity enhancing inputs leading to a national average yield of 1 to 25 tonnes per hectare (Nwite *et al*, 2008).

Rice been the most important food crop in developing countries and account for 29% of the total calorie intake of these populations. It's most important to increase food production so as to keep pace with population growth and reduce the dependence on the other crops (Ashagidigbi, 2019; Ibrahim, 2020)

Rice is commonly boiled and eaten with stew or vegetable soup. It is also used in the preparation of several local dishes that are eaten in every home, especially during festival and ceremonies. Rice straw is used as livestock feeds particularly the ruminant such as cattle sheep and goat, however the strew can be used for thatching roof and in cottage industry for preparation of hats, mats, ropes, sound absorbing, straw board and used as litter material while the husk and bran are used as animal feed, paper making and as source of fuel (Wudil *et al.,* 2023).

Rice production is hindered by several factors and one of such factors is weed and recommended dose of application which most of the farmers have little or no knowledge about (Lavabre, 2011). Among the constraint limiting the production of the crop, application rate of an herbicide appears to have the most deleterious effect causing of about 75 to 100% reduction in potential paddy rice yield (Imeakparia, 2011). The efforts are starting to show results, as Nigeria's rice production rise from 4.0 million metric tonnes in 2018 to 9.2 million metric tonnes in 2024 (FAO, 2024).

Despite the yield potential of this crop, the average yield in Nigeria is still very low (2 t/ha) compared to other rice growing countries (China 5 t/ha, Thailand 4.5 t/ha, United States 6 t/ha). The low yield obtained in Nigeria could be as a result of many factors such as drought, pest and diseases, weeds, soil fertility problem among others, in which weeds causes a major threat to the crop productivity. Yield losses in rice due to weeds ranges from 35-50% (Khaliq *et al.*, 2011). Manual weeding is the most popular weed control method among local farmers in Nigerian, which is slow, tedious and sometimes labor is not available. Therefore, efficient, economical and easier method of weed control such as the use of herbicide become necessary. This research work was aimed at determining the effects of different concentrations of selective herbicide (Patriarc) on the growth and yield of Rice in Sudan Savanna Zone of Kebbi State.

Materials and Methods

Experimental Site

The research was conducted at the Teaching and Research Fadama Farm of the Abdullahi Fodio University of Science and Technology, Aliero, located at Jega, Kebbi State, during the cool dry season. Jega is located between Longitude 4°23'E and Latitude 12°11'N in Kebbi State. Jega falls within the Sudan savanna of the semi-arid zone of Nigeria, the mean rainfall in the study area ranges between 550-650 mm per annum, and average relative humidity of 51-79%. Harmattan period which is the drier and coolest period of the year has a

temperature range of 17-22°C experienced in December to February which makes it favorable for rice production.

Treatments and Experimental Design

The experiment consisted of five weed control treatments which were applied at 10 and 20 days after transplanting (DAT). They included three rates of Patriac herbicide (0.2L/ha at 10DAT, 0.3L/ha at 20DAT, and 0.2 + 0.3L/ha at 10 and 20 DAT), manual weeding and weedy check. The treatments were laid out in a Randomized Completely Block Design (RCBD) and replicated three times.

Cultural Practices

Land preparation and plot layout

The experimental area was harrowed to a fine tilth. The land was then marked into plots 4 m x 4 m (16 m^2). The Border spaces of 0.5 m between the plots and 1m between replicates were marked, giving a total number of fifteen (15) plots with an experimental area.

Seed dressing and sowing

The seeds were dressed with fungicide (dithiocarbamate) powder at (2.0 g kg^{-1}) and the sowing was done by drilling method at the spacing of 30 x 30 cm.

Fertilizer application

Single Super Phosphate (SSP) was used at 1 week after transplanting (WAT) while NPK was subsequently applied 2 and 4 WAT at recommended dosage.

Crop protection

Karate (Lamdacyhalothrin) was sprayed at 2 ml^{-1} of water against insect pests at 2, 4 and 8WAT.

Irrigation

Water channels were constructed for effective supply of water to each furrow during irrigation. The water was conveyed from the source to the plots at the interval of four (4) days at 1 and 2 WAT and subsequently at Seven (7) days.

Source of Seeds and Herbicide

Faro (44) and Patriarc post emergence were sourced from National Cereal Research Institute (NCRI) Badeggi, Niger State, Gwadangwaji, Birnin Kebbi Branch.

Herbicide application

The post-emergence herbicide (Patriarc) were applied at 10 and DAT on treatment basis.

Data Collection

Plant Height (cm)

The plant height was determined by measuring the height of the tagged plants from the base to tip using meter rule and mean were recorded at 20, 30, 40, 50, and 60 Days After Transplanting.

Number of Leaves per Plant

Number of leaves from five (5) tagged plants were counted in each plot and the mean were recorded at 20,30,40,50 and 60 DAT.

Leaf Length (cm)

The leaf length of five randomly selected plants per plot was measured using meter rule and mean were obtained and recorded at 60 DAT.

Flag leaf Length (cm)

The length of the flag leaf was obtained using meter rule and the mean recorded at 60 DAT.

Tiller Count

Five plants were randomly selected and tagged in each net plot, the tillers were counted and mean was recorded at 20,30,40,50 and 60 DAT.

Weed Density

Weeds score were taken from a 1 m^2 quadrant placed randomly in each plot at 20,30,40,50 and 60 DAT. The uprooted weed sample was classified base on species and counted to obtain the density of individual weed species. The sum of all species recorded at each sampling time taken as the cumulative weed density.

Number of Days to 50% flowering
Number of days to 50% flowering was taken by counting the days from the sowing date to 50% flowering.

Panicle Length (cm)
Number of Seeds per Spike
The number of seeds per spike was obtained by counting the spike of five selected plants in each plot and mean was recorded.

Total Grain Weigh (kg)
The total grain weight was measured by weighing the thrashed paddy using a digital weighing balance.

Weight of Straw per Plot (g)
Weight of the fresh straw were measured using weighing scale.

100 Grains Weight (g)
Weight of 100 grains from each plot was obtained using digital weighing scale (Ohaus CS series).

Data Analysis
Data collected were subjected to the Analysis of Variance (ANOVA) and significant means were separated using Least Significant Difference (LSD) at 5 % level of probability.

Results
Plant Height (cm)
Effect of weed control treatments on plant height of rice in Jega LGA during the 2023 dry season
The effect of treatments on plant height of rice showed that there was a significant difference among the treated plants at all the period of sampling except at 20 DAT. Application of Patriarc herbicide at 0.2 and 0.3 L/ha at 10 and 20DAT consistently produced the tallest plants than the rest of the treatments and the shortest plants were recorded in the weedy check at 10, 30, 50 and 60 DAT (Table 1).

Table 1: Effect of weed control treatments on plant height of rice in Jega LGA during the 2023 dry season

Treatment	**Plant height (cm)**				
Partriac (L/ha)	**20DAT**	**30DAT**	**40DAT**	**50DAT**	**60DAT**
0.2 at10DAT	32.80	37.80^{ab}	42.33^{ab}	71.40^{b}	85.40^{b}
0.3 at 20DAT	34.53	39.00^{ab}	45.53^{ab}	80.53^{ab}	88.40^{ab}
0.2+0.3 at 10 and 20DAT	39.13	46.80^{a}	55.47^{a}	84.67^{a}	99.80^{a}
Manual weeding at 2 and 6 WAT	24.60	28.20^{b}	32.47^{b}	45.73^{c}	48.63^{c}
Weedy check	20.00	23.00^{b}	26.30^{b}	30.70^{d}	35.75^{d}
LSD	**15.822**	**14.457**	**14.808**	**8.821**	**11.448**

Means within a column have the same alphabet are not significantly different at 5 percent level of probability. DAT: Days after transplanting, WAT: Week after transplanting.

Number of Leaves per Plant

Table 2 present the effect of weed control treatments on number of leaves of rice. There was a significant difference among the treatments at all the sampling stages except at 40 DAT. Where plants treated with 0.2 and 0.3Lha^{-1} of Patriarc herbicide at 10 and 20 DAT recorded the highest number of leaves that was statistically similar with 0.3L/ha at 20 DAT and 0.2L/ha at 10 DAT but significantly differed from plants in two hoe weeded treatment and weedy check. Likewise, a similar observation was recorded at 30, 50 and 60DAT.

Table 2: Effect of Patriarc herbicide on the number of leaves of rice in Jega during the 2023 dry season

Treatment	**Number of leaves**				
Patriarc (L/ha)	**20DAT**	**30DAT**	**40DAT**	**50DAT**	**60DAT**
0.2 at 10DAT	77.67^{a}	92.67^{b}	120.07	138.07^{a}	142.07^{a}
0.3L at 20DAT	84.67^{a}	103.67^{a}	128.20	143.27^{a}	154.33^{a}
0.2 + 0.3@ 10 and 20 DAT	86.80^{a}	100.67^{ab}	135.13	148.33^{a}	157.67^{a}
Manual weeding 2and6 WAT	40.80^{b}	52.67^{c}	68.67	77.07^{b}	84.33^{b}
Weedy check	34.67^{b}	42.60^{d}	53.00	58.33^{b}	62.60^{b}
LSD	**13.375**	**9.172**	**68.045**	**60.918**	**53.103**

Means within a column have the same alphabet are not significantly different at 5 percent level of probability. DAT: Days after transplanting, WAT: Week after transplanting.

Leaf and Flag Leaf Length (cm)

The influence of weed control treatments on leaf and leaf flag length is showed in Table 3 below. There was a significant difference among the treatments on leaf length and flag leaf of rice at 60 DAT. Where application of Patriarc herbicide recorded the highest mean value that was statistically at par with all the remaining weed control treatments except the weedy check which had the least value

Table 3: Effect of weed control treatments on leaf and flag leaf length (cm) of rice at 60 DAT in Jega LGA during the 2023 dry season

Treatment Patriarc (L/ha)	**Leaf length (cm)**	**Flag leaf length (cm)**
0.2L/ha 10DAT	26.67^{a}	22.33^{a}
0.3L/ha 20DAT	28.67^{a}	24.13^{a}
0.2&0.3L/ha 10 and 20DAT	28.67^{a}	25.27^{a}
Manual weeding at 2 and 6 WAT	24.07^{a}	22.23^{a}
Weedy check	19.08^{b}	18.21^{b}
LSD	**8.641**	**4.010**

Means within a column have the same alphabet are not significantly different at 5 percent level of probability. DAT: Days after transplanting, WAT: Week after transplanting.

Tillers Count

The influence of weed control treatments on tillers count of rice is showed in table 4. There was a significant (P = 0.05) difference among the treatments. The plot that received 0.2 and 0.3L/ha of Patriarc herbicide significantly

produced the number of tillers per plant in all the sampling periods than the rest of the weed control treatments and the unchecked plots consistently recorded the lowest tillers count.

Table 4: Effect of weed control treatments on rice tiller count in Jega LGA during the 2023 dry season.

Treatment	**Tiller count**				
Patriarc (L/ha)	**20 DAT**	**30 DAT**	**40 DAT**	**50 DAT**	**60 DAT**
0.2 at 10DAT	22.67^{b}	28.33^{b}	34.67^{b}	38.67^{b}	37.67^{b}
0.3 at 20DAT	27.00^{ab}	34.13^{ab}	42.00^{ab}	44.67^{ab}	43.67^{ab}
0.2+0.3 at 10 and 20DAT	30.67^{a}	39.00^{a}	45.33^{a}	48.00^{a}	48.67^{a}
Manual weeding at 2 and 6WAT	14.67^{c}	18.33^{c}	23.00^{c}	24.67^{c}	28.00^{c}
Weedy check	13.00^{c}	15.30^{c}	20.55^{c}	22.60^{c}	26.00^{c}
LSD 0.05	**6.982**	**9.172**	**8.964**	**8.004**	**9.414**

Means within a column have the same alphabet are not significantly different at percent level of probability. DAT: Days After Transplanting, WAT: Week After Transplanting.

Weed Density (g/m^2)

The effect of treatments on weed density of rice was significant (P = 0.05) where the weedy check plots consistently recorded the highest density in all the stages of sampling while the lowest density was recorded in the plot that received 0.2 and 0.3 L/ha of Patriarc herbicide at 10 and 20 DAT (Table 5).

Table 5: Effect of weed control treatments on weed density of rice in Jega LGA during the 2023 dry season

Treatment	**Weed density (g/m^2)**				
Patriarc (L/ha)	**20DAT**	**30DAT**	**40DAT**	**50DAT**	**60DAT**
0.2 at 10DAT	15.43^{c}	11.13^{c}	8.77^{c}	7.47^{c}	9.33^{c}
0.3 at 20DAT	13.43^{c}	9.43^{c}	7.19^{c}	5.47^{c}	6.67^{cd}
0.2+0.3 @10 and 20DAT	08.10^{c}	9.33^{c}	6.97^{c}	4.97^{c}	5.20^{d}
Manual weeding at 2 and 6 WAT	36.23^{b}	14.50^{b}	17.00^{b}	12.20^{b}	10.67^{b}
Weedy check	67.60^{a}	78.00^{a}	83.00^{a}	103.66^{a}	105.00^{a}
LSD (0.05%)	**9.351**	**4.259**	**4.470**	**5.253**	**7.310**

Means within a column have the same alphabet are not significantly different at 5 percent level of probability. DAT: Days after transplanting, WAT: Week after transplanting.

Days to 50% flowering, panicle length; number of seeds per spike, TGW fresh straw weight and 100gw

The effect of treatments on days to 50% flowering, panicle length; number of seeds per spike, TGW fresh straw weight and 100gw of rice is presented in Table 6 there was no significant effect of treatments on days to 50% flowering. The effect of weed control treatment was significant the yield parameters of rice. Where plot treated with 0.2 and 0.3L/ha of Patriarc herbicide at 10 and 20 DAT consistently recorded the highest mean while the unchecked plot recorded the lowest mean value

Table 6: Effect of weed control treatments on Days to 50% flowering, panicle length, number of seeds per spike, TGW, fresh straw weight and 100gw of Rice in Jega LGA during the 2023 dry season

Treatment	No. of Days to 50% Flowering	Panicle length (cm)	Number of seeds/spike	TGW (Kg)/plot	Fresh straw yield (g)	100 GW (g) /plot
0.2L/Ha at 10DAT	86.00	27.00^{b}	111.00^{b}	7.70^{c}	10.07^{b}	27.10^{c}
0.3L/Ha at 20DAT	86.00	27.43^{ab}	123.67^{ab}	9.80^{b}	11.60^{ab}	28.13^{b}
0.2L and 0.3L/Ha at 10 DAT and 20 DAT	86.00	27.80^{a}	134.33^{a}	11.90^{a}	13.80^{a}	29.21^{a}
Manual weeding at 2 and 6 WAT	86.00	27.00^{b}	102.00^{b}	6.93^{c}	8.37^{b}	26.97^{c}
Weedy check	86.00	26.13^{c}	74.33^{c}	4.81^{d}	5.28^{c}	24.32^{d}
LSD	**2.803**	**0.562**	**17.461**	**2.002**	**2.771**	**0.966**

Means within a column have the same alphabet are not significantly different at 5% level of probability. TGW: Total grain weight, GW: Grain weight, WAT: Week after transplanting.

Discussion

Globally, weeds are a serious pest of rice, which tend to decrease growth and rice yield especially if weeds invasion reaches beyond threshold levels at seedling stage. Weeds have emerged as one of the major constraints for rice production (Florkowski and Landry, 2002). Chemical weed management remains the most used and reliable method of controlling weeds in the rice fields (Kim *et al.*, 2006; Anwar *et al.*, 2012). The present study investigated the performance of rice as influenced by rates of Patriarc herbicide in Sudan savannah of Nigeria. The study has established the general effectiveness of Patriarc herbicide over conventional hand weeding practices and control plants (weedy treatment). The results corroborate the previous report of Singh *et al.* (2016) and Hakim *et al.* (2021), who demonstrated the effectiveness of synthetic herbicides on the weed management infesting rice field.

The study revealed that the application of varying rates of Patriarc herbicide did not differ in their performance on rice number of leaves throughout the period of the study. The higher number of rice leaf production observed among plants treated with varying rates Patriarc herbicide than those recorded on hand weeded and control rice plant could be

influenced significantly by higher competition in the later for nutrient, space and water due to higher weed density. The suppression of weeds by herbicide allows plants to judiciously utilized nutrient space and water which enhances the production of growth parameters including leaves (Florkowski and Landry, 2002; Hakim *et al.*, 2021).

The study also revealed that a significant variation on plant height between 0.2L/ha PH at 10DAT or 0.3L/ha at 10 20DAT and either hand weeded or control treatments was only observed from 50 days after transplanting of rice. However, Patriarc herbicide application of 0.2 and 0.3L/ha at 10 and 20 DAT respectively significantly influenced the plant height of rice throughout the period the crop production compared to hand weeding and weedy treatment. Therefore, it could be inference that application of 0.2 and 0.3 L/ha of at 10 and 20 days after transplanting effectively suppressed weeds, checked crop-weed competition for nutrients and other resources during crop's tender and critical growth stage thereby enhancing the performance of vegetative parameters such as plant height. Weeds compete with the crop for available growth resources in the early stages resulting to the crop's slow growth (Bretagnolle and Gaba, 2015). Weeds have been reported to compete with crops for sunshine, water, space, and nutrients, which results in a decline in crop growth and yield parameters (Giles and Slaughter, 1997; Singh *et al.* (2016).

The study elucidated that irrespective of dosage, the application of Patriarc herbicide resulted in the production of significantly higher tiller count compared with hand weeded and weedy plants. However, significantly higher tiller counts were achieved on plants treated with the application of either 0.3L/ha of Patriarc herbicide at 20 DAT the combined application of 0.2 and 0.3 L/ha of at 10 and 20 days after transplanting effectively. This observation further buttresses the assertion that the performance of growth parameters in crops is significantly improved with minimal or absence of competition for nutrients, water, space and sunshine (Manalil, 2015; Shittu *et al.*, 2022).

Irrespective of dosage, the application of Patriarc herbicide on rice has demonstrated a significant effectiveness on weed control over the hand weeding and weedy check wherewith had the lowest weed density. The performance of Patriarc herbicide on rice corroborates the previous reports on the effective suppression of weed density by synthetic herbicides on cereals and other crops have been well established.

On the other hand, none of the Patriarc herbicide treated rice plants had longer leaves than the hand weeded plants throughout the cultivation period. This therefore suggest the beneficial role of herbicides and hand weeding on the enhancement of plant leave length which provides wider surface area for photosynthetic processes.

Expectedly, the study demonstrated that none of the treated crops significantly attended days to fifty percent flowering than each other. This is because attainment of flowering days by plant is majorly genetically influenced and none of the treatments applied constitute a bio-stimulating agent. For other rice yield parameters, the study revealed that higher length of panicle, number of seeds per spike and fresh straw weight were obtained from plants treated with either 0.3L/ha of Patriarc herbicide at 20 days after transplanting or the combined application of 0.2 and 0.3L/ha of Patriarc herbicide at 10 and 20 days after transplanting respectively. On the contrary, total grain and 1000 grain weights were obtained from plants the received the combined dosage of Patriarc herbicide. Weed competition was directly linked to a decrease

in crop output (Kombiok *et al.*, 2012). Weed infestation is the most significant yield-limiting issue. They interfere with crop growth if not regulated, resulting in a decrease in production and, in severe cases, crop failure (Llewellyn *et al.*, 2016). Employing Patriarc herbicides to control weeds eliminates weed interference and increases panicle length, number of seeds/spikes, fresh straw weight, grain weight and seed yield due to optimal nutrient uptake. Adhikary *et al*. (2016) and Shittu *et al.* (2022) discovered that a larger number of pods and pod weight collected were associated with improved nutrient accretion, which translates to increased dry matter and CGR from agricultural plants. Similarly, Sinha *et al*. (2018) reported same on 100 seed weight due to effective weed management. Weedy check, on the other hand, resulted in poor performance of yield parameters, which could be due to competition between rice and weeds for water, light, space, and nutrients, as well as allelopathic impacts of weed biotypes in weedy check, which resulted in poor crop growth and yield quality (Florkowski and Landry, 2002).

Conclusion

Irrespective of dosage applied, Patriarc herbicide was effective in suppression of weed density compared to hand weeding and weedy check. The combined application of Patriarc herbicide dosages (0.2 and 0.3L/ha at 10 and 20 DAT) gave better performance on weed control thereby enhancing growth and yield parameters in rice than its single dose application.

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