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# Contribution of Human Urine in the Production of NERICA 4 Rice in the Sudano-Sahelian Zone in the Village of N'Djinina Commune of Guegneka in Mali

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***Abstract***— *In West Africa, and particularly in Mali, rice is the staple food of the population. However, its production is faced with various constraints, including soils poor on the one hand and difficult access to inputs on the other. Indeed, waste, especially excreta, contains nutrients that are essential for crop development. It is within this framework that this study was conducted to determine the human urine effect on the production of NERICA 4 rice in the Sudano-Sahelian zone. Different urine doses in combination or not with organic fertilizer were put in competition through an experimental design in Ficher Block with eight repetitions. The results after variance analysis showed statistical differences between treatments. The yield increase was most marked with the 111 kg N/ha urine + 5 t organique fumure (T7), which provided the highest rice yield with 1623 kg/ha compared to the mineral fertilizer control (T9) with 1550 kg/ha. It resulted in a 69.5% increase in production over the no-fertilizer control (T1).*

***Keywords***— *NERICA 4 rice, human urine, yield, fertilization*.

## I. Introduction

Sub-Saharan Africa's population is expected to double by 2050 to 2 billion, while food needs will quadruple [1]. This situation of population growth and rapid urbanization is leading to an increasing demand for food in parallel with per capita waste production [2]. Thus, average consumption is expected to increase from 20 to 48 million tonnes in 2050 [3]. The main concern of the Malian government is to intensify agricultural production in order to ensure food security for the benefit of a galloping demography and make Mali the breadbasket of West Africa [4]. However, this production faces major constraints due to the poverty characteristic of soils on the one hand and on the other hand to the difficult access to inputs, especially nitrogen in particular [5]. In a context of food insecurity, reduced soil poverty, high unemployment, causing poverty among the population and rising fertilizer prices on the markets, it appears necessary to use available and low-cost fertilizers for agriculture [6]. In view of the enormous agronomic potential offered by urine, its treatment and reuse will not only improve agricultural production, but also contribute to the management of the significant quantities of waste produced dumped into nature and thus preserve our environment [7]. The objective of this work is to contribute to the improvement of the productivity of NERICA 4 rice through the use of human urine as a fertilizer and more specifically to evaluate the effect of human urine on the production of NERICA 4 rice in the Sudano-Sahelian zone.

## II. Materials and Methods

*2.1. The site*: The trial was implemented on crepa Mali's research plots in N'Djinina, rural commune of Guégneka. The climate is Sudano-Sahelian with a rainfall varying between 600 and 1200 mm [8].

*2.2. Plant material*: The plant material used is NIRICA 4 rice from the cross (Oryza sativa x Oryza glaberrima)

*2.3. Implementation of the experimental system*: The test was installed using a Fisher block device at eight (8) repeats. Treatments were randomly assigned to elementary plots. Each elementary plot is 2m/2m or 4m2 of area, there is 1m between the elementary plots and 2m between the blocks, for a total length of 30m, and a total width of 26m. The total area of the plot is 780m² divided into 72 elementary plots. Rice sowing was carried out in-line due to three to four seeds per poquet at spacings of 20 cm x 20 cm.

*2.4. Processing*: Treatments initiated through different doses of urine in combination or not with organic manure (FO) are T1 = Fertilizer-free, T2 = 74 kg N/ha, T3 = 37 kg N/ha, T4 = 111 kg N/ha, T5 = 74 kg N/ha +5t FO, T6 = 37 kg N/ha +5t FO, T7 = 111 kg N/ha +5t FO, T8 = 37 kg N/ha +1/2 mineral manure dose (FMV), T9 = FMV

*2.5. Maintenance operation*: Profeba (organic manure) and cotton complex were brought only once just before sowing to the entire surface of the elemental plot and buried in the ground. Urine was provided by splitting into three intakes as maintenance manure. The maintenance operations consisted of remarriage, refilling, weeding.

*2.6. Observation of data*: Observations focused on performance and its components. The rice yield was determined after threshing and winnowing of the harvested panicles. The number of tillers of the plants is determined by counting the number of tillers emitted by the plant 60 days after sowing corresponding to the panicle initiation phase. The number of fertile tillers per plant was determined by counting the number of fruiting branches on the 75th day after sowing, which corresponds to the grain filling phase. The number of spikelets was determined by counting after harvest the number



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of spikelets on the rice panicle. The length of the panicle was determined using a graduated ruler placed from the base of the panicle (first node) to the end of the last spikelet. The weight of the rice panicle was determined using a Roman scale.

*2.7. Data processing*: The data analysis was carried out with genStat 12th edition software considering the 5% significance rate and the Student, Newman and Keuls test for the comparison of treatment averages.

## III. Results

After statistical analysis of the data collected on yield and its components, a highly significant difference between the different treatments emerges (Table 1). T7 treatment gives the most performance to the competition of T9 treatment. It gives effects statistically similar to that of T4, T5, and T6. The intake of the half dose of urine alone (37 kgN/ha) and the normal dose of urine alone (74 kg N/ha) gives a yield gain of the order of 155 kg/ha and 277 kg/ha respectively compared to T1. The combination of organic manure with urine resulted in an increase in yield of around 266 kg/ha. The set of treatments with urine intake doses increases the yield more than the T1 treatment. For the number of fertile tillers, the T7 treatment provided two (2) more fertile tillers than the T1. All other fertilizer doses do not show a statistically significant difference between them and with the control without fertilizer. For fertile tillers, treatments with the different doses of fertilizer do not give off a statistical difference between them, but differ from T1 by providing one (1) more fertile tiller. For the length and weight of the panicle, urine treatments combined with organ manure (T7, T5) and high dose of urine (T4) give weights similar to that of vulgarized mineral manure (T9), all doses of urine intake give a length and panicular weight greater than without fertilizer. Urine increased the yield of rice and its components, this increase is greater when urine is brought to the high dose combined with organic manure.

TABLE 1. Analysis of variance in rice plant size.

| Treatments | Fertile tiller numbers | Panicle length | Panicle weight | Yield (kg/ha) |
|---|---|---|---|---|
| T1 | 3c | 18,33c | 1,58d | 790d |
| T2 | 4ab | 19,38bcd | 2,03bc | 1067bcd |
| T3 | 4ab | 19,61bc | 1,75cd | 945cd |
| T4 | 4ab | 19,97ab | 2,32ab | 1343ab |
| T5 | 4ab | 20,21ab | 2,28ab | 1333ab |
| T6 | 4ab | 19,49bc | 2,25ab | 1247abc |
| T7 | 4ab | 19,64ab | 2,58a | 1623a |
| T8 | 4ab | 20,80ab | 2,38ab | 1257abc |
| T9 | 4ab | 21,21a | 2,54a | 1550a |

Legend: T1, T2, T3...= treatments, T1= Fertilizer-free, T2 = 74 kg N/ha, T3=37 kg N/ha, T4 = 111 kg N/ha, T5= 74 kg N/ha +5tFO, T6=37 kg N/ha +5tFO, T7 = 111 kg N/ha +5tFO, T8 = 37 kg N/ha +1/2 FMV, T9= FMV, a, c, d, ab, abc, bc, cd, bcd ... are the homogeneous groups

## IV. Discussion

The provision of urine as a fertilizer in rice production has promoted increased yield and its components. Urine intake at the dose 111 kg N/ha + 5t FO (T7) gives the best yield to the competition of vulgarized mineral manure and non-significant yield differences with the dose 111 kg N/ha urine and 74 kg N/ha urine + 5t FO. The set of treatments with urine intake modes increases the yield by more than the treatment without fertilizer. The beneficial effect of urine on increasing yield and its components has been found by several other researches including [9], [10], [11]. They showed that the nutrients in the urine are ionic in shape, and their availability to the plant rivals chemical fertilizer well. The [12] showed an increase in yield of various urine-fertilized crops more than the control including cotton in Mali by 48.57%, maize by 32.95% in Benin, lettuce by 55.17% in Togo, eggplant by 82.40% in Burkina Fasso, [13] made the same observation in Côte d'Ivoire on yam by 50%, as well as [14] on rice in Mali with 52% and [15] in Côte d'Ivoire on rice. The addition of organic manure to urine induced an increase in yield of the order of 266 kg/ha compared to urine alone, similar to that found by [16] and which shows that the combination of urine with bovine manure and with PNT induced on average an increase in cotton grain yield of 238.30 kg compared to urine intake alone. The increase in the dose of urine promoted yield in the same way as the addition of organic manure to urine, the yield of rice increased with increasing doses of urine, and better in combination with organic manure. This result is similar to those of [17] and [18]. This is the same as the results obtained by Kpéra et al (2017) whose combination of cow dung and urine gave the best growth of pineapple plants and/or fruits. The intake of the urine dose at 74 kg N/ha alone equivalent to the dose of mineral manure was insufficient for optimal rice production. This result is similar to those of [19] and [20] who showed respectively that the grain yield of maize and sorghum increases with doses of hygienized urine and that there is no significant difference between urine fertilization and mineral fertilizer at almost equivalent doses.

## V. Conclusion

Urine at the dose 111kg N/ha plus organic manure, appears to be the dose that significantly improves the yield of NERICA 4 rice under Sudano-Sahelian agro-ecological conditions to competition from mineral manure. The dose of 74 kg N/ha of urine alone was insufficient for proper rice production.

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