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PERFORMANCE OF RICE UNDER THE INFLUENCE OF THREE SELECTED POST EMERGENCE HERBICIDES AND SEEDLING AGE IN JEGA SUDAN SAVANA ZONE OF NIGERIA

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Abstract: The trial was conducted in the Fadama area of Teaching and Research Farm of Kebbi State University of Science and Technology Aliero located at Jega Sudan Savanna zone of Nigeria. The study was instituted to investigate the performance of rice (*Oryza sativa* L.) under the influence of three selected post emergence herbicides and seedling age. Treatments consisted of rice variety (Faro 44), three seedling ages (10, 17 and 24 days old) Five weed management methods comprising of three selected post emergence herbicides (namely, Bracer, Bracerplus and Nomineegold at four rates each), that is Bracer at: 0.250 Lha^{-1}, 0.275 Lha^{-1}, 0.300 Lha^{-1}, and 0.325 Lha^{-1}, four rates of Bracerplus namely;0.129 Lha^{-1}, 0.142 Lha^{-1} 0.155 Lha^{-1}, and 0.168 Lha^{-1}, four rates of Nomineegold namely 0. 200 Lha^{-1}, 0.300 Lha^{-1}, 0.400 Lha^{-1}and 0.500 Lha^{-1};hoe weeding at 4 and 8 weeks after transplanting (Farmers practice), and a weedy check, imposed as control. The treatments were laid out in a complete randomized block design with three replications. Age of seedlings were allocated to the main plot, while weed management methods were allocated to the subplots. Thirty-six weed species were identified growing in association with rice under study. Seventeen (17) species or 47.22% were broadleaved, Sixteen (16) species or 44.44% were grasses while three (3) or 8.33% were sedges. Application of Bracerplus at 0.129 Lha^{-1} and Nomineegold at 0.500 Lha^{-1} recorded the highest significant grain yield of 3,316.32 and 2,908.08Kgha^{-1} respectively. Seedlings transplanted at 10-day old recorded the highest yield of 1309.0 Kgha^{-1} followed by 17-day old seedlings (1163.6 Kgha^{-1}) and 24- day old seedlings recorded the least yield of (1096.8 Kgha^{-1}).Application of Bracerplus at 0.129 Lha^{-1} (followed by hoe weeding at 6 WAT), was observed to record the highest crop dry matter (0.1722 Ton ha^{-1}) which was superior to crop dry matter recorded from application of other weed management treatments and the weedy check.

Keywords: Herbicides, Performance, Randomized, Seedling Age, Transplanting.

I.INTRODUCTION

Rice (*Oryza sativa*L.*)* is an annual grass that belongs to the family Poaceae and genus *Oryza*. It is regarded as the first cultivated crop of Asia [1]. The centre of origin of rice is believed to be south-east Asia (*Oryza sativa)* and Africa *(O. glaberrima*). Some of the important rice producing countries are China, Burma, India Indonesia Japan United States of America, Spain, Italy and Brazil, before it was spread to Africa [2]. Although the original parental species of rice are native to South-East Asia and certain parts of Africa, centuries of trade and exportation have made it a common place in many cultures world – wide [3]. Rice is grown in more than 100 countries of varying climatic conditions and is particularly productive in tropical region with abundant moisture [4].

Rice is a staple for more than 60 % of the worlds' seven billion people and more than 90% of this rice is consumed in Asia {[5]; [6]}. During the year 2017 nearly 482 million metric tonnes of paddy were produced worldwide [7]. Although rice protein ranks high in nutritional quality among cereals, protein content is modest. The minerals, vitamins and other constituents of rice except carbohydrate are reduced by milling [8]. In Nigeria, rice is important for several reasons including being a major contributor to internal and sub-regional trade [4]. Two types of rice have been mainly cultivated in Nigeria; the African rice (*Oryza glabberrima)* and Asian rice (*Oryza sativa*) [4]. In recent times, however new rice varieties have also been introduced including the West African Rice Development Association's (WARDA) hybrid rice varieties e.g. New rice for Africa (referred to as NERICA) which are inter specific hybrid between the African and the Asian rice.

According to a recent documented survey by National Agricultural Extensions and Research Liaisons Services (NAERLS) of Ahmadu Bello University Zaria, in conjunction with Agricultural Development Project (ADPS) and the Federal Department of Agricultural Extension; Niger State produced 545,700 metric tons (MT) of rice to top the National production output for the 2017 wet season. The total land area cultivated by the state for the period was 229,080 hectares. All the 36 states of the Federation, including FCT, were assessed in the survey certified by National Technical Committee on Agricultural Statistics, Kogi state followed with an output of 512,610MT cultivated on 235,521 hectares. Benue was in the third position with a production volume of 486,620MT cultivated area was 227,730 hectares. Kano (418,480), Kebbi (411,490), Nasarawa (410,820), Kwara (408,250) and FCT (408,111) were rated 4th, 5th, 6th, 7th and 8th respectively. The ranking also showed that AkwaIbom with a volume of 19,199MT was the least rice producing state in 2017, with a little over 10,000 hectares of land cultivated. Other lesser producers are Delta (44,230mt) in 36th position and Abia (50,312MT) in 35th place. According to the Agricultural performance survey, the estimated cropped area for rice was 3.90 million hectares wat a total output of 8.02 million MT was produced in 2017 as against the 6.99 million MT recorded in 2016, showing a significant increase in output of about 14.7 percent [9].

Rice farmers choose varieties adapted to the region's length of growing season, soil, altitude and the depth of water in the field [4]. Farmers in developing countries usually sow rice seeds in small seed beds, then transplant the seedling into flooded field that have been levelled. For this study, Faro 44 was chosen because of its yield potentials and adaptability in the study Area.

Of the biotic and abiotic stresses that pose constraints to rice production, weeds are the most prominent of them across the ecologies in terms of yield reduction, labour demand and cost of control {[10]; 11]}. [12] cited that about 20% of production costs incurred by farmers are attributed to weed control during growing season. In sub-Saharan Africa, 2.2 million tonnes of rice yield is lost annually as a result of uncontrolled weeds [13]. About 28-74% of rice yield is lost due to uncontrolled weed growth in transplanted lowland rice, while 48-100% loss in upland ecosystems [14].

Weeds are real constraints to rice production [15]. Improved weed control can increase rice yields by 15-23% depending on the agro-ecosystem [14]. As an alternative to hand weeding and other methods of controlling weeds among farmers, herbicides offer a practical and economical option for reducing crop losses and production cost {[10]; [16], [17]}. The use of herbicides in rice cultivation is gaining widespread acceptance among rice farmers worldwide including Nigeria. The conventional method of weed control in rice, i.e. hand weeding is very laborious, expensive and inefficient. Chemical weed control can be considered as a better alternative [18]. Use of chemicals to control weed has been found to be effective and economical [19]. [20] reported that chemical weeding is easier, saves time and economical as compared to hand weeding alone. Weed control using herbicides offers an advantage to save labour and money. It is regarded as cost effective method of weed control as opined by [21]. [22] stated that herbicides gave significant control of weeds when applied one day after transplanting rice. In China and South Korea rice is treated with herbicides by 70% and 90% respectively. [23] stated that herbicide use moves the agro-ecosystem to low species diversity with new problem weeds appearing, so that there is need for the use of post emergence herbicides to manage the weeds.

Post emergence herbicides are a major tools used to control weeds in rice. The growth stage of weed species may have an effect on herbicide efficacy by influencing uptake and metabolism of herbicides [24]. Diclofop, for example, was more effective on green foxtail (*Setaria viridis* (L.) Beauv.) and wild oat (*Avenafatua* L.) when applied at an early growth stage. Conversely, trifloxysulfuron was more effective on yellow nut sedge (*Cyperus esculentus* L.) at late application stages [24]. Generally, the herbicide efficacy is lower when applied on bigger weeds. The herbicide degradation rate may be faster in big plants, and herbicide rates may need to be increased to achieve the desired level of control[24]. Therefore, optimum time of herbicide application and range of herbicides may help control these weeds effectively [25].

II. STATEMENT OF THE RESEARCH PROBLEM

Weeds are recognised as major biological constraints that hinder the attainment of optimal rice productivity and quality {[26], [27]}. It is estimated that every year, weeds cause yield losses from 15 to 76% in rice crop {[28], [29], [30], [31], [32]}. Direct yield loss has been estimated to range from 16 – 86% depending on type of rice culture, cultivars, weed species and density, duration and time of weed infestation, climatic and environmental conditions {[33], [34]}. It is well established that weeds remove considerable quantities of nutrients from rice crop field. Estimate showed that weeds can deprive the rice crops by 47% N, 42% P, 50% K, 39% Ca and 24% Mg of their nutrient uptake thereby reduce the yield potential of the crop [35]. Hence timely and effective weed control is essential for obtaining higher yield of rice {[36], [37]}. Nutrient removal by weeds has been reported to be about 21 – 42kg N, 10 – 13.5kg P and 17 – 27 kg K ha^{-1} in transplanted rice depending upon the soil, condition of cropping and location of growing rice {[38], [39], [40]}. In rain-fed lowland rice, a period of 30-60 days after sowing was considered as critical period for crop weed competition to avoid grain yield losses [41]. Therefore weed control measures must be instituted before this period of time to avert economic yield loss in rice.

Chemical weed control is a practical and economic alternative to hand weeding. The conventional method of weed control in rice, i.e. hand weeding is very laborious, expensive and inefficient. Chemical weed control can be considered as a better alternative [18]. Use of chemicals to control weeds in rice, has been found to be effective and economical [19]. [20] reported that chemical weeding is easier, saves time and economical as compared to hand weeding alone. Weed control using herbicides offers an advantage to save labour and money. It is regarded as cost effective method of weed control as opined by [21]. [22] stated that herbicides gave significant control of weeds when applied one day after transplanting rice. Application of herbicide appropriately prevents weed infestation from planting to harvesting and promotes higher yields by allowing closer crop spacing and therefore higher plant population [42]. The use of herbicides in intensive rice cultivation is gaining widespread acceptance among rice farmers in Nigeria. Consequently, there is a dire need to continuously evaluate new selective post emergence herbicides for broad spectrum weed control in rice field, therefore a selective broad spectrum herbicide for control of grasses, sedges and broad leaved weeds in a single spray in rice field is required.

The aim of the study was to evaluate three selected post emergence herbicides for weed control in the rice variety, while the specific objective was to determine the effect of herbicides on weed suppression and on the growth and yield of rice.

III. MATERIALS AND METHOD

3.1 Experimental site

The Experiment was conducted during the dry season of 2022/2023 in the Fadama area of Teaching and Research Farm of Kebbi State University of Science and Technology Aliero located at Jega (lat. 12^0 18.64'N: long.04^0 29.85', 262 m above sea level). The area is characterized by erratic and scanty rainfall that lasts for about 5 months (May – September) and long dry period (October – April). The climate of the area is semi-arid with average rainfall of 550-650mm per annum. The relative humidity ranges from 21-47% and 51- 79%during the dry and rainy seasons respectively. Temperature averages between 14 – 30 ^{0}C during dry season and 27-41^{0}C during the rainy season [43].

3.2 Soil sampling and analysis

Soil samples was collected from random points within the (lowland) experimental site at Teaching and Research Farm of Kebbi State University of Science and Technology located at Jega. The samples was collected within the depth of 0-30 cm at four locations using a 10 cm diameter soil auger. The samples was bulked, air dried sieved and then subjected to routine laboratory analysis for physico-chemical properties following the standard procedures. [44].

3.3 Treatments and Experimental Design

Treatments consisted of rice variety (Faro 44), three seedling ages (10, 17 and 24 days old) Five weed management methods comprising of three selected post emergence herbicides (namely, Bracer, Bracerplus and Nomineegold at four rates each), that is Bracer at: 0.250 Lha^{-1}, 0.275 Lha^{-1}, 0.300 Lha^{-1}, and 0.325 Lha^{-1}, four rates of Bracerplus namely;0.129 Lha^{-1}, 0.142 Lha^{-1} 0.155 Lha^{-1}, and 0.168 Lha^{-1}, four rates of Nomineegold namely 0. 200 Lha^{-1}, 0.300 Lha^{-1}, 0.400 $Lha^{-1}$and 0.500 Lha^{-1};hoe weeding at 4 and 8 weeks after transplanting (Farmers practice), and a weedy check, imposed as control. The treatments was laid out in a completely randomised block design in split plot arrangement with three replications. Variety and age of seedlings were allocated to the main plot, while weed management methods was allocated to the subplots.

3.4. Cultural practice

3.4.1. Field layout and Plot size

The field was cleared ploughed harrowed and levelled to allow for free flow of water. Plots were marked out. The plot size was 2 x 2m =4m^2 separated by 1m space between the plots of the same replicate, while 2m space was provided between blocks. The inter and intrar row spacing was 20x20cm with two seedling per stand, the net plot area (1.80m^2) contained ten (10) middle rows for growth and yield assessment, while the boarder rows were used for destructive sampling. The total plot area was 14 x 22m = 396m^2

3.4.2. Nursery preparation

Three nursery beds were prepared for Faro 44 with dimensions of 5x2m (10m^2). The beds were fertilized with NPK 20:10:10 at 50gm^{-2}. The rice seeds were sown by drilling at an inter row spacing of 30cm. The beds were adequately irrigated in every two days interval to supply enough water. Twenty four days to transplanting seedlings into field, seeds were sown in the first bed, there after seven days later, second seeds were sown in the second bed, and the third bed were sown ten days after the second bed was sown. Ten days after sowing the third bed, the set of seedling ages for 24, 17 and 10days was achieved; transplanting was done right away into the field on that same day during the 2020/2021 dry season.

3.4.3. Transplanting

Rice seedlings were transplanted according to treatments (10, 17 and 24 days after sowing) at spacing of 20x20cm in the plots.

3.4.4. Irrigation

Surface Irrigation method was done at an interval of three days to fill the basin which was increased to two days when the evapo-transpiration increased.

3.4.5. Manual Weeding

Hand weeding was done using hoe at 4 and 8Weeks after transplanting (WAT) according to treatment and at 6 WAT supplemental hoe weeding was done on first rates or lowest rates of each of the herbicides. Weeds were collected using (50 x50) cm^2 Quadrat prior to the weeding. The weeds were washed cleaned identified into species, air dried and fresh weight was recorded and subsequently oven dried at 70 ^{0}C weighed until a constant weed dry matter weight was achieved, while weed dry matter from chemical weed control treatments was taken at harvest.

3.4. 6. Fertilizer Application

Application of 120:50:50 kg ha^{-1} NPK was done in split doses. The first half application of N (50 kg), and full dose of P_2O_5 and K_2O (50 kg) was applied at the basal stage. The second half of N was applied at maximum tiller stage and at panicle initiation stage using urea (46%) as source.

3.4.7. Herbicide Application

Rates of bracer; 0.250 + Hoe weeding at 6 WAT, 0.275, 0.300 and 0.325L/ha and Bracerplus; 0.129 + Hoe weeding at 6 WAT, 0.142, 0.155 and 0.168 L/ha, Nomineegold at 0.200 + Hoe weeding at 6 WAT, 0.300, 0.400 and 0.500 L/ha respectively, according to treatment were applied at 2-weeks after transplanting using 15 L knapsack sprayer. Application was done once only during the cultivation period. (However the first rates of the herbicide treatment were followed by hoe weeding at 6 WAT after application of the herbicides). The application was done when the soil was saturated with water but not flooded. This was done after calibration of the sprayer to avoid wastage of the herbicide. A day after application of the herbicide, the soil was flooded for 2–3 days according to the herbicide manufacturers' regulations to boost the weed control efficiency of the chemicals.

3.4.8. Harvesting

The crops were harvested at maturity when the entire plants have dried. The plants within the net plot were cut at ground level and bundled into sheaves. Each net plot harvested was threshed by putting into polythene sack and beating with sticks. The paddy collected was threshed, winnowed, cleaned and sun dried.

3.5. Data Collection

3.6. Observation for Yield contributing characteristics of rice

3.6.1. Length and weight of panicle

The length and weight of 5 sampled panicles was taken from five hills of each plot just before harvesting, and means will be calculated.

3.6.2. Number and weight of grains per panicle

Panicle was weighed in an electronic balance by taking the panicles from five hills of each plot just before harvesting. At the same time numbers of filled and unfilled grains was counted to determine the number of filled grains per panicle.

3.6.3. 1000- grain weight (g)

A randomly selected 1000 seeds was collected from each plot and weighed using a mettler-P 1210 weighing balance.

3.6.4. Harvest Index

Harvest index (HI) was computed by dividing grain yield with the biological yield (total dry matter yield) as per the following formula:

$$\text{HI\%} = \frac{Grain\ yield}{grain\ yield + straw\ yield}\ x\ 100$$

3.6.5. Days to 50% booting

Days to 50% booting was determined from each plot by counting the number of days from transplanting, whereby 50% of plants attained booting stage.

3.6.6. Days to 50% heading

Days to 50% heading was determined from each plot by counting the number of days from transplanting to the time that 50% of plants attained heading stage.

3.6.7. Days to 50% maturity

Days to 50% maturity was determined from each plot by counting the number of days from transplanting to the time that 50% of plants attained maturity stage.

3.6.8. Productive tillers

Productive tillers was determined from five sampled plants in the net plot from each plot and the average recorded. The feature to be considered include viable panicles borne by the tiller that has a direct bearing with the productivity of the plant.

3.7. 0 Grain yield (Kg ha^{-1})

Grain weight was determined from the net plot of each plot after harvest. It will be expressed in kilogram ha^{-1}.

3.8.0 Data Analysis

Data generated was subjected to analysis of variance procedure (ANOVA) as described by [45] and differences between treatment means were separated using Duncan Multiple Range Test (DMRT) at 5% level of probability as described by [46]. The relationships between characters was determined through simple correlation analysis as described by [47].

IV RESULTS AND DISCUSSON

At the end of the study, ability of the rice plant to establish in the study area was determined, also plant tolerance to the toxicity effect of the respective levels of applied herbicides was determined, the effect of the herbicides on the growth and yield of the rice plant was also determined, the study was able to determine herbicidal suppression of the weed growth and the study was able to identify weed types and species found growing in association with rice in the study area.

4.1. Weed flora identified in the Lowland (Fadama) experimental plot at Jega.

The weed flora explains the types of weed species identified growing in association with rice crop. The weed species were categorized under the following indices; Density, Frequency, Abundance, Relative density, Relative frequency, Relative abundance and Important value index (IVI). The IVI is the sum of all the indices from density to relative abundance, it indicates which weed species has the most important value to the rice crop during the study period. The result of the weed flora identified is presented on table 4.1.

During the 2022/2023 dry season farming, thirty- six weed species were identified growing in association with rice under study. Seventeen (17) species or 47.22% were broadleaved, sixteen (16) species or 44.44% were grasses while three (3) or 8.33% were sedges. The most dominant weed species were *Digitaria ciliaris* and *Echinochoa colona* of the grass species, they were followed by *Cyperus iria* and *C. difformis* of the sedges species, while the least dominant species occurs from all the species of broadleaf, grass and the sedges; *Melochia corchorifolia* from the broadleaf weeds, *Ischaemum rugosum* from the grass weeds and *Cyperus haspan* from sedges weeds were among the least dominant species of the weeds found growing in association with rice under study. The most frequent species were *Echinochloa colona* followed by (fb) *Digitaria ciliaris* fb *Cyperus difformis* and *Cyperus iria*, while *Mimosa pudica* and *Digitaria horizontalis* have equal frequency of 10.32. The frequency of 0.79 was shared among the weed species. The grass species *Hacklechloa granularis* was the most abundant weed during the growing season, it was fb *Digitaria ciliaris* fb *Brachiaria lata* fb *Echinochloa colona* it was fb *Cyperus iria* fb *Digitaria horizontalis* while the least abundant species included *Ischemum rugosum, Echinochloa stagnina, Neptunia oleracea, Mariscus longibracteatus, Melochia corchorifolia, Schizachyrium exile, Aeschynomene indica and Mimosa pudica.* The grass species *Echinochoa colona* had the highest value index of 52.12 fb *Digitaria ciliaris* with IVI of 48.79 it is fb *Cyperus difformis* (24.06) and *C. iria* (23.56) respectively. *Digitaria horizontalis* was next important weed fb *Hacklechloa granularis* fb *Echinochoa obtusiflora.* The weed species with the least importance were *Ischaemum rugosum, Echinochloa stagnina, Neptunia oleracea, Melochia corchorifolia, Schizachyrium exile* and *Panicum subalbidum*

4.2. Plant establishment count.

The effect of weed management and seedling age on plant establishment count of rice at Jega is presented in Table 2. The result showed that the highest number of established plants was from the application of Nomineegold at 0.500Lha^{-1}, while the weedy check was observed to have the least established number of plants that were significantly ($p \leq 0.05$) different from other weed management treatment. Application of Bracer at 0.250 Lha^{-1} followed by hoe weeding at 6-weeks after transplanting (6WAT) and Manual weeding at 4 and 8 WAT recorded significantly ($p \leq 0.05$) different number of established plants from the application Nomineegold at 0.500Lha^{-1}. All other treatments were statistically comparable with each other although there exist variation in magnitude. The number of plants established from the application of Bracer at 0.275, 0.300 and 0.325 Lha^{-1} were observed to be statistically comparable to the number of plants established from the application of all the rates of Bracerplus and application of Nomineegold at 0.200, 0.300 and 0.400 Lha^{-1}.

Significant ($p \leq 0.05$) difference was observed between plant seedling ages in number of established plants. Rice plants transplanted at 10-days old and 17-days old recorded significantly ($p \leq 0.05$) similar number of established plants that was higher than 24-days old plants.

There was no significant interaction observed between weed management and seedling ages on number of established plants during the period of the study.

4.3. Plant height

The effect of weed management and seedling age on plant height of rice at 3 weeks after transplanting during 2022/2023 dry season is presented on table 4.3. The result showed that, application of Bracerplus at 0.155 Lha^{-1} produced significantly ($p \leq 0.05$) taller plants than application of Bracerplus at 0.142 Lha^{-1} and by application of Nomineegold at 0.200 Lha^{-1} fb hoe weeding at 6WAT, but was significantly similar to all other weed management treatments. While, Bracerplus at the rate of 0.142 Lha^{-1} had shortest plants, at 3 WAT, although, comparable to all other treatments except bracer at 0.275 Lha^{-1}, bracerplus at 0.155 Lha^{-1} and hoe weeding at 4 & 8 WAT. At 6WAT, however significant difference was observed in heights of plants of the weed management and heights of plants of the weedy check. The plant heights of the weedy check were the shortest. Application of Bracer at 0.275 Lha^{-1} recorded the tallest plant, while application of Bracer at 0.300 Lha^{-1} at 6WAT was observed to record plant heights that were statistically comparable to plant heights recorded from the application of Bracerplus at 0.142 Lha^{-1}; also application of Bracer at 0.325 Lha^{-1} produced plants with heights comparable to plant heights recorded from the application of Bracerplus at 0.155 Lha^{-1}, Nomineegold at 0.200 Lha^{-1} and 0.500 Lha^{-1} for the same period of the study. Also application of Bracer at 0.250 Lha^{-1} followed by hoe weeding at 6WAT, produced plant with similar heights when applied with Bracerplus at 0.168 Lha^{-1}, Nomineegold at 0.300 Lha^{-1} and 0.400 Lha^{-1}. Significant difference in plant heights was observed between plants applied with Bracerplus at 0.129 Lha^{-1} and plants applied with Nomineegold at 0.300 and 0.400 Lha^{-1}, Manual weeding at 4 and 8 WAT and with the weedy check. Plant heights recorded from the application of Bracer at 0.129 Lha^{-1} were the tallest while those of the weedy check were the shortest for the period of study. This may be attributed to the competition for nutrients and moisture between the rice plants and weeds due to infestation in the weedy check. At 9WAT, heights of plants progressively increased; plants applied with Bracerplus at 0.142 Lha^{-1} were tallest during this period. Next tallest plants were obtained from the application of Bracer at 0.250 Lha^{-1} followed by hoe weeding at 6WAT, application of Bracer at 0.275 Lha^{-1} and application of Nomineegold at 0.500 Lha^{-1} that produced plants whose heights were statistically similar but significantly different with the plants in the weedy check at 5%, while application of Bracerplus at 0.142 Lha^{-1} was observed to record plant heights that were comparable to plant applied with Bracer at 0.250 Lha^{-1} followed by hoe weeding at 6WAT and 0.275 Lha^{-1} and Nomineegold at 0.500 Lha^{-1}. At 12WAT, plant heights were tallest throughout the period of study. Application of Bracerplus at 0.142 Lha^{-1} progressively produced the tallest plant from 9WAT. This plant height was statistically similar to plant height recorded from the application of Bracer at 0.250 Lha^{-1} followed by hoe weeding at 6WAT and at 0.275 Lha^{-1}. It was observed that plant heights recorded from the application of Nomineegold at 0.500 Lha^{-1} were taller and significantly different from the weedy check treatment whose heights were least among the treatments. Plant heights produced from the treatment of Bracerplus at 0.168 Lha^{-1}, Nomineegold at 0.200 Lha^{-1} , 0.300 Lha^{-1} and 0.400 Lha^{-1} all recorded statistically comparable plant heights.

Plant seedling age did not significantly differ between each other in plant heights they were statistically comparable throughout the period of study, though they vary in magnitude.

4.4. Effective tillers per plant

The effect of weed management and seedling age on effective tillers is shown on table 4. The Result showed that the effective tillers progressively increased from 3WAT to 12WAT respectively. At 3WAT, plots treated with Nomineegold at 0.500Lha^{-1} produced the highest number of tillers (5.24) that was significantly different from the application of all the rates of other herbicides and with weedy check except Bracerplus at 0.129 Lha^{-1} followed by hoe weeding at 6WAT. Application of Bracerplus at 0.142 Lha^{-1}, Bracerplus at 0.155 Lha^{-1} and Bracerplus at 0.168 Lha^{-1} were statistically similar. Weedy check was observed to have the least number of tillers during the period. At 6 WAT, significant difference was observed between the number of tillers recorded from the application of Bracer at 0.325 Lha^{-1} which were the highest and the weedy check. The number of tillers of the weedy check were the least, however application of Bracer at 0.325 Lha^{-1} produced comparable number of tillers recorded from the application of Bracer at 0.250 Lha^{-1}, 0.275 Lha^{-}1 and 0.300 Lha^{-1}, Bracerplus at 0.129 Lha^{-1} followed by hoe weeding at 6WAT, Bracerplus at 0.142 Lha^{-1} , Bracerplus at 0.155 Lha^{-1}, Nomineegold at 0.200 Lha^{-1} followed by hoe weeding at 6WAT, and Nomineegold at 0.300 Lha^{-1}. Application of Bracer at 0.300 Lha^{-1}(W3) produced comparable number of tillers as application of Bracerplus at 0.155 Lha^{-1}, Nomineegold at 0.400 Lha^{-1}and at 0.500 Lha^{-1} and hoe weeding at 4 and 8 WAT. Application of Bracerplus at 0.155 Lha^{-1} recorded statistically comparable number of tillers as Nomineegold at 0.400 Lha^{-1}, although the number of tillers from application of Bracerplus at 0.155 Lha^{-1} were inferior. From 9WAT till 12 WAT, application of Bracerplus, progressively produced the highest tillers that were significantly different from tillers of plants in the weedy check during both periods. Application of all the rates of Bracer and Bracerplus produced statistically similar number of tillers and most superior tillers over tillers obtained from the application of rates of Nomineegold at 0.500 Lha^{-1} that produced tillers that were statistically comparable and the weedy check was observed to be the least at 9 and 12 WAT. This may be attributed to the weed infestation of the treatment plots.

There was no significant difference observed between the seedling ages in the number of tillers. The seedling ages recorded statistically comparable number of tillers during the study period. From 3WAT to 6WAT, seedlings transplanted at 17-days old recorded highest number of tillers among the seedlings, while seedlings transplanted at 10-days old recorded highest number of tillers from 9WAT to12WAT. Seedlings transplanted at 24-days old recorded the minimum number of tillers throughout the growing period.

There was no observed significant difference in interaction between the weed management and seedling ages in number of tillers during the study period.

4.5. Number of Leaves

The effect of Weed management and seedling ages on number of leaves is presented on table 4.5. The result showed that application of Bracerplus at 0.129 Lha^{-1} recorded the highest number of leaves that was significantly different from number of leaves observed from the weedy check at 3WAT. Application of all rates of Bracerplus and Nomineegold recorded higher number of leaves that were superior to number of leaves observed from the application of all rates of Bracer. At 6WAT, Bracer applied at the rate of 0.325 Lha^{-1}, produced the highest number of leaves that were most superior overall number of leaves recorded from the application of any of the other weed management treatments especially the weedy check that was observed to produce the least number of leaves which were significantly smaller and different from the highest number of leaves recorded by the application of the highest rate of Bracer (0.325 Lha^{-1}). The application of all the rates of Bracerplus and Nomineegold produced plants with similar and statistically comparable number of leaves with each other while application of all the rates of Bracer produced plants with statistically similar number of leaves that were comparable to number of leaves produced by plants applied with either rates of Bracerplus or Nomineegold. At 9WAT, Bracer at the highest rate (0.325 Lha^{-1}), recorded highest number of leaves at the period. Application of all the rates of Bracerplus and Nomineegold were observed to be statistically similar with one another, while application of all the rates of Bracer produced plants with significantly different from one another. At 12WAT, the application of the highest rates of Bracer consistently recorded the highest number of leaves from 6-12WAT. Application of Bracer at 0.250, 0.275 and 0.300 Lha^{-1} produced plants whose number of leaves were significantly different with the number of leaves obtained when highest rate of Bracer was applied. Application of all the rates of Bracerplus and Nomineegold produced plants with similar and statistically comparable number of leaves with each other. The weedy check treatment consistently produced plant with the least number of leaves throughout the period of study indicating the effect of weed infestation on the number of leaves.

Plant seedling ages produced comparable number of leaves throughout the period of study although the number of leaves progressively increased from 3-12WAT. At 12WAT, seedlings transplanted at 10-days old produced highest number of leaves than other seedling ages of 17 and 24-days. There was no significant interaction between weed management and seedling ages in the number of leaves produced throughout the period of study.

4.6. Days to 50% Booting, Heading and Maturity

The effect of weed management and seedling age on 50% booting, heading and maturity is shown on table 4.6. The result showed that plants in the weedy check took longer days to attain 50% booting, heading and maturity while plants applied with the herbicides attained 50% booting, heading and maturity earlier. At 50% booting, significant difference was observed between weedy check and manual weeding at 4 and 8 WAT, application of all rates of Bracerplus (W_5-W_8) attained 50% booting comparably the same time.

At 50% heading, weedy check also delayed attainment by taking longer days (78.44) to achieve 50% heading. Significant difference was observed in attainment of 50% heading between the weedy check and application of all the rates of Nomineegold, Bracer and the last three rates of Bracerplus namely 0.142 Lha^{-1}, 0.155 Lha^{-1}, and 0.168 Lha^{-1}. Significant difference was also observed between the weedy check and application of Bracer 0.250 Lha^{-1}, 0.300 Lha^{-1},0.325 Lha^{-1} and the manual weeding at 4 and 8 WAT (W_{13}) (farmers practice); Plants treated with the herbicides attained 50% heading earlier over the plants in the weedy check (W_{14}). 50% maturity was also observed to be delayed by taking longer days to attain in the weedy check treatment. Plants applied with rates of Bracer(W_1-W_4), Bracerplus (W_5-W_8) and Nomineegold(W_9-W_{12}) all attained 50% maturity earlier than the plants in the weedy check; significant difference was also observed in attaining 50% days to maturity between the weedy check and application of Bracer at 0.275 Lha^{-1}, 0.300 Lha^{-1}(W_3), Bracerplus at 0.129 Lha^{-1}(W_5) (followed by hoe weeding at 6 WAT), Nomineegold at 0.300 Lha^{-1}(W_{10}), 0.500 Lha^{-1}(W_{12}) and manual weeding at 4 and 8 WAT (W_{13}) (farmers practice).

Seedling age did not show significant difference in days to attain 50% booting, heading and maturity although the seedling age were statistically similar, 10-days old seedling took longer days (67.09) to attain 50% booting, while 24- day old seedlings attained 50% booting earlier 66.80 days. The same trend was observed in days to attain 50% heading, the 24-day old seedlings attained 50% heading earlier over 10-days old plants and 17-days old plants. The 24-day old plants matured earlier of over 10-days and 17- days old plants during the study period. There was no significant interaction observed between weed management and seedling age on days to attain 50% booting, heading and maturity.

4.7. Panicle weight and panicle length

The effect of weed management and seedling age on panicle weight and panicle length is shown on table 4.7. The result showed that application of Bracerplus at 0.129 Lha^{-1}, produced the highest panicle weight and panicle length. Significant difference was observed in panicle weight between plants applied with Bracerplus at 0.129 Lha^{-1} (W_5) (followed by hoe weeding at 6 WAT) and plants applied with Bracer at 0.325 Lha^{-1}(W_4), Bracerplus at 0.155 Lha^{-1}(W_7), 0.168 Lha^{-1}(W_8), and with all the rates of Nomineegold and manual weeding at 4 and 8 WAT, (farmers practice) and the weedy check. The panicle length of plants applied with the weed management treatment were all superior over the panicle length of the plants in weedy check treatment. The panicle length of the plants treated with rates of Bracerplus and Nomineegold were statistically similar to one another. Significant difference was observed (only) between the panicle length of plants applied with Bracerplus at 0.129 Lha^{-1} (followed by hoe weeding at 6 WAT) and plants in the weedy check, all the other plants treated with the rates of Bracerplus and Nomineegold and Bracer at 0.275, 0.300, and 0.325 Lha^{-1} were observed to have panicle length that were statistically similar.

Plant seedling age did not show significant difference in either panicle weight or panicle length. Despite the insignificance seedling transplanted at 10-days old were observed to have highest panicle weight than either 17 or 24- days' old seedling. Similarly the panicle length of seedling transplanted at 10-days old were longer than panicle length of 17- day old seedling and 24- day old seedling.

There was no significant interaction observed between weed management and seedling age in either panicle weight or panicle length during the period of study.

4.8. 1000 grain weight, Grain yield, crop dry matter and harvest index

The effects of weed management and seedling age on 1000 grain weight, grains yield, crop dry matter and harvest index are presented on table 4.8. The result showed that application of Bracerplus at 0.129 Lha^{-1} (W_5) recorded the highest (27.00g) 1000 grain weight which was significantly different to 1000 grain weight of the weedy check and manual weeding at 4 and 8 WAT and application of Bracer at 0.275 Lha^{-1} (W_2). Application of Bracer at 0.300 Lha^{-1} (W_3), and 0.325 Lha^{-1}(W_4), Bracerplus at 0.142 Lha^{-1} (W_6) and Nomineegold at 0.200 Lha^{-1} (W_9), 0.300 Lha^{-1}(W_{10}) and 0.500 Lha^{-1} (W_{12}) were observed to record comparable 1000 grains weight. Application of Bracer at 0.250 Lha^{-1}, Bracerplus at 0.129 Lha^{-1} (W_5) and Nomineegold at 0.400 (W_{11}) were observed to record similar 1000 grains weight.

The highest grains yield (1,842.4 $Kgha^{-1}$) was observed to be recorded by the application of Bracerplus at 0.129 Lha^{-1} (W_5) (followed by hoe weeding at 6 WAT), this was statistically comparable to grain yield obtained from the application of Nomineegold at 0.400 and 0.500 Lha^{-1}. The grain yield was significantly different to manual weeding at 4 and 8 WAT (W13) and the weedy Check. Application of all the rates of Bracer recorded yield that were similar to one another and with application of Nomineegold at 0.400 Lha^{-1}, they were statistically different to yield recorded by the application of Bracerplus at 0.168 Lha^{-1} (W_8). Application of Bracerplus at 0.129 Lha^{-1} (W_5) (followed by hoe weeding at 6 WAT), was observed to record the highest crop dry matter (0.1722 Ton ha^{-1}) which was superior to crop dry matter recorded from application of other weed management treatments and the weedy check. Significant difference was observed among the weed management treatments; application of Bracerplus at 0.129 Lha^{-1} (W_5) recorded crop dry matter that was significantly different from crop dry matter obtained from application of Nomineegold at 0.300 Lha^{-1} (W_{10}), and Bracerplus at 0.168 Lha^{-1} (W_8), however, application of all the rates of Bracer were statistically similar to application of Nomineegold at 0.200 Lha^{-1}(W_9), and at 0.500(W_{12}) and Bracerplus at 0.155 Lha^{-1} (W_7).

The least crop dry matter 0.0265 $Tonha^{-1}$ was observed to be recorded by the weedy check while Nomineegold at 0.300 Lha^{-1} (W_{10}) was observed to record the least crop dry matter (0.0643 Ton ha^{-1}) among the chemical herbicide treatment. Application of Bracer at 0.250 Lha^{-1} (W_1) was observed to record comparable crop dry matter as application of 0.400 Lha^{-1} (W_2) of Nomineegold.

The application of Bracerplus at 0.129 Lha^{-1} (W_5) (followed by hoe weeding at 6 WAT) recorded the highest harvest index of 0.5357 during the period of study which was comparable to harvest index recorded by application of Nomineegold at 0.500 Lha^{-1} (W_{12}) (0.5246). Both were superior over the harvest indices observed from application of other herbicide treatment and manual weeding (farmers practice) at 4 and 8 WAT (W_{13}). The highest harvest index significantly differed with harvest index recorded by the weedy check 0.3460. Harvest index recorded from application of all the rates of Bracer were observed to be statistically comparable to harvest index recorded from the application of Bracerplus at 0.142 Lha^{-1} and at 0.155 Lha^{-1}, Nomineegold at 0.300 Lha^{-1}, and at 0.400 Lha^{-1} and manual weeding at 4 and 8 WAT (farmers practice).

Seedling age did not differ significantly in weight of 1000 grains, 10 day old seedling and 24 day old seedlings were observed to record higher 1000 grains weight over 17 day old seedlings.

Seedling age of plant differed significantly ($p<0.05$) in grain yield; seedlings transplanted at 24 days old recorded highest grain yield significantly over seedlings transplanted at 10-days old, while seedlings transplanted at 17 days old recorded higher grain yield over 10-day old seedlings but lower than 24 day old seedling. The crop dry matter did not differ significantly between the seedlings ages, however plants transplanted at 24- days old recorded highest crop dry matter (0.1367 Ton ha^{-1}) while seedlings transplanted at 10-days old recorded the least crop dry matter (0.0868 Ton ha^{-1}), seedlings transplanted at 17 day old recorded crop dry matter of 0.1025 Ton ha^{-1} lower than the highest crop dry matter of 0.1367 Ton ha^{-1}.

Significant difference was observed between the seedling age in harvest index, seedlings transplanted at 24 day old recorded highest harvest index 0.4836 while seedlings transplanted at 17-days old recorded lower harvest index 0.4493 and seedlings at 10 days old recorded the least harvest index 0.3924 which was significantly different with the highest harvest index, this may be attributed to the respective ages of the seedlings.

There was no significant interaction between weed management and seedling age in 1000 grains weight, grains yield and crop dry matter and harvest index during the study period.

Phytotoxicity

There was no phytotoxic effect of bispyribac sodium at any of the doses on rice crop during the study period.

Discussions

Effective tillers

Significant difference was observed between the weed management treatments and across the period. The highest effective tillers (28.44) were observed to be recorded by the application of Bracerplus at 0.129 L ha^{-1} supplemented by hoe weeding at 6WAT at maturity (12 WAT), this might be attributed to the combination of herbicidal and manual weeding which is an integrated weed management approach on the plants that enhanced production of tillers due to reduced competition with weeds, hoe weeding at 4 and 8 WAT recorded the next highest effective tillers (23.56) amongst the weed management treatments, while the weedy check recorded the least (7.70) effective tillers. This may be attributed to the competition with weeds (due to weed infestation) for nutrients by the rice plants which makes it difficult for the production of tillers. Seedling age did not show significant difference in effective tillers across the period of study and at maturity; 10-day old seedlings recorded the highest number of effective tillers followed by 17-day old seedlings while 24- day old seedling recorded the least number of tillers. Rice transplanted with 5-day old seedlings had the highest number of tillers at MT, and flowering, both total and productive tillers at harvest than all others. In contrast, the DSR reported the lowest number of tillers at maximum tillering, at flowering and at harvest and productive tillers at harvest.

Crop dry matter

At maturity, the dry matter accumulation obtained from the application of all other weed management treatment and the farmers practice (Manual wedding at 4 and 8 WAT) were significantly different from dry matter accumulation obtained by the application of Bracer at 0.250 Lha^{-1} (followed by hoe weeding at 6 WAT). Dry matter accumulation obtained in the weedy check at 12 WAT was statistically similar to dry matter produced by plants manually with it at 4 and 8 (farmers practice).

Plants seedling age did not differ significantly in dry matter accumulation produced. However, at 3WAT, 17- day old seedlings accumulated the highest dry matter of 22.08 g, while at 9 WAT 24- day old seedling produced the highest dry matter accumulation of 22.56g conversely at 12 WAT, 24- day old seedlings accumulated the least dry matter of 17.50 g. The highest straw yield (6.30 t ha^{-1}) was obtained from application of Panida + one had weeding at 35 DAT (W5) which was statistically identical with application of Manage + one hand weeding at 35 DAT (W4), application of Panida (W3) and application of manage (W2) treatments. The lowest straw yield (5.73 t ha^{-1}) was recorded in no weeding (W0) treatment. [50] further observed interaction between weed management and seedling age on straw yield also reports that the highest straw yield (6.70 t ha^{-1}) was produced from the interaction of 25-day-old seedlings × (application of Panida + one hand weeding at 35 DAT) (W5) treatment which was statistically similar with 25-day-old seedlings and other weed management practices except no weeding (W0).

At days to 50% heading, weedy check also delayed attainment by taking longer period (78.44 days) to attain 50% heading. Significant difference was observed in attainment of 50% heading between the weedy check and application of all the rates of Nomineegold, Bracer and the last three rates of Bracerplus namely 0.142 Lha^{-1},(W_6) 0.155 Lha^{-1}(W_7), and 0.168 Lha^{-1}(W_8). Significant difference was also observed between the weedy check and application of Bracer 0.250 Lha^{-1}(W_1), 0.300 Lha^{-1}(W_3), 0.325 Lha^{-1} and the manual weeding at 4 and 8 WAT (farmers practice); Plants treated with the herbicides attained 50% heading earlier over the plants in the weedy check (W_{14}). 50% maturity was also observed to be delayed by taking longer days to attain in the weedy check treatment. Plants applied with rates of Bracer(W_1-W_4), Bracerplus (W_5-W_8) and Nomineegold(W_9-W_{12}) all attained 50% maturity earlier than the plants in the weedy check; significant difference was also observed in attaining 50% days to maturity between the weedy check and application of Bracer at 0.275 Lha^{-1}(W_1), 0.300 Lha^{-1}(W_3), Bracerplus at 0.129 Lha^{-1}(W_5) (followed by hoe weeding at 6 WAT), Nomineegold at 0.300 Lha^{-1}(W_{10}), 0.500 Lha^{-1}(W_{12}) and manual weeding at 4 and 8 WAT (farmers practice).

1000-grain weight, Grain yield

The weed management treatments significantly affected 1000 grain weight, grain yield, crop dry matter and harvest index. The highest grain yield (1,842.40 $Kgha^{-1}$) was observed to be recorded from 10-day old seedlings x (the application of Bracerplus at 0.129 Lha^{-1} + hoe weeding at 6 WAT), this was statistically comparable to grain yield obtained from the application of Nomineegold at 0.400 and 0.500 Lha^{-1}. This was similar to the findings of Salam *et al.*,(2014) who reported that "the highest grain yield (6.29 t ha-1) was recorded from25-day-old seedling × (application of Panida + one hand weeding at 35 DAT) which was statistically similar

(6.20 t ha-1) with 25-day-old seedling × (application of Manage + one hand weeding at 35 DAT). The integrated approach like herbicides + hand weeding performed better than herbicides or hand weeding alone, such as application of Panida + one hand weeding at 35 DAT or application of Manage + one hand weeding at 35 DAT". The grain yield was significantly different to manual weeding ta 4 and 8 WAT and the weedy check. Application of all the rates of Bracer recorded yield that were similar to one another and with the application of Nomineegold at 0.400 Lha^{-1}, they were statistically different to yield recorded by the application of Bracerplus at 0.168 Lha^{-1}. [50] reports that all the yield and yield contributing characters except 1000-grain weight of boro rice was significantly affected by different weed management practices, They observed that the highest grain yield (5.76 t ha^{-1}) was recorded from application of Panida + one hand weeding at 35 DAT was statistically identical with application of Manage + one hand weeding at 35 DAT (W4) and purgation of Panida (W3) treatments. The lowest grain yield (4.38 t ha^{-1}) was obtained from no weeding (wo) treatment.

Summary

Experiment was conducted during the dry season of 2022/2023 in the Fadama area of Teaching and Research Farm of Kebbi State University of Science and Technology Aliero located at Jega (lat. 12^0 16.04' N: long.04^0 29.85', 262 m above sea level),to investigate the performance of ice under the influence of five weed management methods and seedling age. Jega is characterized with erratic and Scanty rainfall that lasts for about 5 months (May - September) and long dry period (October- April), The climate of the area is semi-arid with average rainfall of 550-650mm per annum. The relative humidity ranges from 21-47% and 51- 79%% during the dry and rainy seasons respectively. Temperature averages between 14- 30 "C during dry season and 27-41°C during the rainy season.

Treatments consisted of rice variety (Faro 44), three seedling ages (10, 17 and 24 days old) Five weed management methods comprising of three selected post emergence herbicides (namely, Bracer, Bracerplus and Nomineegold at four rates each), that is Bracer at: 0.250 Lha^{-1} +1 hoe weeding at 6 WAT, 0.275 Lha^{-1} ,0.300 Lha^{-1}, and 0.325 Lha^{-1}, four rates of Bracerplus namely;0.129 Lha^{-1} + 1 hoe weeding at 6 WAT, 0.142 Lha^{-1}, 0.155 Lha^{-1}, and 0.168 Lha^{-1}, four rates of Nomineegold namely 0.200 Lha^{-1} +1 hoe weeding at 6 WAT, 0.300 Lha^{-1}, 0.400 Lha^{-1} and 0.500 Lha^{-1} hoe weeding at 4 and 8 weeks after transplanting (Farmers practice), and a weedy check, imposed as control. The treatments were laid out in a completely randomized block design in split plot arrangement with three replications. Variety and age of seedlings were allocated to the main plot, while weed management methods were allocated to the subplots.

Plots were marked out. The plot size was 2 x 2m = 4m separated by lm space between the plots of the same replicate, while 2m space was provided between blocks. The inter and intrar row spacing was 20x20cm with two seedling per stand, the net plot area ($1.80m^2$) contained ten (10) middle rows for growth and yield assessment, while the boarder rows were used for destructive sampling. The total plot area was 14 x 22m=$396m^2$. Three nursery beds were prepared for Faro 44 with dimensions of 5x2m ($10m^2$). The beds were fertilized with NPK 20:10:10 at $50gm^{-2}$. The rice seeds were sown by drilling at an inter row spacing of 30cm. the beds were adequately irrigated in every two days interval to supply enough water. Twenty tour days to transplanting seedlings into field, seeds were sown in the first bed, there after seven days later, second seeds were sown in the second bed, and the third bed were sown seven days after the second bed was sown. Ten days after sowing the third bed, the set of seedling ages for 24, 17 and 10 days was achieved transplanting was done right away into the field on that same day during the 2020/2021 dry season. Surface Irrigation method was done at an interval of three days to fill the basin which was increased to two days when the evapo-transpiration increased.

Results obtained for the weed flora during the 2022/2023 dry season farming, showed that thirty-six weed species were identified growing in association with rice under study. Seventeen (17) species or 47.22% were broadleaved, Sixteen (16) species or 44.44% were grasses while three (3) or 8.33% were sedges. The most dominant weed species were *Digitaria ciliaris* and *Echinochoa Colona* to the grass species, they were followed by *Cyprus iria* and *C. deformis* of the sedges species, while the least dominant species Occurs from all the species of broadleaf, grass and the sedges; *Melochia corchorifolia* from the broadleaf weeds, *Ischaemum rugosum* from the grass weeds and *Cyperus haspan* from the sedges weeds were among the least dominant species of the weeds found growing in association with rice under study. The grass species *Echinochoa colona* has the highest value index of 52.12 followed by *Digitaria ciliaris* with IVI of 48.79 it is fb Cyprus deforms (24.06) and C. area (23.56) respectively. *Digitaria horizontalis* was next important weed fb *Hacklechloa granularis* fb *Echinochoa obtusiflora*. The weed species with the least importance are *Ischaemum rugosum*, *Echinochloa stagnina*, *Neptunia oleracea*, *Melochia corchorifolia*, *Schizachyrium exile* and *Panicum subalbidum*.

Conclusion

From the study on the performance of rice (*Oriza sativa*) under the influence of three selected post emergence herbicides and seedling age. It was concluded that:

1. Thirty-six weed species were identified growing in association with rice under study. Seventeen (17) species or 47.22% were broadleaved, Sixteen (16) species or 44.44% were grasses while three (3) or 8.33% were sedges.
2. Application of Bracerplus at 0.129 Lha^{-1} and Nomineegold at 0.500 Lha^{-1} recorded the highest significant grain yield of 3,316.32 and 2,908.08$Kgha^{-1}$ respectively.
3. Seedlings transplanted at 10-day old recorded the highest yield of 1309.0 $Kgha^{-1}$ followed by 17-day old seedlings (1163.6 $Kgha^{-1}$) and 24- day old seedlings recorded the least yield of (1096.8 $Kgha^{-1}$).

Recommendations

Applications of Bracerplus at 0.129 Lha^{-1} and Nomineegold at 0.500 Lha^{-1} are recommended for use on Faro 44 in the study area, while rice seedlings should be transplanted between the ages of 10-day and 17-day old.

Table 4.1.0: Weeds Identified and their respective attributes in rice plots at Jega in 2019/2020 dry season

Weed Species	D	F	A	RD	RF	RA	IVI
Broad leaf							
Starchytarpheta cayenensis	1.397	3.97	8.80	2.17	2.43	4.01	8.61
Ludwigia abyssinica	0.190	2.38	2.00	0.30	1.46	0.91	2.66
Echinochloa obtusiflora	6.063	17.46	8.68	9.42	10.68	3.96	4.06
Sida linifolia	0.063	0.79	2.00	0.10	0.49	5.13	5.71
Hyptis lanceolata	0.063	0.79	2.00	0.10	0.49	0.91	1.50
Shrankia leptocarpa	0.095	1.59	1.50	0.15	0.97	0.68	1.80
Aeschynomene indica	0.063	1.59	1.00	0.10	0.97	0.46	1.53
Melochia corchorifolia	0.032	0.79	1.00	0.05	0.49	0.46	0.99
Euphobia hyssofolia	0.095	0.79	3.00	0.15	0.49	1.37	2.00
Ethulia cinyzoides	1.27	8.73	3.64	1.97	5.34	1.66	8.97
Fimbristylis ferruginea	0.921	3.17	7.25	1.43	1.94	3.31	6.68
Fimbristylis littoralis	1.143	7.94	3.60	1.78	4.85	1.64	8.27
Mimosa pudica	0.540	10.32	1.31	0.84	6.31	0.60	7.75
Alternanthera sessilis	0.698	4.76	3.67	1.08	2.91	1.67	5.67
Poligonium salicifolium	0.508	1.59	8.00	0.79	0.97	3.65	5.41
Leptochloa caerulescens	0.095	0.79	3.00	0.15	0.49	1.37	2.00
Leersia hexandra	0.127	0.79	4.00	0.20	0.49	1.82	2.51
Neptunia oleracea	0.032	0.79	1.00	0.05	0.49	0.46	0.99

Weed Species	D	F	A	RD	RF	RA	IVI
Grasses							
Echinochloa obtusiflora	1.746	3.97	11.00	2.71	2.43	5.02	10.16
Dactyloctenium aegyptium	0.063	0.79	2.00	0.10	0.20	0.91	1.21
Hackelochloa granularis	1.016	0.79	32.00	1.58	0.49	14.59	16.66
Brachiaria lata	0.476	0.79	15.00	0.74	0.49	6.84	8.07
Eleusine indica	0.254	0.79	8.00	0.39	0.49	3.65	4.53
Schizachyrium exile	0.032	0.79	1.00	0.05	0.49	0.46	0.99
Paspalum vaginatum	0.254	1.59	4.00	0.39	0.97	1.82	3.19
Chloris pilosa	0.190	1.59	3.00	0.30	0.97	1.37	2.64
Digitaria ciliaris	17.111	21.43	19.96	26.58	13.11	9.10	48.79
Echinochloa colona	17.270	30.95	13.95	26.82	18.93	6.36	52.12
Digitaria horizontalis	5.143	10.32	12.46	7.99	6.31	5.68	19.98
Mariscus longibracteatus	0.063	1.59	1.00	0.10	0.97	0.46	1.53
Panicum subalbidum	0.063	0.79	2.00	0.10	0.49	0.91	1.50
Echinochloa stagnina	0.032	0.79	1.00	0.05	0.49	0.46	0.99
Oryza barthii	0.476	3.17	3.75	0.74	1.94	1.71	4.39
Ischaemum rugosum	0.032	0.79	1.00	0.05	0.49	0.46	0.99
Sedges							
Cyperus difformis	6.063	17.46	8.68	9.42	10.68	3.96	24.06
Cyperus iri	6.444	12.70	12.69	10.01	7.77	5.79	23.56
Cyperus haspan	0.317	0.79	10.00	0.49	0.49	2.55	3.53

Table 4.2.0: Effect of Weed management and seedling age on plant establishment count during 2022/2023 dry season at Jega

	Rate (Lha^{-1})	Establishment
Weed management		
Bracer 1 +hoe weeding @ 6WAT	0.250	70.00b
Bracer 2	0.275	77.53ab
Bracer 3	0.300	76.17ab
Bracer 4	0.325	81.61ab
Bracerplus 1+ hoe weeding @ 6WAT	0.129	80.25ab
Bracerplus 2	0.142	81.24ab
Bracerplus 3	0.155	77.04ab
Bracerplus 4	0.168	76.05ab
Nomineegold 1+ hoe weeding @ 6WAT	0.200	74.57ab
Nomineegold 2	0.300	81.61ab
Nomineegold 3	0.400	71.73ab
Nomineegold 4	0.500	86.67a
Hoe weeding @ 4 and 8WAT	-	69.51b
Weedy Check	-	67.04b
SE±		**1.245**
Seedling ages		*
10-days old	-	82.80a
17-days old	-	78.25a
24-days old	-	68.44b
SE±		**0.576**
		*
WXS		**NS**

Means followed by the same letter(s) in a treatment group are not significantly different at 5% level of significance using DMRT
NS= non significant

Table 4.3: The Effect of weed management and seedling age on plant height during 2022/2023 dry Season at Jega

	Rate		Plant height		
	Lha^{-1}	3WAT	6WAT	9WAT	12WAT

Weed management					
Bracer 1 +hoe weeding @ 6WAT	0.250	6.44abc	11.74cde	23.80ab	55.53ab
Bracer 2	0.275	7.15ab	16.89a	23.21ab	54.16ab
Bracer 3	0.300	6.39abc	14.34bc	20.94abcd	48.87abcd
Bracer 4	0.325	6.17abc	12.75bcd	20.13abcd	46.98abcd
Bracerplus1+hoe weeding @ 6WAT	0.129	6.19abc	15.03ab	22.01abc	51.36abc
Bracerplus 2	0.142	5.30c	14.41bc	25.06a	58.46a
Bracerplus 3	0.155	7.21a	12.86bcd	21.34abc	49.80abc
Bracerplus 4	0.168	6.38abc	10.70de	18.77bcd	43.79bcd
N/gold 1+ hoe weeding @ 6WAT	0.200	5.49bc	12.55bcd	18.79bcd	43.84bcd
Nomineegold 2	0.300	5.78abc	11.91cde	18.58bcd	43.35bcd
Nomineegold 3	0.400	6.02abc	11.13de	17.29cd	40.34cd
Nomineegold 4	0.500	6.15abc	12.36bcd	23.40ab	54.60ab
Hoe weeding @ 4 and 8WAT	-	6.72ab	9.92e	17.52cd	40.88dc
Weedy Check	-	6.28abc	9.64e	15.51d	36.19d
SE±		**0.409**	**0.525**	**0.756**	**1.156**
Seedling ages		*	*	*	*
10-days old	-	6.61	12.21	19.33	45.12
17-days old	-	6.11	12.73	20.60	48.07
24-days old	-	6.05	13.03	21.42	49.99
SE±		**0.189**	**0.243**	**0.350**	**0.534**
WXS		**NS**	**NS**	**NS**	**NS**

Means followed by the same letter(s) in a treatment group are not significantly different at 5% level of significance using DMRT.
NS= non significant

Table 4.4: The Effect of weed management and seedling age on number of effective tillers per plant 2022/2023 dry Season at Jega

	Rate Lha^{-1}	Effective tillers 3WAT	6WAT	9WAT	12WAT
Weed management					
Bracer 1 +hoe weeding @ 6WAT	0.250	3.51bc	13.52abc	15.67bc	20.89bc
Bracer 2	0.275	3.84bc	13.88abc	16.64bc	18.52bcd

Bracer 3	0.300	3.89bc	11.74abc	13.56bcd	18.07bcd
Bracer 4	0.325	4.09bc	17.98a	16.22a	21.63bc
Bracerplus1+hoe weeding @ 6WAT	0.129	4.17abc	15.46ab	21.33a	28.44a
Bracerplus 2	0.142	4.16abc	16.18ab	16.33bc	21.78bc
Bracerplus 3	0.155	4.56ab	11.92abc	11.22cd	14.96cd
Bracerplus 4	0.168	4.56ab	10.00bc	10.33de	13.78de
N/gold 1+ hoe weeding @ 6WAT	0.200	3.80bc	14.58ab	13.33bcd	17.78bcd
Nomineegold 2	0.300	3.69bc	14.09ab	11.33cd	15.11cd
Nomineegold 3	0.400	3.96bc	13.43abc	12.22cd	16.30cd
Nomineegold 4	0.500	5.24a	13.27abc	15.78bc	21.04bc
Hoe weeding @ 4 and 8WAT	-	3.87bc	13.83abc	17.67ab	23.56ab
Weedy Check	-	3.22c	7.39c	5.78e	7.70e
SE±		**0.341**	**0.813**	**0.736**	**0.849**
Seedling ages		*	*	*	*
10-days old	-	4.09a	14.70a	14.57a	19.43a
17-days old	-	4.23a	14.81a	13.92a	18.57a
24-days old	-	3.79a	11.20a	13.21a	17.62a
SE±		**0.158**	**0.377**	**0.340**	**0.393**
WXS		**NS**	**NS**	**NS**	**NS**

Means followed by the same letter(s) in a treatment group are not significantly different at 5% level of significance using DMRT. NS= non-significant

Table 4.5: The Effect of weed management and seedling age on number of leaves per plant during 2022/2023 dry Season at Jega

	Rate Lha^{-1}	Number of leaves per plant 3WAT	6WAT	9WAT	12WAT
Weed management					
Bracer 1 +hoe weeding @ 6WAT	0.250	11.89ab	24.03ab	27.91bcd	39.80bc
Bracer 2	0.275	13.11ab	25.92ab	27.40bcd	40.73bc
Bracer 3	0.300	11.00b	21.76bc	31.06bc	42.06bc
Bracer 4	0.325	13.11ab	29.22a	45.11a	58.22a

Bracerplus1+hoe weeding @ 6WAT	0.129	14.44a	26.05ab	31.17bc	45.61bc
Bracerplus 2	0.142	11.33b	24.39ab	29.62bc	40.96bc
Bracerplus 3	0.155	11.56ab	26.21ab	22.78cd	34.33cd
Bracerplus 4	0.168	13.22ab	21.32bc	23.31cd	36.53cd
N/gold 1+ hoe weeding @ 6WAT	0.200	12.78ab	24.58ab	27.69bcd	40.47bc
Nomineegold 2	0.300	12.56ab	23.66ab	25.46bcd	38.01bcd
Nomineegold 3	0.400	11.44b	24.86ab	23.19cd	34.63cd
Nomineegold 4	0.500	12.44ab	24.49ab	29.99bc	42.43bc
Hoe weeding @ 4 and 8WAT	-	10.67b	26.95ab	38.98ab	49.64ab
Weedy Check	-	11.11b	15,58c	17.38d	26.49d
SE±		**0.551**	**0.808**	**1.152**	**1.127**
Seedling ages					
10-days old	-	12.19	25.49	30.61	42.80
17-days old	-	12.19	24.47	27.94	40.13
24-days old	-	12.24	23.11	26.96	39.20
SE±		**0.255**	**0.374**	**0.533**	**0.521**
WXS		**NS**	**NS**	**NS**	**NS**

Means followed by the same letter(s) in a treatment group are not significantly different at 5% level of significance using DMRT.
NS= non-significant

Table 4.6: The Effect of weed management and seedling ages on 50% Booting, Heading and maturity during 2022/2023 dry Season at Jega

	Rate Lha^{-1}	50%, Booting	50% Heading	50% Maturity
Weed management				
Bracer 1 + h/weeding @ 6WAT	0.250	66.67abc	74.44ab	88.33abc
Bracer 2	0.275	67.11abc	76.33bc	87.22c
Bracer 3	0.300	67.44abc	74.78bc	87.22c
Bracer 4	0.325	66.77abc	74.56bc	88.11abc
Bracerplus1+h/weeding@ 6WAT	0.129	64.87c	73.11c	86.78c

Bracerplus 2	0.142	67.67ab	74.11bc	88.33abc
Bracerplus 3	0.155	67.56ab	74.44bc	89.22ab
Bracerplus 4	0.168	66.67abc	74.33bc	88.22abc
N/gold 1+h/weeding @ 6WAT	0.200	67.56ab	76.33abc	88.11abc
Nomineegold 2	0.300	66.56ab	75.00bc	87.67bc
Nomineegold 3	0.400	66.67abc	74.00bc	88.22abc
Nomineegold 4	0.500	66.67abc	74.44bc	87.11c
Hoe weeding @ 4 and 8WAT	-	66.22bc	74.00bc	86.77c
Weedy Check	-	68.78a	78.44a	89.44a
SE±		**0.480**	**0.568**	**0.403**
Seedling ages				
10-days old	-	67.09a	75.52a	88.02a
17-days old	-	66.75	75.00a	87.78a
24-days old	-	66.80	74.50a	88.07a
SE±		**0.223**	**0.263**	**0.186**
Interaction				
WXS		**NS**	**NS**	**NS**

Means followed by the same letter(s) in a treatment group are not significantly different at 5% level of significance using DMRT.
NS= non-significant.

Table 4.7: The Effect of weed management and seedling ages on Panicle weight and panicle length during 2020/2021 dry season at Jega

	Rate (Lha^{-1})	Panicle weight (g)	Panicle length (cm)
Weed management (W)			
Bracer1 + h/w@ 6WAT	0.250	2.86ab	23.77ab
Bracer 2	0.275	2.16b	22.44ab
Bracer 3	0.300	2.59ab	23.26ab
Bracer 4	0.325	2.00b	22.31ab
Bracerplus 1+h/w @6WAT	0.129	3.47a	23.94a
Bracerplus 2	0.142	2.52ab	23.46ab
Bracerplus 3	0.155	2.33b	22.59ab
Bracerplus 4	0.168	2.13b	22.27ab
Nomineegold 1+ h/w@6WAT	0.200	2.41b	22.84ab
Nomineegold 2	0.300	2.23b	22.80ab
Nomineegold 3	0.400	2.14b	22.69ab
Nomineegold 4	0.500	2.38b	22.81ab
Weeding @4 & 8 WAT	-	2.20b	23.17ab
Weedy check	-	1.78b	22.08b
SE±		**0.331**	**0.411**
Seedling ages(S)			
10-days old		2.56a	23.19
17-days old		2.47a	22.66a
24-days old		2.39a	22.80a

SE+	**0.153**	**0.190**
Interaction		
WXS	NS	NS

Means followed by the same letter(s) in a treatment group are not significantly different at 5% level of significance using DMRT. **NS**= non-significant.

Table 8: The Effect of weed management and seedling ages on 1000 grain weight, Grain yield, crop dry matter and harvest index during 2022/2023 dry Season at Jega

	Rate Lha^{-1}	1000 Grain Wgt(g)	Grain yield (Kg/ha)	Crop dry matter (Ton/ha)	Harvest Index (HI)
Weed management					
Bracer 1 + h/weeding @ 6WAT	0.250	26.67ab	4283.44ab	0.1604ab	0.43abc
Bracer 2	0.275	20.67c	3607.80ab	0.1071abc	0.43abc
Bracer 3	0.300	23.78abc	3607.80ab	0.1270abc	0.41abc
Bracer 4	0.325	22.33abc	4395.44ab	0.1272abc	0.45abc
Bracerplus1+h/weeding@ 6WAT	0.129	27.00a	1842.4a	0.1722a	0.53a
Bracerplus 2	0.142	23.79abc	1213.4abc	0.1057bc	0.44abc
Bracerplus 3	0.155	26.44ab	1250.0ab	0.1229abc	0.42abc
Bracerplus 4	0.168	23,00abc	401.9cd	0.0388de	0.35c
N/gold 1+h/weeding @ 6WAT	0.200	24.33abc	1080.2abc	0.1100abc	0.37bc
Nomineegold 2	0.300	24.44abc	1040.8abc	0.0643cde	0.49abc
Nomineegold 3	0.400	26.22ab	1607.0a	0.1341ab	0.45abc
Nomineegold 4	0.500	25.00abc	1615.6a	0.1298abc	0.52ab
Hoe weeding @ 4 and 8WAT	-	21.78bc	729.8bcd	0.0953bcd	0.48abc
Weedy Check	-	20.67c	201.9d	0.0265e	0.34c
SE+		**0.706**	**9.376**	**0.081**	**0.125**
Seedling ages					
10-days old	-	24.57	1309.0	0.1367a	0.39b
17-days old	-	23.40	1163.6	0.1025b	0.44ab
24-days old	-	24.04	1096.8	0.0868b	0.48a
SE+		**0.326**	**4.341**	**0.038**	**0.058**
Interaction					
WXS		**NS**	**NS**	**NS**	**NS**

Means followed by the same letter(s) in a treatment group are not significantly different at 5%level of significance using DMRT **NS**= non-significant.

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