

# Purification of the Popular Rice Variety (*Oryza sativa*) IR841 in the Municipality of Cove (Benin)

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**Abstract:** The study of the purification of the popular IR841 rice variety was carried out at the SPRR/CRA-Sud/INRAB experimentation site in the commune of Cove. The objective of this research is to identify the pure strains of the IR841 variety for seed multiplication. To achieve this goal, 10 strains from INRAB, Toulou1, Toulou2, AfricaRice, Ouesse, Dangbo, Malanville, Glazoue, Togo and Banterice variety IR841 were collected. The experimental setup is a total randomization. This device has three repetitions. Each repetition includes ten (10) treatments. The results reveal that the strain Toulou1 groups together all the characteristics of the variety IR841, namely: height (Toulou1:  $98.63 \pm 7.47$  cm, IR841: 100 cm), duration of the seed-heading cycle (Toulou1: 83 days, IR841: 84 days), length and width of the panicle leaf (Toulou1:  $31.56 \text{ cm} \pm 2.58$  cm, IR841: 33.72 cm) and (Toulou1:  $1.46 \text{ cm} \pm 0.04$  cm, IR841: 1.50 cm), number of tillers per tuft (Toulou1:  $12.73 \pm 1.85$ , IR841: 12). The strain of Toulou2 includes only a part of the characteristics of the variety IR841 (semis-épiaison cycle (83 jrs), height of the plants (101.63 cm), length of the panicle leaf (29.92 cm)). Then the strain Toulou1 is characterized by extra-vigorous seedlings, an intermediate pubescence of the leaves, a bifid ligule, an erect port and an erect panicle leaf, the absence of the anthocyanin colouration and especially its homogeneity (absence of off-types) which make it a more or less pure strain which can serve as a multiplication of seed.

**Key words:** Rice, purification, strain, seed, Cove.

## 1. Introduction

Rice is a staple of the diet of many people around the world, especially in Asia and Africa. The second largest crop in the world and the main foodstuff for nearly half of the world's population, rice contributes more than 20% to the global supply of calories consumed [1]. In 2000, world rice production was around 415 million tonnes of milled rice [2]. Rice cultivation in Africa is a very valuable activity for the populations of certain areas of West and Central Africa, ensuring the food security of nearly 20 million producers, and directly supporting nearly 100 million people, if we admit an average of five people per peasant family [3]. It is cultivated in Benin and is one of the most consumed foodstuffs in households. So, rice has had an unparalleled history in the Republic of Benin over the past decade. In the period from 2000 to

2010, statistics revealed a gradual increase in national production from single to double and more; as well as the area sown at national level which has increased over time [4]. This situation explains the extent of rice growing in Benin and the efforts made by the various rice promoters including the SPRR. The SPRR/CRA-Sud/INRAB has the national mandate to produce rice seeds including the IR841 variety which is an improved variety with good yield potential and a short vegetative cycle. It is a variety suitable for both lowland rainfed crops and irrigated crops and well appreciated by producers and consumers for the fragrant aroma of its grain and for its good level of yield [5]. The non-respect of technical itineraries by the producers and the use of field seeds for production have led to the decline in the quality of the production of the variety. Given the importance of the IR841 variety and the deterioration it should be subject to, the future of this variety has thus become a major concern for researchers given the place it occupies in Benin rice cultivation and its appreciation of the

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Beninese population in the diet; hence the present study is in order to contribute to the purification of the popular IR841 rice variety in the commune of Cove (southern Benin).

## 2. Material and Methods

### 2.1 Study Environment

The test was installed on the experimental site of the National Institute of Agricultural Research of Benin (INRAB) located in the village of Koussin at 7°14' N and 02°17' E, Commune of Cove, Department of Zou in Benin. This municipality is limited to the east by the municipality of Zagnanado, to the west by the Zou river (which separates it from the municipalities of Djidja and Za-kpota), to the south by the municipality of Zogbodomey and to the north by the municipality by Dassa-Zoumè (Fig. 1). The study area enjoys a climate of transition between the maritime sub-equatorial climate and the Sudano-Guinean climate of northern Benin. An average annual rainfall varies from 900 mm to 1,100 mm. The soils of the Koussin rice-growing perimeter are mineral hydromorphic to deep gley [6] with moderate drainage, moderately humus brown, silty clay [7]. These are soils of average physical fertility to be cultivated. In the dry period, they have large cracks up to 40 cm deep. These slits, more or less 2 to 4 cm wide, fill with dry matter and water. It is a soil which, after the water recedes, is very suitable for growing rice.

### 2.2 Plant Material

The trial involved 10 different strains of the IR841 rice variety grouped as follows (Table 1).

### 2.3 Experimental Apparatus

The experimental device set up is a randomized block. It is a device consisting of three repetitions of 10 elementary plots each. Each elementary plot has an area of 10 m<sup>2</sup> (5 m × 2 m) and has 10 lines of 25 pockets with a distance of 20 cm between pockets, for a total of 250 pockets per plot. The inter-plot distance

is 0.5 m and the inter-block distance is 1 m (Fig. 2).

### 2.4 Conduct and Monitoring of the Test

The installation of the device was carried out by means of poles 60 cm high following the dimensioning described above while respecting the principle described by Gomez [8], and principle according to which the blocks are perpendicular to the slope while the lengths of plot are parallel to it. Indirect sowing has been carried out. A dapog nursery was set up and then transplanted to one (1) plant per pocket one month later at spacings of 20 × 20 cm. Three fertilizer applications were made during the conduct of the test. When transplanting the plants, a basic fertilizer of NPK fertilizer (15, 15, 15) was broadcast at the rate of 200 kg/ha or 200 g per plot; 21 days after transplanting, urea (46% N) was still applied on the fly, at a rate of 40 kg/ha, i.e. 40 g per plot, then the third addition of 40 g per plot of urea 41 days after the second urea intake. The control of unwanted weeds was carried out manually in two operations. The first carried out 21 days after sowing and the second 62 days after sowing.

### 2.5 Agronomic Data

Most of the data were collected on the central lines of the elementary plots. These data relate to the height of the plants, the length and width of the panicle leaf, the number of tillers per tuft, the number of off-types

**Table 1** Varieties and strains studied.

S/N	Varieties	Strain
1	IR841	Dangbo
2	IR841	INRAB
3	IR841	Bante
4	IR841	Malanville
5	IR841	Ouesse
6	IR841	Glazoue
7	IR841	Togo
8	IR841	Toulou 1
9	IR841	Toulou 2
10	IR841	AfricaRice

Source: INRAB, 2016.

and the sowing-heading cycle. For the qualitative description, the data collected relate to the vigor of sowing at 21JAS and 42JAS, the presence of anthocyanin coloration at the level of the sheath and the leaf blade, the pubescence of the leaf, the attitude of ligule, stem habit, color of lemma and palea, color of apex, uniformity of population and attitude of panicle leaf.

In total, 6 quantitative and 11 qualitative traits were measured according to the methodology for collecting agro-morphological parameters on the rice plant [9].

### 2.6 Statistical Analyses of Data

The Excel 2007 version spreadsheet was used for data entry and the creation of graphs. SPSS version 3.1.3 software was then used for statistical analyses and the least significant difference (ppds) test was

used to compare means for quantitative data. The significance level is 5%.

## 3. Results

### 3.1 Quantitative Nature of the 10 Strains Collected

Table 2 shows the height of the plants, the length and the width of the panicle leaf of the 10 collected strains.

#### 3.1.1 Plant Height

Analysis of variances shows that there is a significant difference ( $p \leq 0.05$ ) between the heights of the different strains tested. The heights of the plants varied from 87.50 cm to 112.90 cm depending on the strain. The strains of Malanville (101.50 cm), Toulou2 (101.63 cm), Bante (99.90 cm) and Toulou1 (98.63 cm) were found to be more similar to the IR841 (100 cm) variety in terms of height. While the Togo (87.50

**Table 2** Plant height, panicle leaf length and width characters.

Treatment	Height plant	Length FP	Width FP
INRAB	108 ± 8.14b	31.60 ± 4.32b	1.56 ± 0.02bc
Ouesse	104.76 ± 10.94b	28.27 ± 0.37b	1.42 ± 0.14ab
AfricaRice	112.90 ± 7.90b	30.07 ± 3.11b	1.60 ± 0.15c
Toulou1	98.63 ± 7.47ab	31.56 ± 2.58b	1.46 ± 0.04abc
Togo	87.50 ± 5.10a	21.04 ± 2.61a	1.38 ± 0.13ab
Glazoué	105.22 ± 9.59b	26.89 ± 1.60b	1.41 ± 0.07ab
Bante	99.90 ± 5.49ab	28.12 ± 2.34b	1.37 ± 0.04a
Toulou2	101.63 ± 12.62ab	29.92 ± 3.72b	1.40 ± 0.12ab
Malanville	101.50 ± 8.02ab	29.93 ± 1.56b	1.40 ± 0.04ab
Dangbo	106.26 ± 6.00b	29.57 ± 3.32b	1.44 ± 0.05abc

The means followed by the same alphabetical letter in the last column are not significantly different at the 5% level.

FP: panicle leaf.

**Table 3** Number of tiller per tuft and number of off type.

Treatment	Number of tiller/tuft	Number of off types
INRAB	1.00 ± 2.61d	0.00 ± 0.00a
Ouesse	12.86 ± 1.62bcd	1.33 ± 1.15a
AfricaRice	11.93 ± 1.52abcd	0.00 ± 0.00a
Toulou1	12.73 ± 1.85bcd	0.00 ± 0.00a
Togo	8.66 ± 1.47a	0.00 ± 0.00a
Glazoue	10.22 ± 1.48abc	6.67 ± 5.03b
Bantè	10.20 ± 1.44abc	5.67 ± 3.51b
Toulou2	13.73 ± 3.20cd	0.00 ± 0.00a
Malanville	10.66 ± 0.80abcd	6.00 ± 2.64b
Dangbo	9.46 ± 1.20ab	0.00 ± 0.00a

The means followed by the same alphabetical letter in the last column are not significantly different at the 5% level.

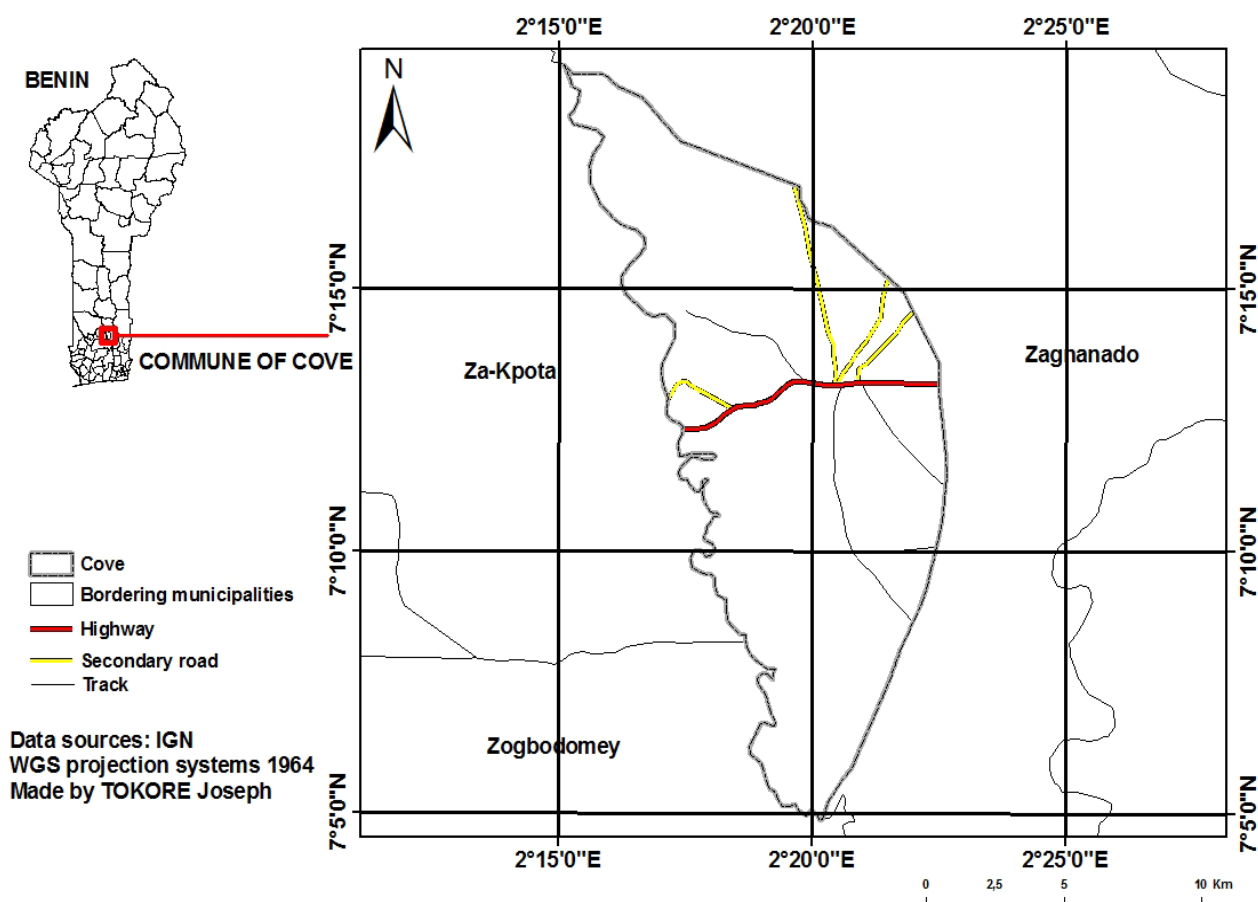


Fig. 1 Map of the municipality of Cove.

cm), AfricaRice (112.90 cm) strains are respectively much higher or lower than that of the IR841 variety.

### 3.1.2 Length of Panicle Leaf

There is a significant difference ( $p \leq 0.05$ ) between the lengths of panicle leaves of the rice strains tested. The strains INRAB (31.60 cm), Toulou1 (31.56 cm) and AfricaRice (31.56 cm) have panicle leaves whose length is similar to that of the variety IR841 while the Togo strain has a panicle leaf whose length is much less (21.04 cm) than that of the IR841 variety (33.72 cm) in terms of panicle leaf length.

### 3.1.3 Panicle Leaf Width

Analysis of the results shows that the width of the panicle leaves differed from one strain to another. The Toulou1 (1.46 cm) and Dangbo (1.44 cm) strains have panicle leaves whose width is more similar to that of the IR841 variety (1.50 cm) while the Bante and Togo

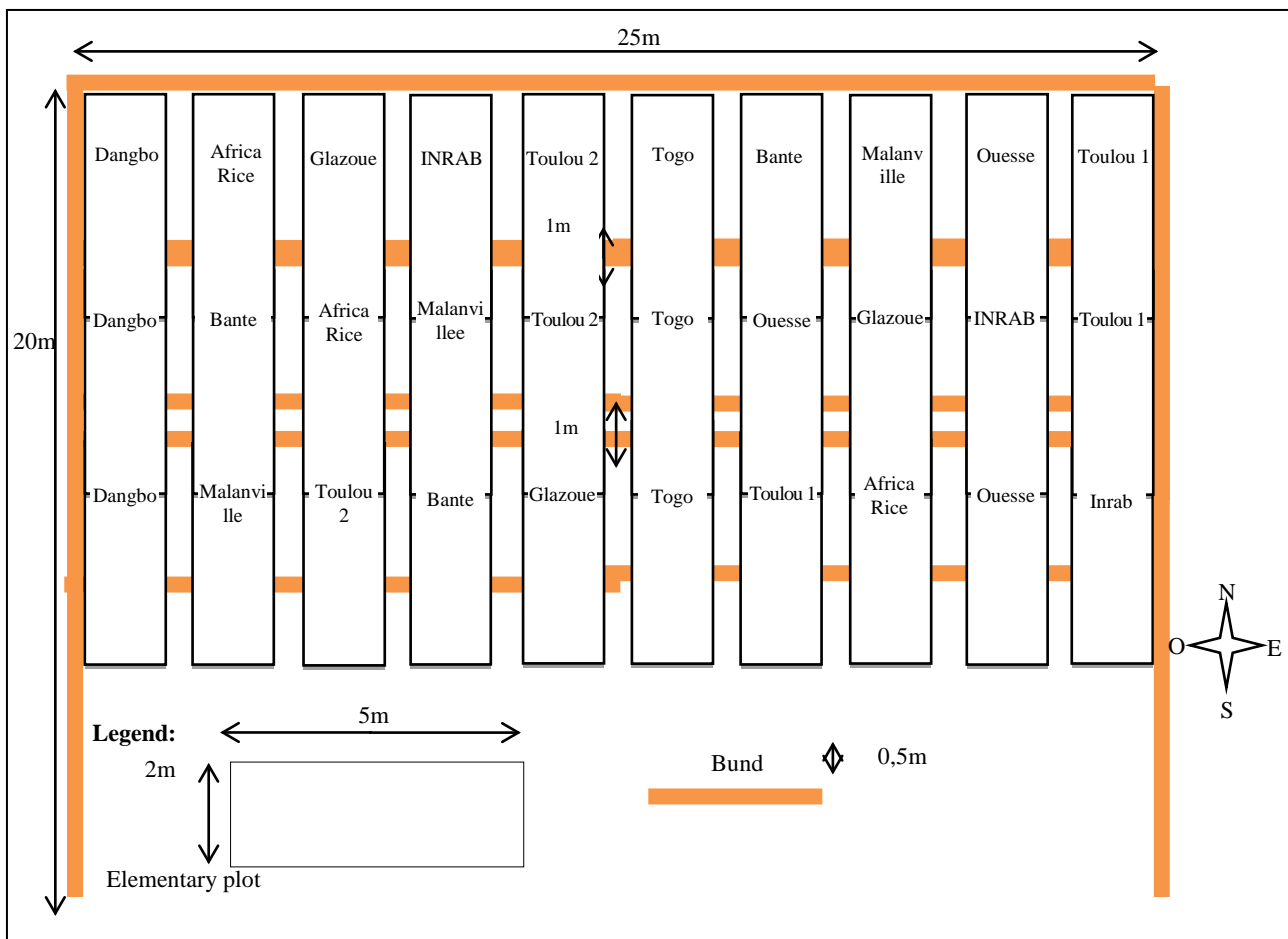
strains produced leaves whose width is lower than that of variety IR841.

### 3.1.4 Tillering of Rice Plants, Number of Off Types and Sowing-Heading Cycle

Table 3 shows the number of tillers per tuft and the number of off types of the 10 strains collected.

### 3.1.5 Number of Tiller per Tuft

The analysis of variances shows that there is a significant difference ( $p \leq 0.05$ ) between the numbers of tiller per tuft of the different strains. The number of tillers per tuft varied from 8 to 14 depending on the strain. The number of tiller per tuft of the Ouesse (12), AfricaRice (11) and Toulou1 (12) strains is similar to that of the IR841 (12) variety, while the Togo (8), Bante (10), Malanville (10), Dangbo (9) INRAB, Toulou2 (13) and Glazoue (10) gave tufts whose number of tillers is much lower than that of the IR841 variety.



**Fig. 2** Experiment set-up.

### 3.1.6 Number of Non-type

There is a significant difference ( $p \leq 0.05$ ) between the numbers of off types of the different strains after the analysis of variances. The number of off types varies from 0 to 6 depending on the strain. We note an absence of off type after culture of the strains, Inrab, AfricaRice, Toulou1, Togo, Toulou2 and Dangbo; on the other hand, there are up to 6 off types at the level of the Malanville and Glazoue strain.

### 3.1.7 Sowing-Heading Cycle

There is a difference ( $p \leq 0.05$ ) between the duration of the sowing-heading cycle of different rice strains after analysis of variances. The duration of the sowing-heading cycle varied from 75 days to 86 days depending on the strain (Fig. 3). The “sowing-heading” cycle of INRAB (83 days), Ouesse (83 days), Toulou1 (83 days), Glazoue (83 days), Bante (83 days), Toulou2 (83

days), Malanville 83 days is similar to that of the IR841 variety (84 days). The strains Dangbo (75 days), AfricaRice (86 days) and Togo (79 days) have cycles longer or smaller than the pure variety.

## 3.2 Qualitative Characteristics of the 10 Strains Collected

### 3.2.1 Qualitative Description

The qualitative description focused on the vigor of sowing at 21JAS and 42JAS, the presence of anthocyanin coloration at the level of the sheath and the leaf blade, the pubescence of the leaf, the attitude of the ligule, stem habit, color of lemma and palea, color of apex, uniformity of population and attitude of panicle leaf. The analysis of the data from the qualitative description reveals common features and dissimilarities between the strains.

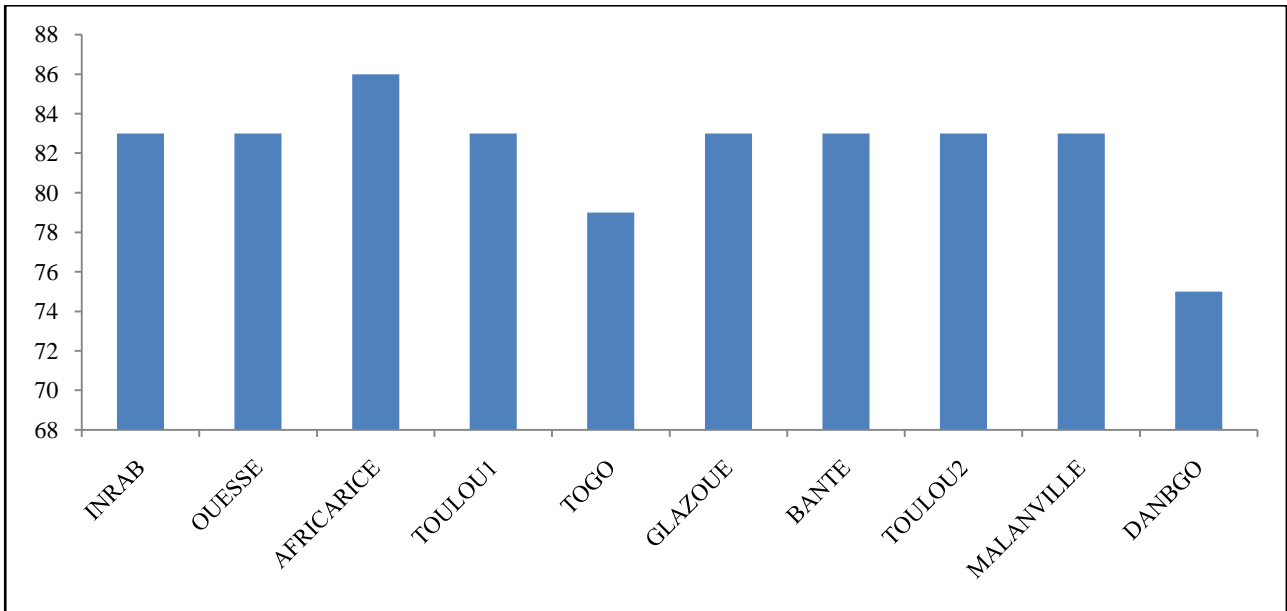


Fig. 3 Seeding cycle heading of the different strains.

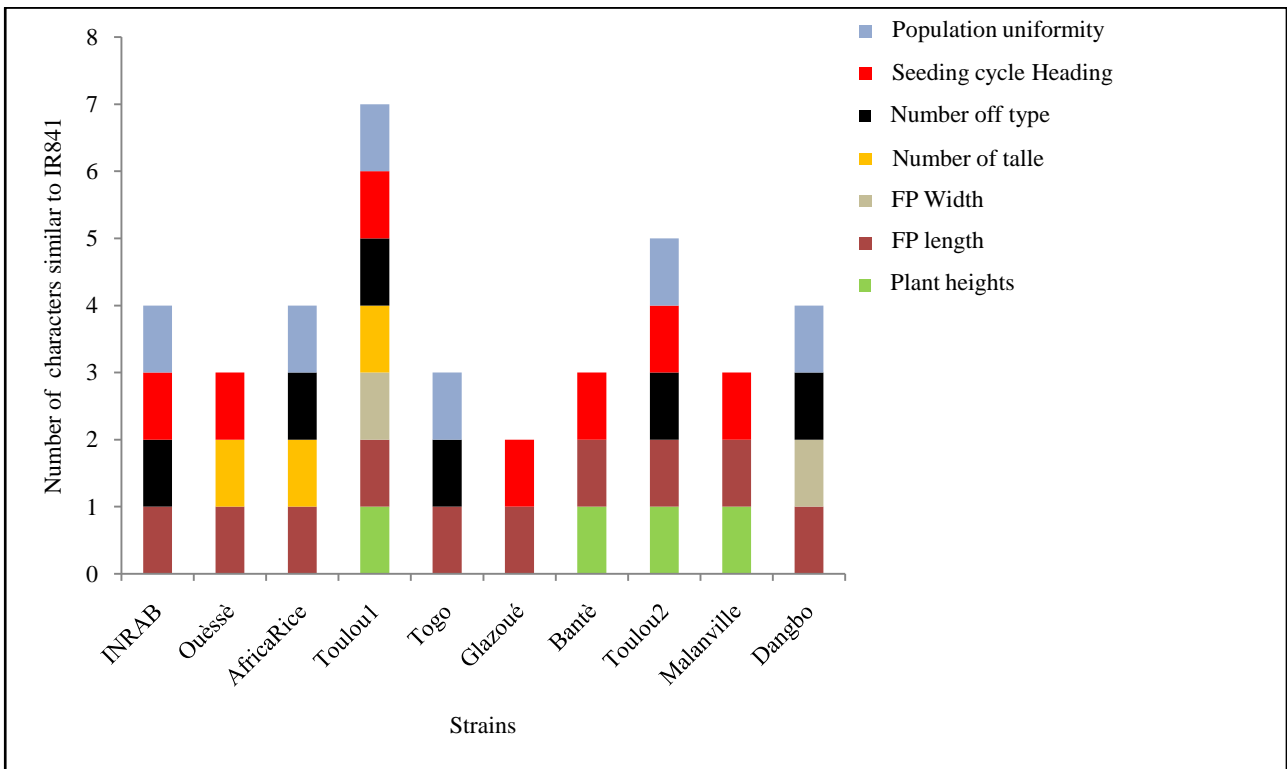


Fig. 4 Characteristics of strains similar to variety IR841.

3.2.2 Common Traits

The different strains show all normal plants on the 21st day while all the plants were extra vigorous on the 41st day after sowing. Likewise, anthocyanin coloration is absent in the leaf sheath and leaf blade of

the strains tested. The pubescence of the leaves is intermediate and the attitude of the ligule bifid. Also the habit of the stem and the attitude of the panicle leaf of the different strains are erected; and the color of the lemma, palea and the apex is green.

### 3.2.3 Dissimilarity

Although having some common features, it was observed specificities in the uniformity of the population of each strain. The strains Inrab, AfricaRice, Toulou1, Togo, Toulou2 and Dangbo present a homogeneous population (characteristic of the IR841 variety) while the Ouesse, Glazoue, Bante, and Malanville strains present a heterogeneous population characterized by the presence of off-type.

### 3.2.4 Characteristics of Strains Similar to the IR841 Variety

Fig. 4 shows the characteristics of strains similar to the IR841 variety. Observation of this figure shows that the Toulou1 strain has more characteristics similar to the IR841 variety followed by the Toulou2 strain which lacks certain characteristics of the variety (width of the panicle leaf, number of tiller per tuft).

## 4. Discussion

Analysis of the results obtained reveals that the Toulou1 strain groups together more traits similar to the IR841 variety, namely plant height, panicle width and length, average number of tillers per tuft and the sowing and heading cycle. These results corroborate those of Dossou [10], who showed that the Benin ecotype called IR841 by farmers reveals an average of 100 cm for the height of the plants, 33.72 cm for the length of the panicle leaf, 1.50 cm for the width of the panicle leaf. These results are also confirmed by Agbobli et al. [5] who specify that the IR841 variety of rice whose cycle is 120 days has a height of 100 cm. Wopereis [11] goes in the same direction through his study which reveals that the last leaf which envelops the panicle called panicle leaf or flag leaf has a length between 31 cm and 40 cm. With regard to the number of tiller per tuft, the number of off-types and the sowing-heading cycle, the Toloul variety has characteristics much closer to the IR841 variety. These results are in agreement with those of Ref. [9], which shows that the number of tillers per tuft of the variety IR841 is 12 and has a sowing-heading cycle of

84 days. Ref. [12] goes in the same direction through the study which shows that the number of tiller per tuft of the fragrant varieties including the IR841 variety is 12 or even 13, with a sowing-heading cycle at 80% of 84.33 days. Moreover, the Toulou1 and Toulou2 strains did not show off-type, something which once again confirms their state of purity.

The Toulou1 and Toulou2 strains exhibit morphological characters identical to those of the variety IR841 classified in the species *Oryza sativa*. These characteristics are confirmed by Sarla and Swamy [13] who specify that the rice collection in Benin is essentially made up of ecotypes belonging to the Asian species *O. sativa*, because 72.66% of the rice ecotypes from Benin are extra vigorous at the seedling stage. In total 82.81% have a green color at the base, 88.28% have an intermediate pubescence. Also, the form is 95% bifid; this form of the ligule is indeed a trait that clearly differentiates the *Oryza sativa* species from *Oryza glaberrima*. Also Agbobli et al. [5] confirm that the IR841 variety has an erect growth habit. Dossou [10] in his classification of rice ecotypes from Benin showed that the variety IR841 is classified in a class in which the seedlings are vigorous, marked by an absence of the anthocyanin coloration at the base of the stem and on the leaves, habit and panicle leaf erect with green coloration of apex, lemma and palea. All the characteristics united by the Toulou1 and Toulou2 strains allow us to retain these strains as being more or less pure even if the Toulou2 strain presents a defect for certain characteristics such as the width of the panicle leaf and the number of tillers per tuft.

## 5. Conclusion

In short, the results made it possible to identify the Toulou1 strain of the IR841 variety as being the more or less pure strain that can serve as a seed multiplier. At the end of this study, we suggest to the place of the rice seed producers the use of this strain for the multiplication. Besides, it has many other

characteristics such as fragrant aroma, good yield, which makes her a variety of choices for producers and consumers. And at the place of SPRR researchers, we suggest careful monitoring and maintenance of pure strains of this variety to avoid future spoilage.

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