COMPARATIVE EVALUATION OF THE PRODUCTIVITY OF IRRIGATED AND RAINFED RICE VARIETIES UNDER DRIP IRRIGATION

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ABSTRACT

Rice is one of the strategic and priority cereals for food security. However, its production is constrained by the availability of water resources. Thus, the objective of this study is to evaluate the effect of drip irrigation on the agronomic performance of six rice varieties. Thus, rainfed and irrigated rice varieties were evaluated at Bama under drip irrigation in a three-repeat alpha lattice design. Observations and measurements were made on phenology, growth parameters, yield components and productivity parameters. The irrigated varieties showed a higher tillering ability/m² (1005 tillers) and a higher number of panicles/m² (711 panicles) than the rainfed varieties, which produced 521 tillers and 392 panicles respectively. The irrigated varieties also showed highest average grain yield and highest average water productivity, with more than 12 t/ha and 25 kg of rice produced per 1 m^3 of water consumed, respectively. Drip irrigation thus had a very significant effect on increasing grain yield. Good irrigation management could therefore allow better production and support local consumption.

Key words: irrigated rice, rice, cereal, Burkina Faso

RESUME

EVALUATION COMPARATIVE DE LA PRODUCTIVITE DE VARIETES DE RIZ IRRIGUE ET PLUIVIAL SOUS IRRIGATION GOUTTE A GOUTTE

Le riz est une des céréales stratégiques et prioritaires pour la sécurité alimentaire. Cependant, sa production est confrontée à la disponibilité des ressources en eau. Ainsi, la présente étude a pour objectif d'évaluer l'effet de l'irrigation goutte à goutte sur les performances agronomiques de six variétés de riz. Ainsi, des variétés de riz pluvial et irrigué ont été évalués à Bama sous irrigation goute à goute dans un dispositif alpha lattice à trois répétitions. Des observations et des mesures ont été effectuées sur la phénologie, les paramètres de croissances, les composantes du rendement et les paramètres de productivité. Les variétés irriguées ont présenté une aptitude au tallage/m² (1005 talles) et un nombre de panicules/m² plus élevés (711 panicules) que les variétés pluviales qui ont produit respectivement 521 talles et 392 panicules. Les variétés irriguées ont également exprimé le rendement grains moyen le plus élevé de plus de 12 t/ha et la plus grande productivité moyenne en eau avec 25 kg de riz produit pour 1 m^3 d'eau consommée. L'irrigation goutte à goutte a donc eu un effet très significatif sur le rendement grains. Ainsi, une bonne gestion de l'irrigation pourrait entrainer une meilleure production qui soutiendra la consommation locale.

Mots clés : *riziculture irriguée, riz, céréale, Burkina Faso*

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INTRODUCTION

Rice is one of the subsistence crops for more than half of the world's population and plays a key role in food security in the Sahel region and in West Africa (CTA, 2013; NDIIRI *et al* 2013). In Burkina Faso, rice ranks fourth in terms of area, production, and annual per capita consumption (FAO, 2014). Unfortunately, the production only covers 30% of national consumption needs (FONTAN SERS and MUGHAL, 2020). As a result, imports have become necessary to fill the gap, resulting in foreign currency outflows (FAO, 2014). In Burkina Faso, rice is grown in three modes: strictly rainfed, irrigated and lowland. However, like the rest of the Sudano-Sahelian zone, Burkina Faso is subject to climatic hazards, including the decrease and poor spatio-temporal distribution of rainfall, which has an impact on the hydrology of the developed areas, making them less efficient (MEBF, 2007). Rice cultivation requires large quantities of water for its development and growth to ensure optimal yields (NDIIRI *et al* 2013). With decreasing freshwater resources and increasing non-agricultural water consumption year by year (BELDER *et al.*,2005; XU *et al.,* 2019), the lack of water resources has become the primary issue affecting rice production (FLOWERS, 1995). Therefore, an efficient irrigation system is necessary for a bumper crop of rice. This situation calls for thoughtful use of water in agriculture. It becomes imperative to adopt cultural practices that ensure good water nutrition for the crops. Traditionally, irrigation systems require the construction of huge reservoirs or dams with long and very complex irrigation canals, which are often costly and labor intensive to construct and maintain (ADEKOYA *et al* 2014). In some parts of the world, sprinkler irrigation facilities are used, but this also waste water. There is a need to manage the available water efficiently for maximum crop production. Drip irrigation can deliver water accurately and uniformly at a higher irrigation frequency than furrow and sprinkler irrigation, which can potentially increase yields, reduce subsurface drainage, provide better salinity control and disease management since only the soil is wet while the leaf surface remains dry (HANSON and MAY, 2007). Therefore, an efficient irrigation system is necessary for a bumper crop. However, there are still many uncertainties about the practicability of drip irrigation in terms of water use efficiency on rice plants, yield capacity, and economic profitability. Thus, the present study was conducted to find out the effect of drip irrigation on the agronomic performance of irrigated and rainfed varieties. This includes determining the agronomic performance of irrigated and rainfed varieties, and comparing the performance of the two types of varieties. It also involves determining the water efficiency for each type of rice variety.

MATERIALS AND METHODS

EXPERIMENTAL SITE

The study was conducted during the dry season (2018 - 2019) at IRRIFASO Company demonstration site located in Bama (Burkina Faso) at 25 km northwest of Bobo-Dioulasso city. The commune has an irrigated area in the Kou Valley, also called the Bama rice perimeter. The climate of Bama is the South Sudanese type, characterized by the alternation of a dry season that extends from October to April and a rainy season that extends from May to September. The average annual rainfall in the locality is approximately 1000 mm (KAMBOU, 2019). The soils are quite varied with a predominance of the tropical ferruginous type, poorly leached, of variable depth, characterized by clay-silt and sandy clay-loam textures (NEBIE, 1995). During the experiment, the first rainfall of 2019 was recorded in March with a monthly total of 1.92 mm of water. Minimum and maximum temperatures were 12.71°C in December and 38.48°C in April, respectively. Minimum and maximum humidity were 18.23% in January and 90% in December respectively. The highest insolation was observed in January (9.36 h) and the lowest in April (7.14 h).

BIOLOGICAL MATERIAL

The biological material consisted of six (06) rice varieties, including three (03) irrigated or lowland varieties (FKR19, FKR62N, FKR78) and three (03) rainfed rice varieties (FKR45N, FKR59, FKR61). The varieties FKR45N and FKR62N are interspecifics (NERICA: New Rice of Africa) derived from the cross *Oryza Sativa* x *Oryza glaberrima*. These are the main rice varieties grown in the area. The characteristics of these varieties are recorded in Table 1. The seeds were provided by the Institute of Environment and Agricultural Research (INERA).

Table 1 : Characteristics of the varieties used.

Caractéristiques des variétés utilisées.

Denomination	Variety code	Species	SMC (days)	TGW (g)	Y (t/ha)	Ecology
FKR19	TOX 728-1	*Oryza sativa* L	120	25.3	5-6	Irrigated
FKR45N	WAB 880-1-38-20-17	Nerica	95	34.30	3-4	Rainfed
FKR59	WAB99-84	*Oryza sativa* L	95-100	27.86	5	Rainfed
FKR61	WAB C165	*Oryza sativa* L	91	35	3-4	Rainfed
FKR62N	WAS 122-IDSA 1	Nerica	118	28.98	5-7	Irrigated
FKR78	F6 41	*Oryza sativa* L	97	25.1	6.50	Irrigated

SMC: Sowing-maturity cycle; TGW: Thousand grain weight; Y: Yield; G : grams T/ha : ton per hectare
Source: Institute of Environment and Agricultural Research (INERA) Rice and Rice Culture Programme (Farako-Bâ Station)

EXPERIMENTAL SETUP

The experimental setup for this study was an alpha lattice with three replicates. Each block had a number of plots equal to the number of treatments. Plots were spaced 0.75 m apart and replicates were separated by 1 m. Each variety is sown in four 6 m rows at a rate of one seed per bin in a replication. The distances between rows and between seed pots were 25 cm. The dimensions of the experimental plot were 19.5 m in length and 12.75 m in width, for a total area of 2487.62 m^2. The trial was fed only by irrigation water in drip condition. The drippers were placed parallel between the seed rows with one dripper line between two seed rows. Two drippers in the same line are separated by 0.3 m and the wetting area of a dripper is about 0.5 m^2.

DETERMINATION OF WATER REQUIREMENTS

Water requirements at the field level represent the volume of water needed to compensate for soil water deficits during the growing season of a given crop and depend essentially on potential evapotranspiration (ETP) and crop coefficient (Kc). The quantities of water applied during the experiment are a function of the water needs of the plant at the different phenological stages, taking into account the potential evapotranspiration (ETP) and the crop coefficient (Kc). The crop coefficients used to determine crop water requirements vary between 0.91 and 1.21 depending on the stage of rice plant growth (DEMBELE *et al*., 1999). Monthly potential evapotranspiration (ETP) for the area was obtained from the Burkina Faso Meteorological Department.

The water requirements of rice were calculated according to the formula (DOORENBOS and KASSAM, 1987):

Water requirement = *ETP* X Kc

CULTIVATION PRACTICES

The field was plowed with animal-drawn plows and leveled with dabas. Racking was used to mark out seed lines and spacings. After the development of the experimental site and the installation of the drip system, a pre-irrigation was carried out before sowing. The seedlings were planted on December 04, 2018. The method of crop establishment was direct seeding followed by de-matting at one plant per packet at eight days after seeding. Three weedings were carried out respectively 15 days after sowing, 45 days after sowing and 60 days after sowing. Organic manure based on maize stalk at 5 t/ha was applied at ploughing and a micro-dose of NPK fertilizer (14-23-14) at 200 g/ha was applied at 10 days after sowing with a capsule and urea at 12 days after sowing. Phytosanitary treatments with Thermicale and K. optimal were carried out to control stem borers on demand.

AGRONOMIC PARAMETERS MEASURED AND CALCULATED

Data collection was done using the yield square method, which consists of conducting a delineation in a field or plot to collect data on plant behavior and determine yield. It is based on randomly drawing a number of samples from the plant population within the elementary plots. Thus, a yield square was placed in each elementary plot. In each square, 10 clusters were involved in the data collection. The agronomic parameters measured or calculated during the trial were the sowing-flowering cycle time, the sowing-maturity cycle time, the plant height at harvest, the total number of tillers per bunch, the total number of tillers per square meter harvest, the number of panicles per bunch, the number of panicles per square meter harvest, the percentage of fertile tillers, the grain yield, the straw yield, the harvest index, the number of spikelets per panicle, the percentage of full grain per panicle, the sterility rate, and the thousand kernel weight.

Plant height was measured at physiological grain maturity using a ruler graduated in cm on a sample of ten randomly selected clusters. The number of tillers per cluster and per square meter was recorded at grain maturity. The count was made on ten randomly selected patches at the yield square level after eliminating rows and border plants. The number of fertile kernels per panicle was recorded on thirty panicles. Well-filled fertile kernels are recorded after light pressure on the paddy. Fertile grains are well filled when the grain resists finger pressure. The yield of paddy and straw at harvest was calculated at the yield square. The 1000-grain weight was determined for each variety from 1000 full grains counted and weighed using an ADAM digital scale with a sensitivity of 1/10 gram. The winnowed paddy grains were dried before being weighed to determine the paddy yield in kg/ha adjusted to 13% moisture. Yields per hectare (ha) were estimated by extrapolating the average yield of squares in each treatment. The harvest index, which measures the distribution of assimilate between the harvested organs (grains) and the rest of the plant, was determined by taking the ratio between the grain yield and the straw yield. Water use efficiency (WUE) or water productivity was estimated for each variety according to the formula of Kambou *et al*. This productivity gives the production of grains (kg) of rice per volume (m^3) of water consumed. The quantities of water applied in the experiment were based on the water requirements of the rice plant at different phenological stages. A water meter was installed to measure the amount of water in m^3 used at each irrigation according to the development stage of the rice. To evaluate this water productivity, the water use efficiency was calculated according to the formula :

$$WUE = \frac{\text{Grain yield (kg/ha)}}{\text{Water used (kg/m}^3\text{)}}$$

DATA ANALYSIS

The data collected was first entered, verified and coded using the Micro Soft Excel 2013 spreadsheet. It was also used to create graphs and tables. An analysis of variance (ANOVA) of the data of the different parameters was done using XLSTAT 2018 software. The analysis of variance model for all variables is a multifactorial model taking into account the type of variety (irrigated or rainfed variety) and the agronomic parameters. Means were separated by the Student-Newman-Keuls test when the analysis of variance revealed significant differences at the 5% threshold.

RESULTS

VARIATION IN THE 50% FLOWERING CYCLE AND THE SOWING-MATURITY CYCLE

Observation times for 50% flowering over the course of the trial (Table 2) were relatively shorter for the rainfed varieties tested than for the irrigated or lowland varieties with a highly significant difference (p=0.001). Comparative analysis of the maturity times of the rainfed varieties and those of the irrigated or lowland varieties revealed that the rainfed varieties were earlier than the lowland varieties with a significant difference (p=0.001). However, the two traits assessed had relatively small amplitudes of variation (CV < 10%).

Table 2: Result of the variant analysis on the cycle length of the varieties.

Résultat de l'analyse de variante sur la durée du cycle des variétés.

Type of variety	SFC (days)	SMC (days)
Rainfed	$107^{b} \pm 6.30$	$136^{b} \pm 5.63$
Irrigated/lowland	$122^{a} \pm 8.00$	$151^{a} \pm 8.71$
Coefficient of variation (%)	9.28	7.22
Probability	0.0001	0.001

SFC : Sowing-flowering cycle, SMC : Sowing-maturity cycle

Different letters within a column indicates significant difference at P<0.05 (Student Newman-Keuls test).

VARIATION IN GROWTH PARAMETERS

Analysis of the results in Table 3 shows a significant effect of variety type (rainfed or lowland) on the expression of all growth parameters. With the exception of height at maturity, the irrigated or lowland varieties showed better growth compared to the rainfed varieties. In addition, most parameters expressed high coefficients of variation (CV>30%). Only the height at maturity showed a low coefficient of variation (<20%)

Table 3: Variation of growth parameters according to variety type.

Variation des paramètres de croissance selon le type de variétés.

Type of variety	HM (cm)	TIL/C	TIL/m²
Rainfed	$116.13^{a} \pm 3.66$	$32^{b} \pm 4.64$	$521^{b} \pm 74.26$
Irrigated/lowland	$95.42^{b} \pm 3.96$	$62^{a} \pm 7.53$	$1005^{a} \pm 120.49$
Coefficient of variation (%)	10,66	34.98	34.98
Probability	0.0001	0.0001	0.0001

HM: Height at Maturity, TIL/C: number of Tillers per Cluster, TIL/m²: number of tillers per metre.
Different letters within a column indicates significant difference at P<0.05 (Student Newman-Keuls test).

ANALYSIS OF YIELD COMPONENTS

With the exception of the number of grains per panicle, a significant variety effect was noted on all five other parameters studied (Table 4). The rainfed varieties in particular showed the highest values for tillers fertility rate, number of spikelets per panicle and spikelet sterility rate. In contrast, the lowland varieties had the highest number of panicles per bin and per square meter with a better percentage of full grain. Among all the evaluated traits, the number of panicles per cluster (CV= 31.12%), the number of panicles per square meter (CV= 32.78%) and the spikelet sterility rate (CV= 33.78%) had the highest variability.

Table 4: Performance of yield components by variety type.

Performance des composantes de rendement selon le type de variété.

Type of variety	FERT(%)	PANI/C	PANI/m²	SPIK /P	%FG/P	STERIL(%)
Rainfed	$88.13^{a} \pm 4.55$	$28^{b} \pm 3.88$	$392^{b} \pm 62.43$	$171^{a} \pm 24.60$	$74.56^{b} \pm 4.55$	$25.06^{a} \pm 3.79$
Irrigated/lowland	$79.79^{b} \pm 6.32$	$50^{a} \pm 6.67$	$711^{a} \pm 92.27$	$154^{a} \pm 26.91$	$84.29^{a} \pm 6.05$	$15.63^{b} \pm 6.00$
Coefficient of variation (%)	8.16	31.12	32.78	16.35	9.08	33.78
Probability	0.005	0.0001	0.0001	0.60	0.001	0.001

FERT: Percentage of fertile tillers, PANI /C: number of panicles per cluster, PANI /m²: number of panicles per square meter at harvest, SPIK/P: number of spikelets per panicle, %FG/P: percentage of full grain per panicle, STERIL: sterility rate.
Different letters within a column indicates significant difference at P<0.05 (Student Newman-Keuls test).

VARIETAL PERFORMANCE

From the analysis of the results in Table 5, it is noted that there was a significant effect of the varietal type on the expression of most of the parameters studied, except for the harvest index (p=0.43). Rainfed varieties particularly showed the highest values of average grain yield per panicle, thousand grain weight and harvest index. Straw yield showed the highest coefficient of variation (CV>30%). The lowland varieties were the most productive with more than 12 t/ha (Figure 1).

Table 5: Yield performance by variety type.

Performance du rendement selon le type de variété.

Type of variety	GY/P(g)	SY(t/ha)	TGW(g)	HI
Rainfed	$36.62^{a} \pm 4.62$	$17.45^{b} \pm 5.38$	$29.97^{a} \pm 1.61$	$0.38^{a} \pm 0.06$
Irrigated/lowland	$28.80^{b} \pm 4.92$	$24.68^{a} \pm 7.68$	$22.85^{b} \pm 2.18$	$0.35^{a} \pm 0.09$
Coefficient of variation (%)	18.76	35.25	15.56	21.29
Probability	0.003	0.034	0.0001	0.43

GY/P: grain yield per panicle, SY: straw yield, TGW: thousand grain weight, HI: harvest index.
Different letters within a column indicates significant difference at P<0.05 (Student Newman-Keuls test).

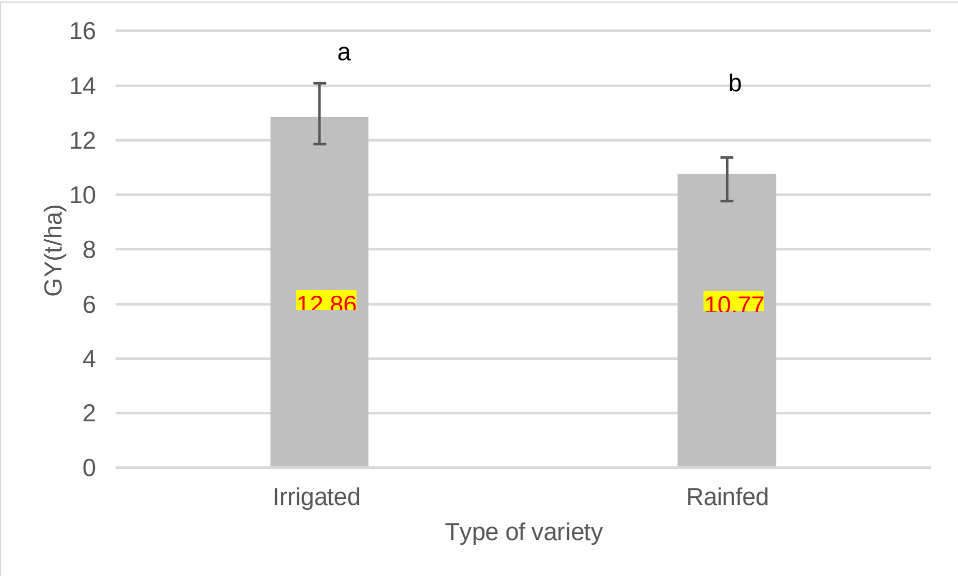

Figure 1: Grain yield by variety type.

Rendement en grain selon le type de variété.

WATER USE EFFICIENCY

Irrigated or lowland varieties showed the highest water productivity with 25.19 kg of rice produced for every 1 m^3 of water consumed compared to rainfed varieties (Figure 2).

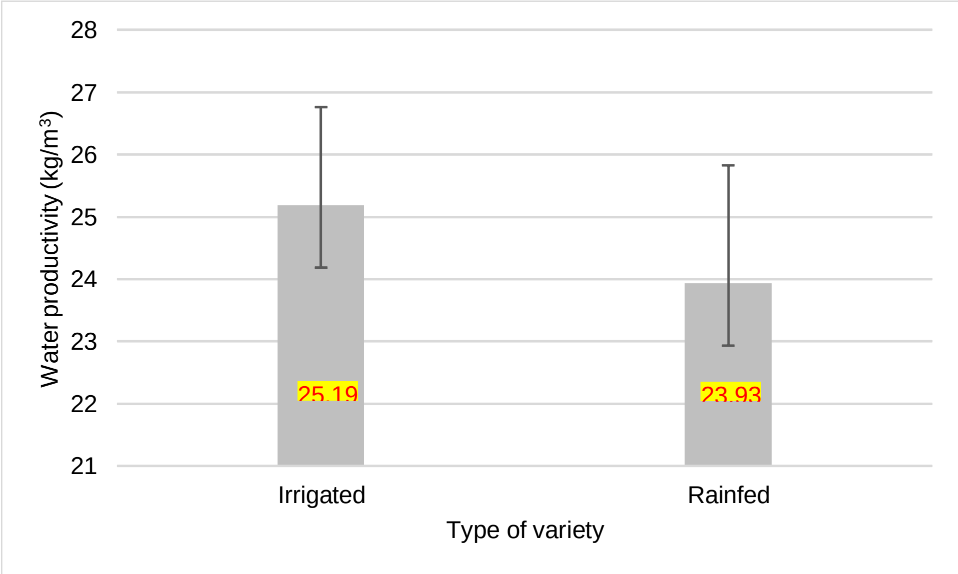

Figure 2: Variation in water use efficiency.

Variation de l'efficience d'utilisation de l'eau.

DISCUSSIONS

Agro-morphological traits varied from one rice variety to another (rainfed and irrigated varieties). The results indicate that the varieties tested produced flowers 100 days after sowing. According to the data sheet, the rainfed varieties used in this study are early varieties and the irrigated varieties are late varieties. The variety is said to be late if the sowing-flowering cycle is longer than 100 days. On the other hand, it is early if the sowing-flowering cycle is less than 100 days (NGUETTA *et al*., 2005). The lengthening of the cycle of varieties has had consequences on rainfed varieties which have gone from early to late varieties in the same way as irrigated varieties. The difference in the number of days between the 50% flowering of these varieties (rainfed or irrigated) is linked to climatic conditions, cultivation and cultivation techniques (SIE, 1997). The seedlings were sown in December when the temperatures our study environment were relatively low. Indeed, the cold constitutes the essential constraint, in the sense that it affects the vegetative cycle by considerably lengthening the cycle of the sown rice varieties. Cold has a variable effect on the growth and development of rice depending on the stage at which it is exposed to it. Indeed the cold decreases the activity of the living tissues and prevents them from developing, which results in the lengthening of the development cycle. The flowering and maturity time of rainfed varieties was relatively shorter than that of irrigated or lowland varieties. This varietal difference in flowering (maturity) times can be attributed to the natural difference in cycle length of the varieties studied (AFRICARICE, 2008). Regarding the number of tillers, the results showed variability between the varieties tested. The large number of tillers per square metere produced by the varieties tested in the study is a good indicator of good productivity. The irrigated or lowland varieties had better tillering than the rainfed varieties under drip irrigation conditions. This could be justified by the fact that irrigated varieties have a longer cycle than rainfed varieties. In general, a long-cycle variety will have a higher tillering ability than a short-cycle variety (SIE, 1997). Indeed, the very high number of tillers observed during the experiment could also be explained by the fact that the water level above the soil was almost zero but the wet part of the soil remained permanently moist and the soil was not saturated and therefore remained well aerated. This created exceptionally favorable wetting conditions (no deficit) and good water nutrition for the plants. According to WOPEREIS et al (2004), tillering is also a function of the water level and its duration above ground. Prolonged submergence of rice plants tends to decrease tillers production (WOPEREIS *et al*., 2008). Similarly, this result confirms that in general drip irrigation at tillering stage improves the number of tillers per square metere. The good tillering obtained in all varieties could be explained by the fact that during the period between sowing and tillering, the plot received significant amounts of water. This is also the observation made by LAHLOU (1989) and DAROUI *et al*. (2011) concerning studies conducted on wheat. In addition, the use of fertilizers such as organic manure could also improve the physico-chemical and biological properties of the soil, allowing to increase its productivity (PETIT and JOBIN, 2005). Indeed, manure releases its nutrient content slowly and progressively, more than chemical fertilizers do, so that plants benefit more (ATS, 2006).

The varieties tested showed a good rate of tillers fertility. Rainfed varieties were more fertile than irrigated or lowland varieties. The low fertility rates observed in these irrigated or lowland varieties could be due to the very high number of tillers per bunch, which caused competition for space and nutrients preventing the tillers from having good vigour and high productivity. However, they are higher than those obtained with improved rice varieties, indicating a rate varying between 69 and 75% (BEDI *et al*., 2017). The sterility rate observed in the varieties during the trial corresponds to the formation of empty panicles. Varieties with more grains per panicle expressed the highest sterility rate. According to VAN TRAN (1982), the phenomen of competition and distribution of assimilates is more intensified by too many grains per panicle, which can lead to sterility of spikelets. The superiority of the 1000 grain weight of rainfed varieties compared to irrigated or lowland varieties would be linked to grain size. According to NADIE (2008), grain weight depends on grain size. Moreover, the number of grains obtained in rainfed varieties was lower than in irrigated or lowland varieties, suggesting competition between grains for assimilates. This could also be explained by the fact that continuous irrigation strongly stimulated the number of grains produced per unit area of irrigated or lowland varieties, which induced a correlative reduction in the weight of a grain. These results are similar to those reported by BAHLOULI *et al.* (2005) who mentioned that increasing the number of grains per square meter induces a reduction in the weight of 1000 grains. The best grain yields were obtained with the irrigated varieties. This shows that the irrigated varieties were better adapted to drip irrigation conditions than the rainfed varieties. Our results are comparable to those obtained by NIKIEMA *et al.* (2021), who showed that irrigated rice varieties performed better under drip irrigation than when the same varieties were grown under flood irrigation. This shows that irrigated rice varieties are well adapted to drip irrigation.The high yield of these varieties could be due to good production conditions such as good crop management, water, applied nutrients and good soil biological activity that led to good plant development. According to KAHIMBA *et al* (2014), good soil biological activity allows for good root development which leads to better tillers development. This allows the plants to support high productivity. Indeed, grain yield is strongly dependent on the number of tillers per cluster, the number of panicles per cluster and the fertility rate of the tillers observed at maturity (KAHIMBA *et al.,* 2014). This increase in yield is believed to be the result of the smooth functioning of the processes related to the yield components, favored by the techniques of the intensive rice growing system (KATAMBARA *et al*., 2013). The addition of organic fertilizers helps to minimize some parasitic attacks and diseases, thus contributing to having healthy plants and increasing yields (SEGDA *et al.*, 2001). According to the same source, organic manure is rich in nitrogen, and when mixed with urea, it increases the paddy yield of rice. In terms of yield increase, the results obtained are higher than those reported by SAIDOU *et al*. (2014) and SANOGO *et al*. (2020) with these same rice varieties.

Water supply to the crop, in the form of drip irrigation in the present experiment, resulted in better water use compared to submerged rice cultivation.

Irrigated or lowland varieties were more efficient in water productivity (25.19 kg/m^3) than rainfed varieties (23.93 kg/m^3). Yields can then be increased while reducing water inputs. According to DJAMAN *et al* (2017), irrigation management through alternating wetting and drying of the land increases rice yield by reducing irrigation applications by about 27% compared to continuous flooding. The varieties tested (rainfed or irrigated) were very water efficient with a productivity of more than 25 kg of rice produced per 1 m^3 of water consumed under drip irrigation. According to NIKIEMA *et al.* (2021), rice grown under drip irrigation requires less water than rice grown under flood irrigation. In conventional rice farming, it takes 1000 liter of water on average to produce 1 kg of rice (IRRI, 2009). In conventional rice cultivation, 2500 l or 2.5 m^3 of water on average are needed to produce 1 kg of rice (IRRI, 2009). In view of these results, drip irrigation could be used to maintain or even increase rice production in arid regions where rainfall is deficient. In the current context of decreasing rainfall, drip irrigation could be an alternative to the long-established, but often water-intensive, rice farming systems.

CONCLUSION

The analysis of yield parameters and its components showed that the types of rice varieties (irrigated and rainfed) tested performed well in relation to the irrigation technique used. The irrigated varieties produced a very high number of mature tillers per square meter and panicles per square meter compared to the rainfed varieties. The irrigated or lowland varieties had the highest grain yields with over 12 t/ha and the highest water productivity with 25 kg of rice produced for every 1 m3 of water consumed. Studies on the influence of this type of irrigation on grain nutritional quality could complement the results of this study.

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