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CHANGES IN MICROBIAL BIOMASS AND GRAIN YIELD OF RICE VARIETIES IN RESPONSE TO THE ALTERNATE WET AND DRY WATER REGIME IN THE INLAND VALLEY OF DERIVED SAVANNA

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Abstract: This investigation tested the hypothesis that the alternate wet and dry (AWD) water regime would increase soil microbial biomass carbon (MBC), microbial biomass nitrogen (MBN) and microbial count. Variations in MBC, MBN and grain yield could be due to varietal differences in a derived savanna. Experiments (both pot and field ones) were conducted at the Federal University of Agriculture, Abeokuta (Latitude 7° 12’ to 7° 20’ N and Longitude 3° 20’ to 3° 28’ E), Nigeria in 2015. In both trials, the treatments consisted of water regimes (continuous flooding [control] and AWD imposed on lowland rice varieties [NERICA® L-19] and Ofada [local check]) at the vegetative growth stage in three cycles. The design in both trials was a completely randomised and randomised complete block design for the pot and field experiments respectively, with three replicates. In the screen house, MBC and MBN were significantly higher in AWD than in continuously flooded soil, especially at the beginning of the AWD cycles. This could have caused nutrient pulses to sustain the improved performance of lowland rice under AWD. A converse pattern was observed in the field in the third cycle. Ofada rice had a significantly higher microbial count and MBC (cycle 1) than NERICA L-19, however, a converse pattern was observed in MBC (cycles 2 and 3) and MBN (cycle 1). Composition of their rhizodeposition and timing of cycles could explain the observed varietal differences in MBC and MBN.

Key words: biomass, cycles, grain yield, lowland, soils.

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Introduction

It was estimated that over 75% of the world’s rice is produced under continuously flooded conditions (Van der Hoek et al., 2001). Under such water management practices, microbial activities are down-regulated with reduced soil microbial biomass (SMB), mineralisation and nutrient release from the soil complexes (Uphoff and Randriamiharisoa, 2002). In another study, it was observed that irrigation had no effect on soil microbial biomass except on the seasonal variation on the ratio of microbial C to N (Rangel-Vasconcelos et al., 2015). SMB forms an integral living component of the soil organic matter through which soil quality could be evaluated (Silva et al., 2010). SMB acts as a source or a sink of mineral nutrients (Qu and Wang, 2008). SMB acting as a sink together with the soil organic matter have been implicated in the formation of cation exchange capacity of the soil (Loureiro et al., 2010). Microbial biomass is a source of mineral nutrients in the soil (Dare et al., 2014). Therefore, it could be inferred that there is a nexus between SMB and crop productivity.

Alternate technologies have been proposed to ameliorate the negative effect of continuous flooding on SMB and lowland rice productivity. One of such is the alternate wet and dry technology. Crops established under AWD were reported to have higher water use efficiency, better root architecture and biology, and higher harvest index than those grown under continuously flooded conditions (Yang and Zhang, 2010). Nutrient pulses due to microbial activities (the Birch effect) had also been reported (Jarvis et al., 2007). These nutrient pulses were reported to be dependent on the frequency of AWD, the environmental conditions and the crop species (Fierer and Schimel, 2002). New Rice for Africa (NERICA) is an interspecific variety that combines the comparatively high yielding trait of O. sativa and the hardiness of O. glaberrima (Jones, 1997). Together with Ofada rice (the popular farmer’s variety), these varieties have been reported to be more tolerant to adverse environmental conditions than the more popular Oryza sativa varieties in Africa. The response of lowland NERICA and Ofada rice varieties to AWD is not well documented in the literature to the best of our knowledge. The use of AWD on rice has been limited to growth stages other than vegetative. However, utilisation of this technology at the vegetative growth stage would provide an understanding of their effect on the initiation of reproductive structures in rice and SMB, especially in the derived savanna agroecology. Furthermore, it has been reported that there is a significant varietal variation in the SMB through rhizodeposition, especially C (Tian et al., 2013). The presence of the root exudates could also alter the rhizosphere, subsequently affecting the soil microbial activities in nutrient cycling. Hence, the experiments tested the hypothesis that lowland NERICA rice established under the AWD water regime would have a higher
microbial count, microbial biomass C and N and yield performance than those under continuously flooded conditions in a derived savanna.

**Material and Methods**

**Description of the experimental location**

Two trials (pot and field experiments) were carried out in the year of 2015. The pot trial was conducted in the Screen house, College of Plant Science and Crop Production, Federal University of Agriculture, Abeokuta (FUNAAB), Nigeria. A field trial was conducted in the inland valley of the Teaching and Research Farm of FUNAAB, Nigeria. FUNAAB (Latitude 7° 12’ to 7° 20’ N and Longitude 3° 20’ to 3° 28’ E) is located in the derived savanna agroecology. The rainy season extends from April/May to September/October.

**Treatments and design**

In the screen house, the treatment consisted of water regime (continuous flooding and alternate wet and dry [AWD]) imposed on lowland rice varieties (NERICA® L-19 and Ofada [local variety]) at the vegetative growth stage, which was laid out in a completely randomised design, replicated three times. The AWD water regime was achieved through intermittent flooding in three cycles at the vegetative growth stage. A cycle had a duration of 10 days that commenced with wetting to keep the soil in each pot saturated but not flooded. Thereafter, the pots were left to dry until the tenth day, before the commencement of another cycle of AWD. The field experiment had similar treatments that were arranged in a completely randomised block design, replicated three times. On the field, AWD was achieved under rainfed conditions. Due to the nature of this condition, water was controlled in each plot through the construction of bunds and a valve around it. Even distribution of water in each plot was ensured through levelling. The release and entrapment of water in each plot were achieved through the opening and closing of the valve placed by its side. AWD in the field had the same duration and number of cycles as obtained in the pot experiment. Water in each plot was maintained in a saturated condition at each cycle under wet conditions. If downpour was observed, then the valve by the side of each plot was released to avoid flooding. Under the same conditions and in the absence of precipitation, the valve was left closed to keep each plot under saturated conditions in the wet phase of AWD. At each AWD cycle, soil samples were collected from each plot. In case downpour was observed, soil sampling was conducted prior to its commencement. All the plots were flooded (through rainfall) after the vegetative growth stage. Continuous flooding was maintained in each plot thereafter until 15 days before
harvesting. All plots were fully drained at harvesting. In both experiments, poultry manure was incorporated into the soil two weeks before transplanting at the recommended rate of 80 kg N ha\(^{-1}\) for this agroecological system that translated into 16,326.5 kg ha\(^{-1}\) of applied quantity. The gross plot size was 4 × 5 m (20 m\(^2\)), while the net plot was 4 × 3 m (12 m\(^2\)). The field trial was established on the 10\(^{th}\) of July, 2015. The seeding method for both trials was transplanting of the 21-day-old seedlings that were earlier established in a nursery. The spacing for the field trial was 20 cm × 20 cm. The plant density was 500 plants per plot. Weeding was done manually as at when due.

**Sampling and data collection**

Soil samples were collected randomly from the experimental site before planting at a depth of 0–0.2 m, air-dried and passed through a 2-mm sieve for the evaluation of their physical and chemical properties. In both trials, soil samples were randomly collected at intervals of 10 days and analysed to evaluate microbial biomass carbon (MBC), microbial biomass nitrogen (MBN) and soil microbial population.

**Microbial biomass carbon and nitrogen**

MBC and MBN were determined by the chloroform fumigation-incubation technique (Jenkinson and Ladd, 1981). Two sub-samples of 10g of soil were poured into 50-ml beakers and a third sub-sample of the same weight into a 125-ml watertight bottle (s\(_0\)). One of the sample beakers was placed in a vacuum desiccator containing 30 ml alcohol-free chloroform in a shallow dish. The lid of the desiccator was closed, and the vacuum was applied until the chloroform evaporated. The desiccator (with the tap closed) was kept in the dark for 24 hours at 25\(^{\circ}\)C after which it was transferred to a watertight 125-ml extraction bottle (s\(_f\)). 50 ml of 0.5 K\(_2\)SO\(_4\) was added to the bottles (s\(_f\) and s\(_0\)) with the stopper tightly in place. Extraction bottles with soil samples were shaken for 30 minutes, the extract was filtered through No. 42 Whatman filter paper and the filtrate was analysed for dissolved organic C and total N.

From the dissolved organic C, MBC can be calculated using the formula:

\[
\text{Microbial biomass C} = \frac{(\text{Extracted Csf} - \text{Extracted Cso})}{2.64}
\]

(Brookes et al., 1985).

From total N, MBN can be calculated using the formula:

\[
\text{Microbial biomass N} = \frac{(\text{Extracted Nsf} - \text{Extracted Nso})}{1.46}
\]

(Brookes et al., 1985).
Total microbial count/population

One gram of soil was serially diluted from $10^{-1}$ to $10^{-6}$ dilutions, and the diluted soil samples were spread on sterile plate count agar. The plates were incubated at 37°C for 24 hours. Colonies were counted and expressed in colony-forming unit/gram (CFUg⁻¹). The CFU was calculated using the formula:

$$Colony\ forming\ unit = \frac{number\ of\ colonies}{\ number\ of\ dilution \times \ amount\ plated}$$

Grain yield

Rice grain yield was determined at 90% harvest maturity when 90% of the panicles turned golden yellow. In the screen house, grain yield per pot was evaluated, while in the field, grain yield was determined from the net plot and converted to grain yield per hectare.

Statistical analysis

The data collected were subjected to the analysis of variance (ANOVA) fixed model that consisted of water regime and variety in the treatment structure and replicates in the block structure at the 5% probability level. All variables were examined for the violation of ANOVA assumption through the graphical analysis of the residuals prior to analysis. Discrete data were log-transformed before analysis. Significant means were separated using the least significant difference (LSD). The statistical package used was GENSTAT 12th edition (Payne et al., 2009).

Results and Discussion

Physical and chemical properties of the experimental soil

The textural class of the experimental site was loamy sand (Table 1). The soil pH was moderately acidic (5.35). The macronutrient content of the soil was 1.5 g kg⁻¹, 7.79 mg kg⁻¹ and 0.01 cmol kg⁻¹ for nitrogen, phosphorus and potassium respectively. The organic carbon content of the soil was 17.0 g kg⁻¹ with 10.17 cmol kg⁻¹ of ECEC.

Chemical properties of poultry manure

Poultry manure added to the soil as an amendment was also analysed for its chemical properties (Table 2). The pH of the manure was neutral (7.05). Exchangeable calcium was 16.90% while magnesium, sodium and potassium were 1.71%, 0.18% and 0.16% respectively.
Table 1. Pre-planting physical and chemical properties of the soil used for the experiment.

| Variable                        | Value  | Method                                          |
|---------------------------------|--------|------------------------------------------------|
| Sand (%)                        | 84.4   | (Bouyoucos, 1962)                              |
| Silt (%)                        | 9.8    |                                                |
| Clay (%)                        | 5.80   |                                                |
| Textural class                  | Loamy sand | USDA textural triangle                        |
| pH in H₂O (1:1)                 | 5.35   | (McLean, 1982)                                 |
| Available phosphorus (mg kg⁻¹)  | 7.79   | (Bray and Kurtz, 1945), (Murphy and Riley, 1962) |
| Total nitrogen (g kg⁻¹)         | 1.5    | (Jackson, 1962)                                |
| Organic carbon (g kg⁻¹)         | 17.0   | Walkley-Black, modified by Allison (1965)       |
| Exchangeable cation (cmolkg⁻¹)  |        |                                                |
| Ca                              | 8.83   | Atomic absorption spectrophotometer            |
| Mg                              | 1.02   | Atomic absorption spectrophotometer            |
| K                               | 0.11   | Flame photometry                               |
| Na                              | 0.16   | Flame photometry                               |
| Exchangeable acidity (cmolkg⁻¹) |        | Summation of exchangeable bases and total acidity |
| Al³⁺ + H⁺                      | 0.05   |                                                |
| ECEC                            | 10.17  |                                                |

Table 2. Chemical properties of the poultry manure used for the experiment.

| Variables                        | Value  |
|----------------------------------|--------|
| pH in H₂O                        | 7.05   |
| Available phosphorus (%)         | 1.76   |
| Total nitrogen (g kg⁻¹)          | 4.9    |
| Organic carbon (g kg⁻¹)          | 88.0   |
| Manganese (%)                    | 0.08   |
| Iron (%)                         | 0.71   |
| Copper (%)                       | 0.01   |
| Zinc (%)                         | 0.11   |
| Exchangeable cations (%)         |        |
| Ca                               | 16.90  |
| Mg                               | 1.71   |
| K                                | 0.16   |
| Na                               | 0.18   |

Microbial biomass carbon in the screen house

Moisture regime had a significant ($P < 0.05$) effect on the MBC (Table 3). Lowland rice cultivated in plots with intermittent flooding had significantly higher MBC than those established with continuous flooding at all irrigation cycles except at the third cycle, where water regimes had no significant effect on the MBC. Significant varietal differences ($P < 0.05$) were observed in the MBC throughout the cycles of water regime. NERICA L-19 had significantly higher MBC than Ofada at all cycles of AWD except at the first cycle. At the first cycle of AWD,
Ofada rice had significantly higher MBC (309.39 ugg\(^{-1}\)) than NERICA L-19 (301.22 ugg\(^{-1}\)). There was a significant \((P < 0.05)\) effect of the interaction of water regime × variety on the MBC in the first cycle of AWD in lowland rice varieties (Figure 1). Lowland rice varieties sown in the plot under AWD had significantly higher MBC in the first cycle than those established under continuous irrigation. The lowland rice variety Ofada had significantly higher MBC than NERICA L-19 under AWD (Figure 1).

![Figure 1. The effect of the interaction of water regime × variety on microbial biomass carbon, cycle 1 in the screen house. MBC 1 – microbial biomass carbon in the first cycle. Vertical bars indicate the standard errors of the mean.](image)

Microbial biomass nitrogen in the screen house

Microbial biomass nitrogen followed a similar response pattern as observed in the MBC in water regimes. In the third cycle of AWD, no significant differences were observed between AWD and continuous flooding on MBN. Significant \((P < 0.05)\) varietal differences were observed in MBN at all cycles except the third cycle of intermittent irrigation. The order of an increase in MBN was NERICA L-19 > Ofada rice in both cycles. There was no significant effect of the interaction of water regime × variety on the MBN at all cycles except at the first cycle of AWD. All the varieties had significantly higher MBN under AWD than under continuous flooding conditions in the first cycle. NERICA L-19 rice variety established under AWD had significantly higher MBN than Ofada rice established in continuously flooded conditions (Figure 2).
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Figure 2. The effect of the interaction of water regime × variety on microbial biomass nitrogen (cycle 1) in the screen house. MBN1 – microbial biomass nitrogen in cycle 1. Vertical bars indicate the standard errors of the mean.

Microbial count in the screen house

There were no significant effects of the irrigation regimes on microbial count (Table 3). Soil microbial count was significantly higher in plots sown with Ofada than with NERICA L-19 rice.

Table 3. The effect of water regime on microbial biomass carbon, nitrogen and microbial count of the soil sown with lowland rice varieties (The screen house experiment).

| Treatments | MBC1 (ug g⁻¹) | MBC2 (ug g⁻¹) | MBC3 (ug g⁻¹) | MBN1 (ug g⁻¹) | MBN2 (ug g⁻¹) | MBN3 (ug g⁻¹) | Microbial count (CFU/ml × 10⁶) |
|------------|---------------|---------------|---------------|---------------|---------------|---------------|-------------------------|
| Moisture regime (MR) |               |               |               |               |               |               |                         |
| AWD        | 324.84        | 313.3         | 255.3         | 286.38        | 271.5         | 237.3         | 40.39                   |
| Flooded    | 285.77        | 280.5         | 254.6         | 269.25        | 255.3         | 237.9         | 38.44                   |
| LSD        | 3.39**        | 4.59**        | NS            | 3.62**        | 5.30**        | NS            | NS                      |
| Variety (V) |               |               |               |               |               |               |                         |
| NERICA® L-19 | 301.22        | 299.2         | 257.8         | 283.23        | 266.5         | 233.5         | 37.64                   |
| Ofada      | 309.39        | 294.6         | 252.1         | 272.40        | 260.3         | 239.7         | 41.19                   |
| LSD interactions | 3.39**        | 4.59**        | 4.86*         | 3.62**        | 5.30**        | NS            | 2.65*                   |
| MR × V     | **            | NS            | **            | NS            | NS            | NS            | NS                      |
**Significant at P<0.01. *Significant at P<0.05. NS – no significant difference. LSD – least significant difference. MBC – microbial biomass carbon, MBN – microbial biomass nitrogen. 1 – cycle one, 2 – cycle two, 3 – cycle three of intermittent irrigation regimes, cfu – colony-forming unit.
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Grain yield in the screen house

Water regime had a significant effect on the grain yield. Significantly higher grain yield per plant (6.86 g plant⁻¹) was obtained in plots of lowland rice established with AWD than those under continuous flooding (4.07g plant⁻¹). There was no varietal variation in the grain yield per plant in the screen house (Table 4).

Table 4. The effect of water regime on grain yield of lowland rice varieties in the screen house experiment.

| Treatments   | Grain yield (g plant⁻¹) |
|--------------|-------------------------|
| Moisture regime (MR) |                |
| AWD          | 6.86                   |
| Flooded      | 4.07                   |
| LSD          | 1.86**                 |
| Variety (V)  |                        |
| NERICA® L-19 | 6.09                   |
| Ofada        | 4.84                   |
| LSD interactions | NS                  |
| MR × V       | NS                     |

**Significant at p < 0.01. * Significant at p < 0.05. NS – no significant difference. LSD – least significant difference.

Microbial biomass carbon and nitrogen in the field

Water regime had no significant (P > 0.05) effect on MBC and MBN in all the irrigation cycles except at the third cycle (Table 5).

Table 5. The effects of moisture regime and variety on microbial biomass carbon, nitrogen and microbial population under field conditions.

| Treatments   | MBC1 (µg g⁻¹) | MBC2 (µg g⁻¹) | MBC3 (µg g⁻¹) | MBN1 (µg g⁻¹) | MBN2 (µg g⁻¹) | MBN3 (µg g⁻¹) | Microbial count (CFU ml⁻¹) |
|--------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------------------|
| Moisture regime (MR) |        |                |               |               |               |               |                           |
| AWD          | 450           | 453           | 441.7         | 208           | 209           | 208.5         | 938                       |
| Flooded      | 520           | 512           | 515.7         | 218           | 219           | 219.8         | 87                        |
| LSD (5%)     | NS            | NS            | 16.27**       | NS            | NS            | 6.90*          | NS                        |
| Variety (V)  |               |               |               |               |               |               |                           |
| NERICA® L-19 | 486           | 481           | 474           | 215           | 210           | 208.3         | 325                       |
| Ofada        | 483           | 484           | 483.4         | 211           | 218           | 214.3         | 700                       |
| LSD (5%) Interaction | NS | NS | NS | NS | NS | NS | NS |
| MR × V       | NS            | NS            | *             | NS            | NS            | NS            | NS                        |

**Significant at p < 0.01. * Significant at p < 0.05. NS – no significant difference. LSD – least significant difference. MBC – microbial biomass carbon, MBN – microbial biomass nitrogen. 1 – cycle one, 2 – cycle two, 3 – cycle three.
Lowland rice established in plots under continuous flooding (515.7\textmu g g\(^{-1}\)) had significantly higher MBC than in those plots under AWD (441.7\textmu g g\(^{-1}\)) water regime in the third cycle. A similar pattern was observed in MBN in the third irrigation cycle. Soil microbial population was not significantly affected by both irrigation regimes and varietal differences in the field (Table 5).

Grain yield per hectare in the field

Neither of the treatments had any significant effects on the performance of lowland rice in the field. However, the response pattern of the performance of lowland rice to the treatments observed in the screen house was repeated in the field.

Table 6. The effect of moisture regime on the grain yield of lowland rice varieties under field conditions.

| Treatments | Grain yield (t ha\(^{-1}\)) |
|------------|-----------------------------|
| Moisture regime (MR) | |
| AWD | 6.41 |
| Flooded | 4.83 |
| LSD (5%) | NS |
| Variety (V) | |
| NERICA | 6.78 |
| Ofada | 4.47 |
| LSD (5%) | NS |
| Interaction | |
| MR × V | NS |

**Significant at \( P<0.01 \). *Significant at \( P<0.05 \). NS – no significant difference. LSD – least significant difference.

Nutrient release from AWD water regime is dependent on the initial nutrient status in the soil (Chepkwony et al., 2001; Gordon et al., 2008). Nutrient availability below a threshold that would support both the microbial activities and plant growth could result in the competition for nutrients. This justified the application of organic nutrient sources to plots where lowland rice was established. The soil used for both trials indicated that it had adequate nutrients to support the activities of the microbes to release nutrients as indicated in the significant increase in MBC and MBN especially at the earlier stages of AWD than those grown under continuous flooding. Soil microbial biomass has been reported to aid availability of carbon, nitrogen, phosphorus (Turner and Haygarth, 2001) and sulphur (nutrient source). The underlying mechanism responsible for nutrient pulses under this regime was described by Jarvis et al. (2007) and Fierer and Schimel (2002). The observed pulses in nutrients, especially N and C at the early cycles of the
imposition of AWD, have suggested that the process of mineralisation is dependent on the frequency of the imposition of AWD. Fierer and Schimel (2002) posited that the reduced nutrient pulses with the increase in the AWD cycles could be linked with the preponderance of microbes with tolerance to osmotic shock and reduced microbial lysis. Roberson and Firestone (1992) proposed that the reduction in C and N mineralisation with increasing frequency of AWD could be a result of the development of a protective layer by microbes. Taken together it could be suggested that the performance of lowland rice cultivars under AWD could be linked with nutrient availability. The pattern of MBN and MBC observed in the screen house was not replicated in the field which could have affected the performance of lowland rice in the field. Belder et al. (2004) suggested that the field variation in the yield under AWD could be attributed to soil hydrological conditions and the timing of its application. However, this position could not be validated in our experiment and requires further studies.

The presence of varietal differences in the microbial population could have an effect on the MBC and MBN. Other studies have reported the influence of crop cultivars and their ages on microbial community structure and activities (Grayston et al., 1998; Hartmann et al., 2009; Knox et al., 2014). This observation was reported to be mediated by the root exudation profile of the crop type (Grayston et al., 1998). It could be inferred that the root exudates from Ofada rice could have favoured an increase in the microbial population in the screen house through the stimulation of their growth and increased activities. However, the metabolic profile of these compounds released by Ofada rice could not be ascertained in this experiment. The increased microbial population in soil established under Ofada rice could have been associated with an increase in MBC at the first cycle of AWD. The MBC could have acted as an energy source to facilitate the activities of the soil microbes. The pattern of MBC observed at the second and third cycles of AWD in NERICA L-19 could have suggested a higher microbial activity in soils due to high concentration of soil C. The presence of high MBN at the first and second cycles of AWD where NERICA L-19 was established could have suggested that the microbial activities leading to the release of N were dependent on the frequency of its imposition for this lowland rice cultivar. A similar varietal variation in MBN was reported by Xu et al. (2015) where wheat was grown as a companion crop with watermelon. Xu et al. (2015) attributed this observed variation in MBN under wheat/watermelon intercropping conditions to the activities of soil enzymes, suppression of soil-borne diseases and changes in the community structure of microbes.

In the screen house, under continuous flooding, both lowland rice cultivars had similar MBC, which could suggest the negative effect of anaerobic conditions on activities of the soil microbes. Tian et al. (2013) posited that in the paddy, anaerobic conditions negatively affect the root morphology and the microbial
community structure. Conversely, under aerobic conditions, Mishra and Salokhe (2011) observed an increase in a finer and branched root system. The presence of oxygen could have increased the root activities and the exudation of C. Under anaerobic conditions, this will be suppressed resulting in reduced MBC irrespective of the rice cultivar involved. Lowland Ofada rice could have released root exudates that ensured increased MBC than NERICA L-19 under AWD in its the first cycle. A similar explanation could be adduced to the increased MBN in NERICA L-19 under both water regimes, probably with differential responses of soil microbes to the metabolic profiles of the root exudates.

Conclusion

The improved performance of lowland rice cultivars under AWD in the screen house could be related to significantly higher MBC and MBN, especially at the first two cycles. This could have resulted in increased microbial activities that could have facilitated nutrient pulses for improved lowland rice performance. In the screen house, a significantly higher microbial population in the soil where Ofada rice was established than in the soil where NERICA L-19 was sown could be related to increasing MBC, especially at the first AWD cycle. There is the need to investigate further the metabolic profiles of the rhizodeposition rice cultivars used under this water regime and the timing of their imposition in the future.

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PROMENE MIKROBIJALNE BIOMASE I PRINOSA ZRNA VARIJETETA PIRINČA KAO ODGOVOR NA NAIZMENIČNI VLAŽNI I SUVI VODNI REŽIM U UNUTRAŠNJOJ DOLINI PRELAZNOG POJASA SAVANE

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Rezume

U ovom istraživanju testirana je hipoteza da bi naizmenični vlažni i suvi (engl. alternate wet and dry – AWD) vodni režim mogao povećati ugljenik u mikrobnoj biomasi (engl. soil microbial biomass carbon – MBC), azot u mikrobnoj biomasi (engl. microbial biomass nitrogen – MBN) i ukupan broj mikroorganizama u zemljištu. Varijacije u vrednostima MBC, MBN i prinosa zrna mogu biti posledica razlika u varijantama u prelaznom pojasu savane. Ogledi (u sudovima i na polju) sprovedeni su na Poljoprivrednom federalnom univerzitetu, u Abeokuti (geografska širina 7° 12' do 7° 20' N i geografska dužina 3° 20' do 3° 28' E), u Nigeriji u 2015. godini. Kod oba ogleda, tretmani su se sastojali od vodnih režima (neprekidno plavljenje [kontrola] i režim AWD uveden kod varijeteta pirinča plavljenih područja [NERICA L-19] i varijeteta Ofada [lokalni kontrolni varijetet]) u fazi vegetativnog rasta u toku tri ciklusa. Dizajn kod oba ogleda podražumeva potpuno randomizirani odnosno randomiziran potpuni blok dizajn za ogled u sudovima i poljski ogled, u tri ponavljanja. U ogledu u sudovima, vrednosti MBC i MBN bile su značajno više kod režima AWD nego kod neprekidno plavljenog zemljišta, naročito na početku ciklusa režima AWD. Ovo je možda bilo uzrok da hranljive materije održe poboljšani učinak pirinča plavljenih područja pri režimu AWD. Suprotan obrazac je uočen kod MBC (2. i 3. ciklus) i MBN (1. ciklus). Sastav rizodepozicije i vreme ciklusa bi mogli objasniti uočene razlike među varijetetima u pogledu vrednosti MBC i MBN.

Ključne reči: biomasa, ciklusi, prinosi zrna, ravnica, zemljišta.

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