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Effect of Water Application Rate on Growth Parameters of Farro 44 Rice Grown in a Selected Irrigation Scheme in Niger State, Nigeria

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Abstract

Water and land are the necessary agricultural inputs, and both are scarce these days. This study aims to determine the effect of water application rate on selected planting and crop parameters of Farro 44 rice during dry season farming and its growth response. The randomised complete block design was employed for the Farro 44 rice variety, with each plot size 4 m^2 (2 m × 2 m) for ease of monitoring. A 0.3 m bound space separated each plot. The crop spacing was 0.2 m × 0.3 m, 0.3 m × 0.3 m, and 0.3 m × 0.4 m, respectively, for the row-to-row and plant-to-plant distance. The data collected were statistically analysed. The height of the faro 44 variety of rice ranged between 35.50 cm to 44.00 cm for plots with 2 tillers per hill, while that of 4 and 6 tillers per hill ranged between 35.50 cm to 41.40 cm and 35.50 cm to 39.30 cm, respectively. Minimum damage of 2.32% was seen for plant hills of 2 tillers, while 9.21% and 11.89% were observed for tillers of 4 and 6, respectively. It was seen that plots with the highest spacing of 30 × 40 cm and tillers of 2 per hill were observed to perform better than those of the other plots within the experimental pots. Such plots had a maximum plant tiller of 37 when counted, with the height of the plants reaching 44 cm after 70 days of planting. In conclusion, farmers within the study area of the Kanko community in Niger State. Nigeria appears not to have any known knowledge of the soil they are cultivating and the water they use as a source of irrigation within the farming areas. It was further concluded that the rice crops would be produced maximally with minimal water application to the rice field.

Keywords

Farro 44, Water, Rice, Irrigation, Days

1. Introduction

Soil moisture content significantly determines plant growth and yield rate, especially in irrigated systems [1]. Therefore, irrigation scheduling aims to reduce the plant's water application rate to the barest level. This process manipulates the biological function of cell elongation and cell reproduction for improved plant yield.

Evolution has carefully chosen plants with decreased leaf area and seed number underwater application rate conditions allowing the production of few viable seeds. As a result, their alleles are not lost during the dry years. Thus, high soil water deficit is a factor that limits seedling establishment and growth in arid environments [2]. Water shortages could affect photosynthesis, stomatal conductance, and plant growth, even in species adapted to dry conditions. Reducing the transpiration rate by diminishing leaf area saves soil water during vegetative stages in favour of reproductive stages and keeps plants at a better water status [3] [4] [5]. However, this old-fashioned approach decreases plant carbon acquisition, but it has two drawbacks. First, it reduces seed number and yield, crucial traits for agriculture and natural environments, because this reduces the number of potential offspring. Secondly, conservative altruistic plants may be outgrown by fast-growing plants in natural habitats and excluded from their niche [6] [7] [8].

Rice is a significant consumer of irrigation water [9]. Though innovative methods such as sprinklers and drip irrigation are available to increase irrigation efficiency, they are unsuitable for crops like rice [10], which demands standing water for its growth. Therefore, the water application rating method was adopted as an alternative, and its effect on rice yield was studied. A field experiment conducted at the National Institute of Technology, Trichy, India's demonstration research farm showed the influence of moisture stress on rice yield under different stress treatments during various crop growth stages [11]. Although rice is consumed globally, there is no general quality characteristic [12]. However, consumers consider rice appearance and cooked rice texture the foremost quality attributes [13]. Thus, determining and understanding the factors that influence appearance and texture properties is an absolute challenge for industries and breeders to meet consumer preferences.

Rice is particularly susceptible to soil water deficit, which causes significant yield losses in many Asian countries [14]. Moreover, drought affects its growth in about 50% of the world's production area. More than 50% of the 40 million ha of the rainfed lowland rice area in South and Southeast Asia is affected by drought annually, which has contributed to significant yield losses [15]. In Nigeria, rice is one of the leading irrigation crops with high water consumption, accounting for 65% of agricultural water consumption [16]. In the Southern country, rice is grown in areas with maximum rainfall availability. Still, the distribution is uneven, with an intense seasonal characteristic of drought sometimes occurring [17]. Reduced rainfall duration has become one of the most limiting factors influencing rice production [18] in some areas of Nigeria. Statistics indicated that the reduction of yield, which the drought causes, may surpass other factors that lead to the total decrease by other factors [19].

In West Africa, the annual consumption of rice has increased by 6.5% annually [15], but there is an upsurge in the water application rate for rainfed crops such as rice [20]. Hence, soil moisture stress is a noteworthy influence on the gap in producing the maximum quantity and quality of rice to meet the growing population demand [21]. The scarcity effect of water on the crop depends on soil nutrient content as well as climate and variety of the crops planted [22] [23].

To improve crop productivity, it is necessary to understand the mechanism of plant responses to drought situations to improve crop performance in vast areas where rainfall is limiting or unreliable. Also, plants' behaviour responses to drought are complex, and different mechanisms are adopted by plants when they encounter water deficit [24].

This study examines the impact of water application rate on specific planting and crop parameters of rice cultivated in an irrigation system during dry season farming. Additionally, the study aims to identify the parameters that affect the growth and yield response of the Farro 44 rice variety under different underwater application rate conditions.

2. Materials and Methods

2.1. Study Area

Niger state is located in the Southern Guinea Savannah ecological zone of Nigeria, between latitudes 8˚10'N and 11˚3'N and longitude 3˚20'E and 7˚30'E, with Wushishi as one of the Local Government Areas within the State. Niger state has two distinct seasons, which are the rainfall and dry seasons. The rainy season usually starts in the southern part of the State in early April, ends in late October, and, in some rare cases, the first half of November. The dry season begins mostly in mid-November and ends in March of the following year. According to Ahaneku and Sadiq [25], Niger State receives an average annual rainfall of 1312 mm. The minimum and maximum temperature range between 27.3˚C and 40˚C, respectively. The relative humidity of the State is around 50.2%.

Gbako Local Government borders Wushishi local government to the south, Rafi and Bosso Local Government Areas to the east, Mariga Local Government Area to the north, Mashegu and Lavun Local Government Areas to the west. The experimental plot location was latitude 9˚39'42"N 6˚5'56"E, 9˚41'22"N 6˚5'35"E, and longitude 9˚44'33"N 6˚5'25"E, respectively.

2.2. Experimental Set Up

The experiment consisted of three treatments with replications for each treatment in a Randomised Complete Block Design (RCBD) for the rice variety of Faro 44. A 1 m alley separated each replication, and a 0.3 m bund space separated each plot. Each replicate plot had a size of 4 m^2 with 2 m length and 2 m breadth. The crop planting space varied between 0.20 m × 0.30 m, 0.30 m × 0.30 m, and 0.30 m × 0.40 m row-to-row and plant-to-plant distance. The six-edged rows were considered net plot rows for yield calculation and plant growth rate observations.

2.3. Cultivation Practice

The nursery bed was prepared on a small wet bed of 3 m in length and a width of 1.5 m in the plot. The plot was initially treated with herbicide. The weeds were left to wither for a week, after which the soils were manually upturned to cover the weeds to a depth of 25 cm using the big local hoe. Water was allowed into the plot to soften the hardpan and smooth the up-turning process of the soil. The plots were left for a week to decay the covered weeds.

Seeds were sown at 50 $kg \cdot ha^{-1}$ for the Farro 44 rice cultivar. A section of the plot was prepared as the nursery beds so the crops could be transplanted with minimal injury to the seedlings. Seeds were soaked for 24 hours and were evenly sown in line in a well-leveled nursery bed. A light surface check basin irrigation system was given for three hours before uprooting to make the seedling easier to uproot.

The experimental field was manually ploughed and crisscrossed twice, and major weeds were removed seven days before transplanting. During these processes, no form of manure was added to the plot. Twenty-eight days old seedlings were transplanted from the nursery plots to the field plots of 2 m × 2 m, with the plant stands varying between two to six per stand. This transplanting process was carried out following the works of Karki *et al.* [26]. Gap fillings were done five days after transplanting to keep the desired plant population in the experimental plots. This agrees with the works of Gopalakrishnan *et al.* [27]. Seven days after transplanting, varying quantities of fertiliser per plot, as shown in **Table 1**, were applied to the different plots. A one-hand weeding was conducted to remove unwanted plants from the plots.

2.4. Determination of Growth Parameters

2.4.1. Root Studies

Root samples were collected from the top 15 cm of soil profile from each plot every two weeks during the growing season. The drugged-out soil was placed in a big bucket, made into a slurry with extra water, passed through a 2 mm sieve to collect roots and other debris, and stored in plastic bags. The root samples were brought to the laboratory, washed, and cleaned to remove debris. The root lengths were measured using a meter rule.

Table 1. Treatments with a different water application rate, fertilisers, plant population stand, and plant spacing for each plot.

Treatment	Water Application Rate (cm^3/tiller)	Fertiliser application (g/tiller)	Tillers per hill (Nos)	Planting Spacing (cm)
1	7	0.025	6	30 × 30
2	7	0.025	4	20 × 30
3	7	0.025	4	40 × 30
4	7	0.030	2	30 × 30
5	8	0.025	4	20 × 30
6	6	0.030	2	30 × 30
7	6	0.020	4	20 × 30
8	6	0.025	4	30 × 30
9	7	0.025	4	30 × 30
10	7	0.025	2	20 × 30
11	7	0.020	2	40 × 30
12	6	0.025	4	40 × 30
13	7	0.030	4	40 × 30
14	8	0.025	4	30 × 30
15	7	0.025	4	30 × 30
16	7	0.025	6	20 × 30
17	8	0.025	4	30 × 30
18	7	0.030	6	30 × 30
19	7	0.025	4	30 × 30
20	8	0.020	2	30 × 30
21	7	0.020	4	30 × 30
22	7	0.020	6	40 × 30
23	8	0.025	6	30 × 30
24	7	0.025	4	30 × 30
25	7	0.025	2	30 × 30
26	6	0.020	6	30 × 30
27	6	0.025	4	30 × 30
28	8	0.030	4	40 × 30
29	7	0.030	4	20 × 30
CONTROL	Unknown measure	Unknown measure	8	20 × 20

2.4.2. The Number of Effective Plants Stands per Square Meter

The number of effective tillers per square meter (m^2) was calculated for each plot just before crop harvesting. The tillers having filled grains were recorded as effective tillers, and the tillers without filled grains were recorded as non-effective tillers.

2.4.3. Number of Tillers per Plant Stand

Tillers from 10 plant stands in each growing stage were counted randomly, and the average stand per plant was calculated. The main stem was also included in calculating the total plant stand per hole.

2.4.4. Number of Grains per Plant Stand

The total number of grains per plant stand was counted manually from the panicles, which were selected randomly from 10 plant stands in each plot. The mean of ten randomly selected panicles from each plot was used to determine the number of grains per panicle.

2.4.5. Straw Yield

After the field's rice harvest, the matured and dried stems, leaves, and chaff were considered straw. Farmers mostly used this farm waste as bedding materials for livestock, erosion control, and mulching. Determination of straw yield was done following the works of Kristensen *et al.* [28]. The straw obtained from the net plot area of each plot was sun-dried for 3 - 4 days and weighed. The yields so obtained were translated into tons per hectare.

3. Results and Discussion

3.1. Water Application Rate

Rice is a major crop in most areas of Niger State, which is known to be a water-loving crop. The crop is mainly grown under submergence or variable ponding conditions in the open field. The soil moisture levels within each plot were achieved through the daily variability application of water, as stated in the experimental design. The soil water content in each plot was successfully controlled according to the design of the irrigation regime. The application rate in each plot maintained differences in water depth due to the abnormality of levelling, which often upset rice growth and yield. Efforts in recent times have been geared towards the effect of deeper ponding of water depth for plant growth because of the different types of irrigation systems employed by farmers and the water table conditions in large-sized paddy fields [29]. Water depth is a significant factor in the prediction of rice growth. In irrigable areas, the frequency at which water is applied to farmlands by force of circumstances of inadequate storage of water in the reservoir during the crop season is resorting to intermittent water supply.

During this study, the difference in water depths presented a tangible impact on the growth and productivity nature of the Farro 44 rice crop. At the early stage of planting of the Farro 44 rice variety, there was no significant difference ($p > 0.05$) in the height of plants and the total number of tillers per hill as similar water depth was applied in all the plots for the first week to avoid the damaging of transplanted plants. The height of the Farro 44 variety of rice ranged between 35.50 cm to 44.00 cm for plots with 2 tillers per hill, while that of 4 and 6 tillers per hill ranged between 35.50 cm to 41.40 cm and 35.50 cm to 39.30 cm, respectively. When the height of the plant was compared to that of the control, it was observed that the control ranged between 18.00 cm and 29.00 cm. This implies a positive response in growth to water application rate. A similar observation was made regarding the survival rate of the plants grown at 2 tillers per hill in 7 cm^3 of water depth over those of the 6 cm^3 and 8 cm^3 for the 4 and 6 tillers per hill. Minimum damage of 2.32% was seen for plant hills of 2 tillers, while 9.21% and 11.89% were observed for tillers of 4 and 6, respectively.

The water entering each prepared plot was limited during the land preparation stage to soften the soils for ease of upturning manually. Three days before crop transplanting, water was made available twice the required amount to soften the soil for ease of penetration of the roots. This implies that a depth of 6 cm, 7 cm, and 8 cm of water was applied to the various plots, as stated in the methodology. The pretreatment process before transplanting ensured the stabilisation of the transplanted crops, which follows the works of Bappa *et al.* [30] within the various plots. **Table 2** presents the volume of water added to the crops during the growing stage at a four-day interval and the initial pretreatment of water given to the plots. The required volume of water was applied to the various plots based on the requirements of various plots based on the soil moisture conditions. The irrigation scheduling period for the 2 tillers per hill plot was every-other eight days, while that of the 4 and 6 tillers per hill was at seven- and six-day intervals, respectively. This conforms with the works of Zaman *et al.* [31]. This scheduling ensured the constant availability of water to take care of

Table 2. Water application rate per tiller per hill per plot for four days intervals and pretreatment given to each plot.

Tillers per Hill	Hill Population	Depth of water per plant hill (cm^3)	Required volume of water per plot (mm^3)	Water requirement before transplanting (mm^3)	Water application rate for controlled experimental plots (mm^3)
2	16	6	192	384	Unestimated amount of water applied according to the farmer's decision.
4	16	6	384	768	
6	16	6	576	1152	
2	16	7	224	448	
4	16	7	448	896	
6	16	7	672	1344	
2	16	8	256	512	
4	16	8	512	1024	
6	16	8	768	1536	

the evapotranspiration process that was taking place. It was observed that after the rice crop was transplanted, more water was applied to the field to allow for the stability of the crop. The intermittent irrigation process is thought to improve the supply of oxygen to the root zone of the rice with the potential for nutrient uptake and help to avoid an accumulation of toxic substances within the zone. Researchers [32] [33] [34] [35] have reported that more activity took place around the root zone, which secured a high photosynthetic activity by supplying sufficient nutrients to the shoot, thus ensuring a high yield of grains.

Water supply to the various plots indicated that 46.6%, 29.1%, and 24.3% of water was saved from the point of tillering to harvest for each of the respective water application rates to the plots. Overall, over 50% of the water used by the regular rice farmers was saved, as observed in the quantity of the grain yield from each rice plot. This is similar to the works of Belder *et al.* [36], Tao *et al.* [37], and Yao *et al.* [38].

Several researchers [39] [40] have stated that excessive and inadequate water supply deterred root development, thus decreasing tiller growth, as observed in the control plot. The population of tillers on the control plot ranged between 14 and 24, while the plots with initial tillers of 2, 4 and 6 had tiller populations of 27 to 35, 22 to 31 and 19 to 28, respectively. Each of the tiller population reached a maximum after 60 days of transplanting. Due to the late transplanting effect of the Farro 44 variety of rice, the population of the paddy per till was negatively affected. Water application showed no significant impact on the average rice paddy per hill (APPS) regarding the respective experimental plots' seed rate and plant spacing. Thus, different water depths produced different grain productivity for the Farro 44 variety of rice. Water application rate at various stages of crop growth and the population of the tillers either reduced or increased the grain and straw yield, which impacted the development of rice crops. The height of the crops, the number of grains per panicle, the length of the leaves, and the root population were affected depending on the amount of water applied to the various plots. Thus affecting the grain yield components of the crop. The grain yield from the various plots was closely observed to have a significant impact because of the amount of water applied to the various plots. It was observed that the plots with 2 tillers, which later increased to between 27 and 35, had the highest grain yield compared to those with initial tillers of 4 and 6. The plots with 2 tillers at the initial stage were determined to be the most sensitive yield component, which is similar to the findings of Matsuo & Mochizuki [41]. This provided further evidence of the sensitivity of water application rate on the reproductive stage of rice production in the various irrigated water depth treatments. The potential value of a newly formed yield component decreased as the previously formed yield component increased. The grain yield observed in this study is similar to the works of Tao *et al.* [37], Wang *et al.* [42], and Yao *et al.* [38]. The total number of panicles and spikelets for the plot with 2 tillers was more (**Table 2**) than those of the 4 and 6 tillers, which indicates more effective water use. The tillers' population density affected the developmental stages of the crops' life cycle. In this study, the survival rate of the tillers per hill was estimated to be 82.73% for the 2-tillers spacing of 30 × 40 cm plot, while those with 4 and 6 tillers had survival rates of 71.26% and 59.13%, respectively, for the same spacing.

A decrease in plant tiller per hill showed stunted growth in all parameters considered for this study. The stunted growth and densely populated plots resulted in a significant reduction of photosynthetic activities, which led to the poor development of the grained yield development of the growth parameters of the plants [43]. The variation in the growth parameters could be linked to the amount of available moisture content within the soils of the study area. This variation follows the study conducted by Akinbile and Sangodoyin [44]. **Table 3** presents the measured Farro 44 rice growth parameters with respect to water application rate, the rate of tillering of the plant and spacing between plant stands while **Table 4** is the measured growth parameter with respect to the water application rate and fixed plant hill spacing.

Table 3. Measured growth parameter to water application rate, plant tiller, and hill spacing.

Plant population	Parameters	Plants				
		1	2	3	4	5
2 per hill	Height of Plant (cm)	35.50	36.00	39.00	41.00	44.00
	No of Leaves	10.00	8.00	9.00	10.00	12.00
	No of roots	12.00	16.00	16.00	15.00	18.00
	Length of root (cm)	3.00	3.50	4.00	5.20	5.80
	Length of leaf (cm)	15.00	18.00	22.00	26.00	32.00
	Width of leaf (cm)	3.00	3.50	3.80	3.80	4.00
4 per hill	Height of Plant (cm)	35.50	36.00	37.30	37.80	41.40
	No of Leaves	10.00	8.00	9.00	10.00	12.00
	No of roots	12.00	16.00	16.00	17.00	18.00
	Length of root (cm)	2.80	3.20	3.90	4.30	4.90
	Length of leaf (cm)	13.00	16.00	18.80	23.40	27.20
	Width of leaf (cm)	2.70	3.20	3.70	3.70	3.90
6 per hill	Height of Plant (cm)	35.50	36.00	37.10	37.70	39.30
	No of Leaves	10.00	8.00	11.00	13.00	15.00
	No of roots	12.00	14.00	16.00	16.00	17.00
	Length of root (cm)	3.00	3.50	4.00	4.30	4.60
	Length of leaf (cm)	11.00	15.00	17.00	19.00	26.00
	Width of leaf (cm)	2.20	2.60	2.90	3.10	3.40

Table 4. Measured growth parameter to water application rate and fixed plant spacing.

Growth Parameters of Crop	Control				
	1	2	3	4	5
Height of Plant (cm)	18.00	22.00	25.00	29.00	29.00
No of Leaves	5.00	7.00	7.00	8.00	8.00
No of roots	6.00	6.00	7.00	7.00	8.00
Length of root (cm)	1.60	2.30	2.70	2.90	3.10
Length of leaf (cm)	25.00	8.00	10.00	10.00	11.00
Width of leaf (cm)	3.20	1.80	2.30	2.60	2.90

3.2. Plant Spacing between Hills

The spacing between hills on the various plots was 30 cm × 30 cm, 20 cm × 30 cm, and 40 cm × 30 cm, respectively, for the experiment plots. The control plot was maintained at 20 cm × 20 cm as the various seed industries recommended. It was observed that plots with the highest spacing of 30 cm × 40 cm and tillers of 2 per hill were seen to perform better than those of the other plots within the experimental pots. Such plots were observed to have a maximum plant tillers of 37, with the height of the plants reaching 44 cm after 70 days of planting. They were observed to have fewer leaves when compared to those plots that had 4 and 6 tillers per hill. The maximum and minimum lengths of the roots with a maximum spacing of 30 cm × 40 cm were 3.00 and 5.80 cm, respectively and when compared with plant hills with lesser spacing, the various roots ranged between 2.80 cm and 4.60 cm. This indicates that spacing significantly affects the length of roots within the study area [43]. The number of roots for experimental plots with a spacing of 20 cm × 30 cm showed fewer root hires. The maximum and minimum number of leaves for the plant hills with maximum spacing of 30 cm × 40 cm was between 10 and 12, respectively, while their length ranges between 15 cm and 32 cm, respectively. The width of the leaves ranges between 3.00 and 4.00 cm.

Plant spacing significantly affected the leaves' number, length, and width. When compared with those with lesser plant hill spacing, the length and number of the leaves in some cases were the same, but the width was much smaller, implying that the width was not significant to the spacing of the plants. The length, number, and width of the plant leaves significantly affected the photosynthetic activities of the plant, which is the primary factor in crop yield. Therefore, it could be said that increased spacing between plant hills increases crop yield. This is similar to the works of Baloch *et al.*, [45]. Durga *et al.* [46] studied the effect of seedling age and spacing schedule on rice productivity and quality traits under India's rice intensification (SRI) system. Table 5 below shows the level of interaction between plant spacing and the other factors considered during the study. It was seen that the plant hill spacing was insignificant for the factors of water application rate, fertiliser application rate, and plant tillers during this study.

Table 5. Statistical interaction between several factors.

Interactions	Sum of squares	df	Mean square	F-value	P-value
Plant Tiller per hill					
AB	52.56	1	52.56	1.87	0.1880
AC	2.25	1	2.25	0.0802	0.7803
AD	14.06	1	14.06	0.5010	0.4881
Average Paddy per tiller					
BC	11342.25	1	11342.25	5.84	0.0299
BD	169.00	1	169.00	0.0870	0.7723
CD	729.00	1	729.00	0.3753	0.5499
Plant tiller with paddy					
AC	12.25	1	12.25	0.8519	0.3682
BC	14.06	1	14.06	0.9779	0.3358
CD	4.00	1	4.00	0.2782	0.6043
Spacing between hills					
AC	2.25	1	2.25	0.0802	0.7803
BC	4.00	1	4.00	0.1425	0.7102
CD	3.25	1	30.25	1.08	0.3129

A is the statistical relationship between the water application rate, B is the fertiliser application rate, C is the plant tiller, and D is the plant hill. It was observed that there were no significant interactions of the various parameters as regards the threshed paddy, plant hill with paddy, and the spacing between the plant hills. This is similar to the findings of Matsuo and Mochizuki [41].

4. Conclusion

The water application rate to farms for irrigation and the nature of the soils are the main factors that determine the amount of water retained in soils and its consequential effect on the growth rate of the crop. It is therefore concluded that with the minimal application of water to the field of the rice crops, various plots showed significant panicle reduction except for plots with a seed rate of 2 and spacing of 30 cm × 40 cm. It is therefore concluded that the multiplication of the tillers within 70 days of planting from the nursery stage for the 2 seed rates with a spacing of 30 cm × 40 cm for the Farro 44 variety of rice is said to be a better method of rice planting that will give a maximum growth rate as observed in the results obtained. Other findings also proved that water stress or deficit provided at the mid-panicle initiation stage caused a significant reduction in the spikelet number per panicle and tillering rate. It was further concluded that water stress at the flowering and ripening stages did not significantly affect the panicle number but significantly reduced the grain yield. The maximum and minimum depth water application rate for rice farmers in the Kanko community should range between 4 and 6 cm as it will help the farmer reduce rice–weed competition. The maximum plant survival and tallest average plant height were recorded in water depths of between 4 and 6 cm from cultivation till to the mid-stage of growth. It was seen that the amount of grain loss due to excessive water depth had an adverse impact compared to deficient water depths. This study has shown that managing soil–plant–water relationships to exploit rice plants' adaptive root traits can achieve "more crop per drop," achieving more satisfactory crops with reduced water applications. Greater root length density increases the storage capacity of the root zone, and a deeper root system is associated with more water uptake from the soil and better crop performance under drought conditions. Deep and healthy root systems are not only correlated with better water uptake, but they also influence yield physiology. The best time to carry out weeding on the farm is 35 days after transplanting the rice to the main plots.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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