Evaluation of the Resistance to Submersion of Four Rice Varieties in the Irrigated Plain of Founkama Faranah (Republic of Guinea)

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ABSTRACT

This research was carried out in Case No. 3 located on the south side of the Main Canal of the Founkama Domain, on a hydromorphy sol-hydro-morphic soil of clay-loam texture with a pH of 5.20 and an organic matter content. of 3.99%. This soil is covered with vegetation dominated by Herbaceae. This study was conducted from 10/06/2015 to 25/01/2016 in Faranah in four (4) submersion times (0 days ; 10 days ; 15 days and 20 days) on four rice varieties. The experiment was carried out on 16 elementary plots of (5 m×2 m) or 10 m^2 each and spaced 0.50 m apart. The emergence, three-leaf stage were uniform for the four varieties, the vegetative cycle between plants was not submerged (0 days). The submersion was observed for 11 days for Karbonka, 12 days for Sonsompolo, 23 days for B38D2 and 26 days for Luoyou 8. The temperature of the water during submersion varied from 27°C to 29°C. The number of live plants, the height of the plants and the yields were influenced by submersion times. The Luoyou 8 had the best yields according to submersion times (0 days ; 10 days ; 15 days and 20 days), (4.83 ; 4.33 ; 3.72 and 3.57 t / ha) and followed by the Karbonka (3.55; 3.39 and 2.56 t/ha).

Keywords : *Evaluation, Resistance, Submersion, Rice, Phenophase, Yield*

1. Introduction

Rice is the staple food of more than half of the world's population. It is polarizing the activities of nearly one billion people in rural areas of developing countries. Most of the world's rice production, more than 90%, comes from Asia (Denis, 2014). The population of sub-Saharan Africa is expected to more than double by 2050 to reach 2 billion while it was only 800 million in 2010 (Pnud, 2012). Thus, its food needs will be multiplied by four. Total rice consumption in sub-Saharan Africa has risen from 20 to 48 million tonnes in 2050, and to 88 million tonnes, assuming an increase of 1.5% per year (Agrimonde, 2009).

In West Africa, with the progress observed due to the extension of cultivated areas and the increase in yields, local production covers only 60%, so it remains highly dependent on rice imports (Patricio et al., 2012).

In the Republic of Guinea, agriculture is largely dominated by family-type farms, which constitute almost all village agricultural activities. These farms cover about 60% of the population and occupy about 95% of the country's agricultural land. This type of farm is usually small (0.30 to 0.50 ha). Rainfed crops are predominant and represent 95% of the total areas developed. Of the rainfed crops, over 40% are on hills or mountains and 30% on plateaus. The shallows and mangroves are poorly exploited (West Africa Food Security, 2011).

Rice occupies more than 40% of the cultivated area in Guinea. All forms of rice cultivation are present, with varying importance depending on the region (Boun et al., 2001). The country is a privileged place for in situ conservation of rice of African origin. For decades the country has been subject to an important stream of improved varieties. Beginning in 1996, extensive dissemination of new nerica-type rainfed rice varieties was undertaken (Mamadou et al., 2008).

For natural submersion outside the humidity that it brings to the cultivated plants covers the flooded lands of deposit which fertilize and clog up the soil which causes a decrease of input of seeds (Andrriankaja, 1991). Resistance to submersion of rice is a complex character that is still poorly defined. According to some authors, from 60 days on, the plant, whatever the variety, resists total submersion for 5 days and if the water is clear the duration can reach 9 days (Baldé, 2014). For other authors, whether continuous or simple submersion, the tests carried out both in temperate zones (Japan) and in tropical zones (India, Philippines, Malaysia, Madagascar, Guinea, etc.), show that 'no difference yield results from depth differences of 0 to 20 cm, above 20 cm, plant height decreases as well as tillering and yield. Rice resistance factors to submersion are related to the age of the

plant at transplanting, the variety, the heights of the plant, the water slide and the duration of submersion (Fofana, 2015 and Camara, Sacko, 2008).

The most common cultivation method in Guinea in flood-prone areas is direct seeding and yields rarely exceed 4t/ha. Most varieties of rice can survive a complete immersion not exceeding three (3) or four (4) days. But immersion-tolerant varieties can survive for up to twelve (12) days. In moist coastal areas, cultivate rice with tolerance to immersion without the capacity to elongate internodes, since floodwaters recede approximately after 15 days (Chaudhary et al., 2003).

Rainfall variations impose constraints on producers (delay in the preparatory work of the soil, early cessation of rainfall or flooding during plant growth) which lead to damage. The extent of the damage depends on the variety, the vegetative phases, the duration and the intensity of the drought or the flood. There are abandonments of plots that were exploited in the floodplain in the lowlands and plains after several years of maintenance. Rice farmers are forced to work on plateaus, hill slopes and mountains by clearing land and burning crops with nearby fallows. Hence the merits of this research, the proposal of a flood-resistant rice variety for a production alternative in the lowlands and floodplains.

2. Materials and methods

This research was carried out at the Higher Agronomic and Veterinary Institute of Faranah in the area of Founkama located 2 km north of the city center and 500 m from the University Campus, on the right bank of the Niger River, north of the Canal Drainage, in the third bin from the Faranah-Dabola National Road. The work took place in the period from 10/06/2015 to 25/01/2016 on hydromorphic soil hydromorphy temporary clay loam with a pH equal to 5.19 ; an organic matter content of 3.99% and with a predominantly herbaceous vegetation cover. The estate is irrigated with water from a reservoir with a capacity of 117529 m^3, a drainage channel of 1529 m long and a belt channel 400 m long. The Pierre Sempé thermometer was used to measure the temperature of the water.

The study included four (4) rice varieties (B38D2, Luoyou N ° 8, Karbonka and Sonsompolo). B38D2 is a variety of a vegetative cycle of 150 days. The average height of the plants is 150 cm, the average number of tillers is 8, the average number of seeds per panicle (115) and the average yield is 4 t/ha. Luoyou N°8 is a variety of a 140-day growing cycle. The average height of the plants is 150 cm, the average number of tillers 8, the average number of seeds per panicle is 115, the yield is between 10.5 to 12.9 t/ha. Karbonka is a local variety of 150 days. The average height of the plants 92 cm, the average number of tillers 5, the average number of seeds per panicle 100, the average yield 2 t/ha. Sonsompolo is a local variety with a vegetative cycle of 128 days. The height of the plants is between 90 and 100 cm, the number of tillers varies between 5 and 25 and the average yield is 3 t/ha.

Four (4) submersion times of 0 days (control), 10 days, 15 days and 20 days, were observed for the four varieties. The experimental device used is the split pad with four (4) blocks. The direction of flow of water in the bin is South-North. The width of the plots 2 m and the length of the plots 5 m is 10 m^2, the width of the elementary plots 1 m and the length 2 m is 2 m^2. The number of parcels is 16 ; the number of elementary parcels is 64. The number of blocks is 4, the distance between the blocks 0.50 m, the distance between the parcels (bunds) is 0.50 m, the width and length of the device are respectively 13.50 m and 22.50 m. The rice varieties were sown in a nursery on a 40 m^2 plot. Transplanting was done on the 33rd day, with a distance between the plants of 20 cm and 30 cm between the elementary plots.

Phenological observations were made on the following phenophases : emergence and stage of three leaves on the hill in the nursery, in the experimental field after submersion (reworking, tillering, flushing, paniculation and ripening). The submersions with a height of the water slide in the blocks at 0.80 m, began from 16 to 26 September 2015 (10 days), from 16 to 30 September 2015 (15 days), from (16 September 2015 to 05 October 2015) (20 days). Weeding was done manually. The number of live plants, the number of tillers per tuft, the number of fertile tillers, the number of branches, the number of seeds per panicle were determined by counting, then the length of the roots and the height of the plants at harvest by measure. The weight of one thousand seeds in grams and the yield per tonne per hectare obtained on the yield square of each elementary parcel were obtained using a 0.1g precision YP5102 electronic scale.

3. Results

The results obtained on the observations of the different phenological phases during this research are illustrated in Tables 3.1, 3.2 and 3.3. Figures 3.1 and 3.2 shows the evolution of the study parameters of the different varieties and the curves of variation of the yields.

3.0. Nursery phase

The results of the phenological observations made during the nursery phase are given in Table 1.

Table 1: Results of phenological observations in the nursery

Variety	Lifting			Stage of three leaves		
	D	F	d	D	F	d
$B_{38}D_2$	3	8	6	9	14	6
Karbonka	3	9	7	10	15	6
Louyou 8	3	8	6	9	14	6
Somsonpol	3	9	7	10	15	6

Legend: D = Start, F = End, d = Duration

3.1. Experimental field

The results of phenological observations made on experimental field are given in Table 2.

Table 2 : Results of phenological observations on experimental field

Dur. (Day)	Variety	Reprise			Tillering			Montaison			Paniculation			Maturation			Cycle
		D	F	d	D	F	d	D	F	d	D	F	d	D	F	d	
0	$B_{38}D_2$	4	6	2	6	9	3	10	11	1	11	12	1	12	13	1	134
	Karbonka	5	14	9	6	10	3	10	11	1	11	12	1	12	13	1	137
	Louyou 8	4	5	1	5	8	3	85	96	1	9	10	1	10	12	1	123
	Somsonpolo	5	6	1	7	10	3	10	11	1	11	12	1	12	13	1	134
10	$B_{38}D_2$	5	7	2	7	10	3	11	12	1	12	13	1	13	14	1	144
	Karbonka	6	15	9	7	10	3	10	11	1	11	12	1	12	13	1	137
	Louyou 8	5	6	1	6	9	3	10	11	1	11	12	1	12	13	1	137
	Somsonpolo	6	7	1	8	11	3	11	12	1	12	13	1	13	14	1	144
15	$B_{38}D_2$	5	7	2	8	11	3	11	12	1	12	13	1	13	14	1	145
	Karbonka	7	16	9	8	11	3	11	12	1	12	13	1	13	14	1	148
	Louyou 8	5	6	1	6	9	3	10	11	1	11	12	1	12	13	1	137
	Somsonpolo	7	8	1	8	11	3	11	12	1	12	13	1	12	14	1	145
20	$B_{38}D_2$	7	9	2	9	12	3	12	13	1	13	14	1	14	15	1	157
	Karbonka	7	16	9	8	11	3	11	12	1	12	13	1	13	14	1	148
	Louyou 8	6	7	1	7	11	3	11	12	1	12	13	1	13	14	1	149
	Somsonpolo	8	9	1	9	12	3	12	13	1	13	14	1	14	15	1	156

3.2. Study parameters

The average values of the different study parameters of the four (4) varieties are presented in Table 3.

Table 3: Mean values of the study parameters of the four (4) varieties

N°	Study parameters	$B_{38}D_2$	Karbonka	Luoyou 8	Sonsompolo	PPDS 1%
1	Average panicle lengths (LMP) in cm	21,97	22,91	23,64	21,20	0,32
2	Mean number of branches (NMR)	8,32	8,29	8,36	8,16	0,12
3	Average root lengths (MRLs) in cm	18,07	18,10	18,09	18,11	-
4	Weight of 1000 seeds (PM1000g)	30,53	30,99	31,8	28,80	1,08
5	Average yields (R) in t / ha	2,78	3,3	4,2	2,43	0,17

PPDS : Smallest Significant Difference

Figure 3.1 shows the different average values of the study parameters of the four (4) varietys.

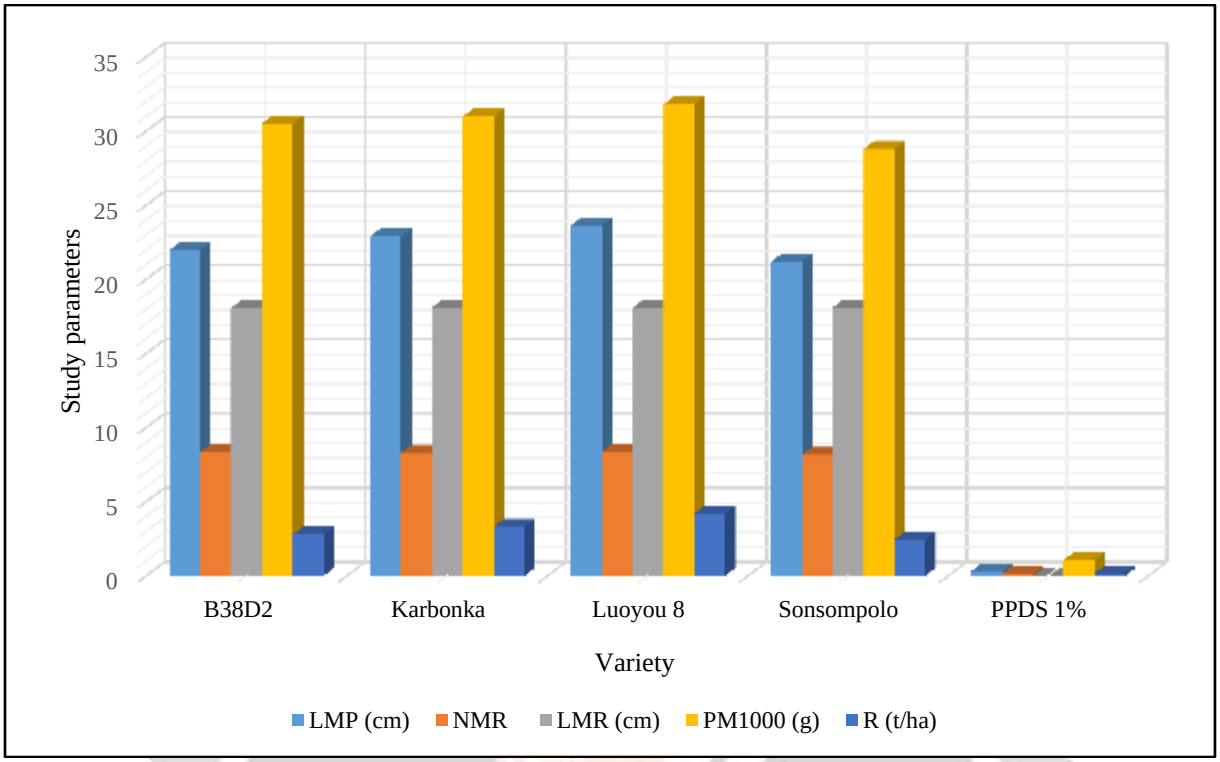

Figure 1: Graph of the average values of the study parameters of the four (4) varieties of rice

Figure 3.2 shows the variation curves of yields in t / ha of the four (4) varieties of rice as a function of submersion times (0 days ; 10 days ; 15 days and 20 days).

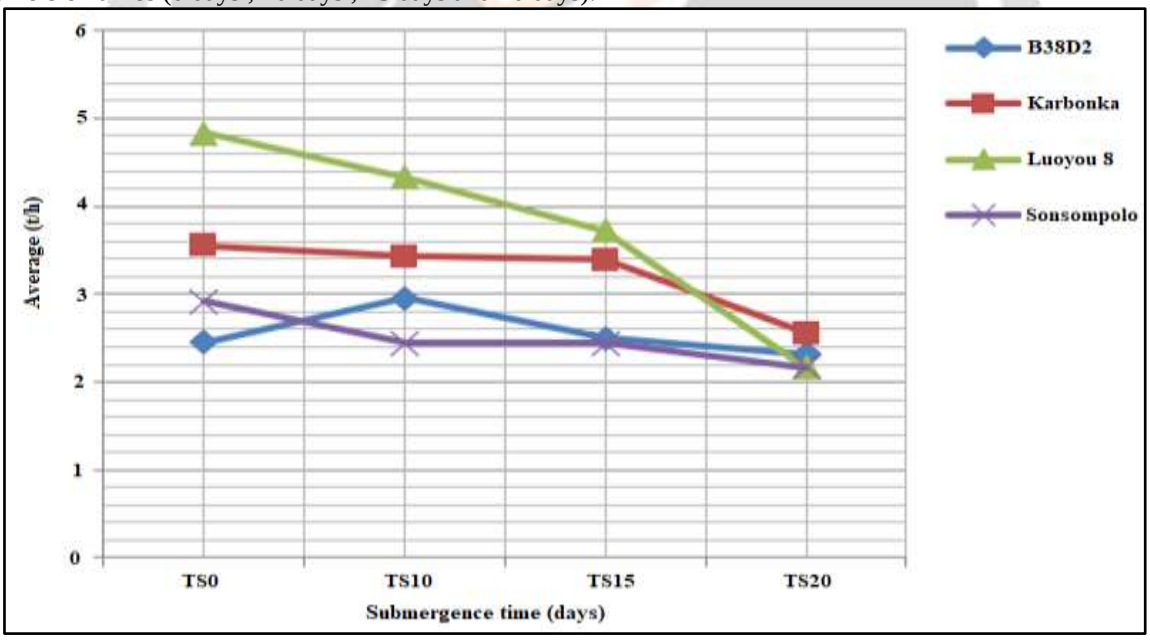

Figure 2 : Yield Variation Curves for the Four (4) Rice Varieties

4. Discussion

The climatic conditions in particular, the rainfall and the temperatures were favorable to the development of the plants, however the distribution of the days of rain influenced the realization of the planned activities. In flood-prone areas, the rice farmer has no control over the height of the water, which is influenced by the intensities of rainfall, so flooding can occur at any stage of the vegetative cycle and reach heights variables preventing the realization of certain activities what happened on 28 and 29 September 2015 and the water temperatures were not observed because of the submersion of the southern part. The water temperature in the channel was always

around 27°C. The blocks were submerged for 10 days from 16 to 26 September 2015, then 5 days for submersion times of 15 days (until 30 September 2015) and 5 days for submersion times of 20 days until 05 October 2015.

During the trial, the development of rice had distinctive stages : the vegetative stage (emergence, formation of the third leaf and early tillering), uprooting and transplanting each took one day, submersion (0 10, 15 and 20) days. Then the reproductive stage (resumption, tillering, spawning, paniculation and maturation). The circulation of the water obtained from the main canal in the channels between the large plots influenced the water temperatures between 27 and 29 ° C which was for the development of the plants. Recovery after submersion times at maturation increased for all varieties, including 11 days for Karbonka, 12 days for Sonsompolo, 23 days for B38D2 and 26 days for Luoyou 8. The average number of tillers fertile in order of magnitude is 11 tillers for Luoyou 8 and for Sonsompolo (7 tillers). The average number of fertile tillers decreased for submersion times of 15 days and 20 days.

The mean heights of the Karbonka plants are 100 cm for the control (0 days) and the submersion time of 10 days, then 101 cm for the submersion time 15 days and for the submersion time of 20 days 103 cm is 3 cm of elongation. He had a lengthening of an average height of 7 cm for the Luoyou 8 ; 4 cm for the B38D2 and 5 cm for the Sonsompolo. It appears that the four varieties showed a sensitivity to the duration of submersion. For yields, the first place is occupied by the Luoyou 8 with a yield of 4.20 t/ha, the last is the Sonsompolo with 2.43t/ha the other two B38D2 and the Karbonka occupy the intermediate positions. The yields were influenced by submersion times compared to the control (4.83 t/ha) against (3.57 t/ha) for the Luoyou 8, it is 2.42 t/ha against 2.32 t/ha for the B38D2.

V. Conclusion

Natural submersion can occur at any stage of the vegetative cycle of rice with multitudes of water, but attention must be focused on water temperatures. Knowledge of the physiology of rice is the common scientific starting point of any proposal to improve the technical and economic performance of rice farmers, combined with current practices and production conditions, will provide a good evaluation of methods (research) current. The submersion strongly influenced the height of the plants, the longer it was, the more the plants were lying down and the Luoyou 8 had the most fertile tillers and the greatest yield. To obtain a higher grain yield in submersion, cultivate varieties capable of developing several tillers.

6. References

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