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Combined Effect of Doses of Fertilizer and Different Densities on Agronomic Parameters of Rice (*Oryza sativa* (L.)) Adapted in Humid Area in The Valley of Benoué, Cameroon

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Abstract: The study was conducted on July 2021, at the Institute of Agricultural Research for Development (IRAD). The main objective of the study was to determine the dose of mineral fertilizers and densities which respond well to the rice culture, variety Nerica L36 in a humid area of the valley of Benoué. Fertilizers doses were: **T1** (0 kg NPKSB+100 Kg Urea/ha); **T2** (150 kg NPKSB+100 Kg Urea/ha); **T3** (200 kg NPKSB+100 Kg Urea/ha; **T4** (250 kg NPKSB+100 Kg Urea/ha). Three densities were considered: **De1**= 20 cm x 20 cm; **De2**= 25cm x 25cm; **De3**= 30 cm x 30 cm. The experimental design was a split-plot, with two factors in three replications: **Factor 1** concerning fertilizers doses and **Factor 2** relating to densities. Evaluation parameters were: the height of plant, the number of tillers, the number of panicle/plants, length of panicles, heading date at 80 % and maturity date. Harvest data collected were: the number of grains/panicles, weight of 1000 grains, potential yields. The results showed that the effect of different amounts especially doses 2, 3 and 4 were highly significant ($P \leq 0.05$) in influencing the height of plant, number of tillers, number of panicles/plants, length of panicles for all densities. These densities were considered suitable for growing aspect of rice. On the other hand, the densities 1 and 2 were suitable for the element of heading date at 80 % for the doses 1 and 2, maturity date with dose 1. However, yield aspects were most significant ($P \leq 0.05$) with the dose 2, 3 and 4 on a number of grains/panicles and potential yield especially, which permit us to deduce that densities 1, 2 and 3 were suitable for these yield parameters.

Keywords: Plant density, Rice, Doses, Mineral fertilizers, Yields.

I. Introduction

Rice (*Oryza sativa* L.) culture represents the first cereal for human food in the world and for around half of world's population (Courtois, 2007). The asiatic country remains dominant in the economy of Rice, with 90 % in terms of surfaces and production (Mendez, 2008). Countries that are more included are China, India and Indonesia which represent more than half of the world's production. Latin America and Africa represent 10 % of the output (Mendez, 2008).

In Africa, Rice culture is the third source of calories for the country (Adrao, 2009). The actual problem in that Africa is confronted is that local production does not never equal the demand (Harold and Tabo, 2015). However, the show estimated at 330.000 tons, is essentially lower than the market, whose requirement is calculated be more than 600.000 tons. To satisfy this deficiency, Cameroon should refer to the importations. Rice takes the first place in the order of five principal food products of high consummation concerned by importation in Cameroon. Importations varied from 552.472 tons in 2000 for the value to 156.6 thousand billion of FCFA to 819.841 tons, equivalent of 212.6 thousand billion of FCFA in 2013, after decreasing from 728.443 tons for the importance of 183.7 thousand billion milliards in 2017. Importation price has increased from 7.9 % (INS, 2017).

Cameroon has the biggest natural potentiality good for Rice culture on all national territories according to the land, resources in water and climate. Many governmental interventions were recorded, but the lower valorization of natural resources and public interventions in this culture remains few. The research domain, the Institute of Agricultural Research and Development (IRAD) diversify research activities and solutions concerning productivity of Rice, through their international partnership (Center of Africa Rice and International Rice Research Institute). IRAD has experimented with high potential technologies for improving the productivity and the quality of local Rice like NERICA (New Rice for Africa). Varieties Nerica were experimented with in 1990, by crossing between Asiatic Rice (*Oryza sativa*) and African Rice (*Oryza glaberrima*). Wide varieties were tested, adopted and vulgarized by IRAD throughout the country. In the Northern part, the variety Nerica L36 is the most used and most appreciated of

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all. These could be justified by the adaptability of this variety in a humid area to irrigated zone. Considering the few irrigated perimeters, this variety responds well to the producers who were satisfied by their production in a humid area and disseminated to others zone in the valley of Bénoué. However, variety NL36 has a high yield (4.5 t/ha in the rural location and with a potential yield of around 6 t/ha), good and appreciable for their quality in terms of gustation. This variety has a short cycle compared to other traditional types, which is recommended for the Sudano-area in the context of climate change.

In fact, to enhanced yield, it is vital to use improved varieties, but also recent agricultural strategies and fertilizers (Sallah *et al.*, 2009). Nowadays, agricultural practices used by the producers are endogens. However, the productivity of rice is low due to delays in nursery sowing and late transplanting, faulty methods of cultivation, and little or no use of fertilizers. The secret of boosting its yields mainly lies in timely transplanting and proper fertilization of the produce (Jagtap *et al.,* 2018). Also, the establishment of crop is very slow the drilling methods resulting in low yields due to heavy weed infestation (Jagtap *et al.,* 2018). But, the introduction of new varieties does not satisfy to increase in the production of Rice. We could ask if the number of fertilizers should be a factor for optimizing the good growing of plants and yields of Rice in a humid area for the populations of the rural zone. In this context that, this research was done to determine the recommended dose of fertilizers recommended for good products of Rice culture in a humid area of the valley of Benoué.

II. Materials et methods

II.1 Description of the site

The study was realized at the experimental site of IRAD precisely on Kismatari near to the valley of Benoué situated from 15 km North, north of the town of Garoua, Cameroon. One place was chosen with geographical coordinates: 09°34'310'' N and 013°27'712'' E. Climate of this locality is Sudano-Sahelean types with two seasons: a short rainy season beginning from May to September and prolonged dry season beginning from October to April.

II.2 Vegetal material

The vegetal material used was the variety adapted to the humid areas. The characteristics of Nerica L36 were detailed in table 1 below:

Table 1: Characteristics of the variety Nerica L36.

Denomination (synonyms)	NERICA L 36
Pedigree	WAS 161-B-6-B-1
Parent	TOG5681/4*IR64
Genetic nature	Pure descendant
Varietal type	*Oryza sativa* x *Oryza glaberrima*
Years of creation	ADRAO (2007)
Date of introduction	2008
Responsible of maintaining	IRAD
Cultural vocation	Humid area, irrigated
Cycle (days)	95-105 days
Seeds texture	Long
Weight of 1000 seeds (g)	30 to 40
Potential yields (t/ha)	4 to 6 t/ha
Others characteristics	Tolerant to dryness, good resistance to diseases and insects' good aptitude to transformation: white seeds; organoleptic characteristics: culinary quality not stick.

Sources: Africa Rice Center (WARDA), 2008.

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II.3 Experimental design and treatments applied

The experimental design was a split-plot with two factors: **Factor 1** concerning the dose of fertilizers and **Factor 2** relating to densities. The study started on July 2021, with preliminary works like clearing and treating an experimental unit with herbicide (Momtaz, insecticide, and fungicide for the seeds). The surface was 86.975 m^2 constituted of four treatments repeated three times. Two weeks after sowing, we proceeded to remove exceeding plants on pockets to have recommended density per pocket and transplant non germinated pockets to two plants per pocket.

The density of plants is constituted of three levels for sowing: **De1**= 20 cm x 20 cm; **De2**= 25cm x 25cm; **De3**= 30 cm x 30 cm. Density used for sowing were 250.000 pockets/ha for the distance of 20 cm within stripe and 20 cm among pockets of every stripe; 160.000 pockets/ha for the space of 25 cm within stripe and 25 cm among pocket of every stripe and 111.111,111 pockets for the space of 30 cm within stripe and 30 cm among bags of every stripe. In every bag, approximately five seeds were sowed.

II.4 Fertilization of plants

Uses of fertilizers are important in Rice culture because they permit the good growth of plants, fructification, and maturation process of panicles (padding). One type of fertilizer (mineral) was used with formula NPKSB 14-23-14-5-1, and treatments (doses) used are constituted to different levels of amounts of fertilizers (Table 2).

Table 2: Treatments were providing the combination of mineral fertilizers doses and urea.

Treatments	Fertilizers types	Cover fertilizers	Combination
	(Kg/ha)	**(Kg/ha)**	
	NPKSB (14-23-14-5-1)	**Urea (46%N)**	
T1	0	100	0kg/ha+100kg/ha urea
T2	150	100	150kg/ha+100kg/ha urea
T3	200	100	200kg/ha+100kg/ha urea
T4	250	100	250kg/ha+100kg/ha urea

II.5 Data collection procedure

Data were collected on nine plants randomly chosen to sample phenological and agro-morphological, and yield data of plants development. Growing parameters obtained by counting were: heading date at the 80 %, maturity date, the number of tillers, the height of the plant, panicles length and the numbers of the panicles/plant. Harvest data collected were constituted of the number of grains/panicles, the weight of 1000 grains, and potential yield.

II.6. Statistical analysis

Statistical analysis was done with the software R commander. Values were estimated in terms of average ± standard error. Means comparison was made using the t-student test and ANOVA on the probability of 5 %.

III. Results

III.1 Agro-morphological aspects

III.1.2 Height of plants

The effect of different doses per density on height of plants is presented in **Table 3**. Comparatively within amounts, doses 2, 3, and 4 were significant ($P \leq 0.05$) on the growth of height of plants for the three densities (1, 2, 3) considered (20 cm x 20 cm; 25 cm x 25 cm and 30 cm x 30 cm). According to different doses, the height of plants varies from 103 to 111 cm for dose 2; 107 to 112 cm for dose 3, and 105 to 115 cm for dose 4. This permits us to deduce that doses 2, 3, and 4 are favorable for growing at the height of plants for the three densities considered of the variety Nerica L36.

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Table 3: Height of plants according to doses and densities.

Treatments	Height (cm)		
	Density 1	**Density 2**	**Density 3**
T1	92.67±4.51b	102.33±7.57b	102.67±9.71b
T2	103±2.0a	110.33±3.51a	111±3.60a
T3	107.67±0.57a	115.33±2.08a	112.33±1.53a
T4	105.33±1.15a	110.67±2.52a	115.33±3.51a

NB: The column data for a variable followed by the same letter are not significantly different at the level of probability considered (P≤0.05). **T1** (0 kg NPKSB+100 Kg Urea/ha); **T2** (150 kg NPKSB+100 Kg Urea/ha); **T3** (200 kg NPKSB+100 Kg Urea/ha); **T4** (250 kg NPKSB+100 Kg Urea/ha). **Density 1** (20 cm x 20 cm), **Density 2** (25 cm x 25 cm), **Density 3** (30 cm x 30 cm).

III.1.3 Number of tillers

Table 4 presents the number of tillers for the different doses per density considered. Compared between the quantities, the three doses (2, 3, 4) were significant (P≤0.05) on the number of tillers of plants for the three densities (1, 2, 3) considered. Concerning the aspect dose per density, the number of tillers varied between from 12 to 22 for dose 2, 14 to 21 for dose 3, and 11 to 22 for dose 4. We could deduce that the doses 2, 3, and 4 favor good tillage of plants during growing for all the densities considered of the variety Nerica L36.

Table 4: Number of tillers according to doses and densities.

Treatments	Number of tillers		
	Density 1	**Density 2**	**Density 3**
T1	9 ± 2.08b	14 ± 1.73b	15 ± 6.1b
T2	12 ± 2.0ab	16 ± 1.53ab	22 ± 1.73a
T3	14 ± 1.15a	18 ± 1.0a	21 ± 2.08a
T4	11 ± 1.15ab	18 ± 1.0a	22 ± 1.73a

NB: The column data for a variable followed by the same letter are not significantly different at the level of probability considered (P≤0.05). **T1** (0 kg NPKSB+100 Kg Urea/ha); **T2** (150 kg NPKSB+100 Kg Urea/ha); **T3** (200 kg NPKSB+100 Kg Urea/ha); **T4** (250 kg NPKSB+100 Kg Urea/ha). **Density 1** (20 cm x 20 cm), **Density 2** (25 cm x 25 cm), **Density 3** (30 cm x 30 cm).

III.1.4 Number of panicles

Table 5 shows the number of panicles per plant according to doses and different densities. Comparatively, between the amount, the doses 2, 3 and 4 were significant (P≤0.05) on the number of panicles per plant for density 2 (25 cm x 25 cm). Considering the doses for density 2, the number of panicles per plant varied from 16 to 18 compared to dose 1 (14). Contrarily, the effect of different amounts not influence the number of panicles per plant for the density 1 and 3. However, in comparison within amounts, doses 2, 3 and 4 increase the number of panicles per plant, deducing that density 2 improves the number of panicles per plant of the variety Nerica L36.

Table 5: Number of panicles according to dose and densities.

Treatments	Number of panicles/plants		
	Density 1	**Density 2**	**Density 3**
T1	11 ± 1.0a	14 ± 1.15b	16 ± 5.51a
T2	14 ± 0.0a	18 ± 2.88a	19 ± 0.57a
T3	13 ± 1.0a	16 ± 0.57ab	19 ± 0.57a
T4	12 ± 1.0a	17 ± 2.64ab	18 ± 1.73a

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NB: The column data for a variable followed by the same letter are not significantly different at the level of probability considered (P≤0.05). **T1** (0 kg NPKSB+100 Kg Urea/ha); **T2** (150 kg NPKSB+100 Kg Urea/ha); **T3** (200 kg NPKSB+100 Kg Urea/ha); **T4** (250 kg NPKSB+100 Kg Urea/ha). **Density 1** (20 cm x 20 cm), **Density 2** (25 cm x 25 cm), **Density 3** (30 cm x 30 cm).

III.1.5 Length of panicles

Table 6 present the length of panicles for the different doses and per density. Compared among different quantities, doses 2, 3 and 4 were significant on the length of panicles for the density 1 (20 cm x 20 cm) and 3 (30 cm x 30 cm). Effect of different doses does not affect the length of panicles for density 2 (25 cm x 25 cm). However, in comparison among quantities, doses 2, 3 and 4 increases the size of panicles and permit us to deduce that the density 1 and 3 improve the size of panicles of the variety Nerica L36.

Table 6: Length of panicles according to doses and densities.

Treatments	Length of panicles (cm)		
	Density 1	**Density 2**	**Density 3**
T1	23 ± 2.64b	26.33 ± 2.52a	24.33 ± 1.53b
T2	26 ± 1.0a	26.67 ± 0.57a	26.33 ± 1.53ab
T3	26.33 ± 0.57a	26.67 ± 1.15a	26.67 ± 0.57ab
T4	27 ± 1.0a	25.67 ± 2.31a	28 ± 0.0a

NB: The column data for a variable followed by the same letter are not significantly different at the level of probability considered (P≤0.05). **T1** (0 kg NPKSB+100 Kg Urea/ha); **T2** (150 kg NPKSB+100 Kg Urea/ha); **T3** (200 kg NPKSB+100 Kg Urea/ha); **T4** (250 kg NPKSB+100 Kg Urea/ha). **Density 1** (20 cm x 20 cm), **Density 2** (25 cm x 25 cm), **Density 3** (30 cm x 30 cm).

III.1.6 Heading date at 80 %

Table 7 presents the effect of different doses per density of sowing for the aspect of a heading of plants at 80 %. Referred to different quantities, dose 1 and 2 were significant (P≤0.05) for the density 1 (20 cm x 20 cm), with the number of days varying respectively from 80 to 84 days after sowing. They were followed by dose 2, with 82 days after sowing for density 2 (25 cm x 25 cm). Dose 1 and 2 were clear for a good heading plant. Concerning the dose 1, the different densities considered were favorable to heading plants, contrarily to dose 2, 3 and 4, the density 1 and 3 were good to the heading plants of the variety L36.

Table 7: Heading date at 80 % according to doses and densities.

Treatments	Heading date at 80 % (days)		
	Density 1	**Density 2**	**Density 3**
T1	84 ± 3.05a	82 ± 5.13ba	80 ± 2.0a
T2	80 ± 3.05ab	76 ± 1.15b	78 ± 2.0a
T3	78 ± 1.0c	76 ± 0.57b	77 ± 0.57a
T4	79 ± 1.15bc	77 ± 1.0b	79 ± 1.73a

NB: The column data for a variable followed by the same letter are not significantly different at the level of probability considered (P≤0.05). **T1** (0 kg NPKSB+100 Kg Urea/ha); **T2** (150 kg NPKSB+100 Kg Urea/ha); **T3** (200 kg NPKSB+100 Kg Urea/ha); **T4** (250 kg NPKSB+100 Kg Urea/ha). **Density 1** (20 cm x 20 cm), **Density 2** (25 cm x 25 cm), **Density 3** (30 cm x 30 cm).

III.1.7 Maturity date at harvest

Table 8 present the maturity of plants at harvest for the different doses and densities. Comparatively, within amounts, dose 1 was significant (P≤0.05) to the date of maturity at yield of plants for the density 1 (20 cm x 20 cm) and 2 (25 cm x 25 cm). However, dose 1 was suitable for a good maturation of plants of the variety Nerica L36 at harvest for the density 1 and 2.

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Table 8: Maturity date at harvest according to doses and densities.

Treatments	Maturity date at harvest (days)		
	Density 1	**Density 2**	**Density 3**
T1	114 ± 3.05a	112 ± 5.13a	110 ± 2.0a
T2	110 ± 3.05b	106 ± 1.15b	108 ± 2.0a
T3	108 ± 1.0b	106 ± 0.57b	107 ± 0.57a
T4	109 ± 1.15b	107 ± 1.0b	109 ± 1.73a

NB: The column data for a variable followed by the same letter are not significantly different at the level of probability considered (P≤0.05). **T1** (0 kg NPKSB+100 Kg Urea/ha); **T2** (150 kg NPKSB+100 Kg Urea/ha); **T3** (200 kg NPKSB+100 Kg Urea/ha); **T4** (250 kg NPKSB+100 Kg Urea/ha). **Density 1** (20 cm x 20 cm), **Density 2** (25 cm x 25 cm), **Density 3** (30 cm x 30 cm).

III.2 Yield aspects

III.2.1 Seeds number/panicle

Table 9 presents the number of seeds per panicle according to doses and density. Comparatively, within amounts, dose 2, 3 and 4 were significant (P≤0.05) on number of seeds per panicle of all thicknesses considered. According to different amounts, the number of grains per panicle varied from 130 to 174 for dose 2, 150 to 174 for dose 3 and 161 to 186 for dose 4. However, we could deduce that doses 2, 3 and 4 increases the number of grains per panicle for all densities considered of the variety Nerica L36.

Table 9: Seeds number per panicle according to doses and densities.

Treatments	Seeds number/panicles		
	Density 1	**Density 2**	**Density 3**
T1	117 ± 15.95c	131 ± 17.58b	144 ± 21.54b
T2	130 ± 11.64bc	156 ± 8.95ab	175 ± 9.14a
T3	151 ± 29.47ab	152 ± 8.05ab	174 ± 15.51a
T4	161 ± 12.26a	163 ± 14.05a	187 ± 18.46a

NB: The column data for a variable followed by the same letter are not significantly different at the level of probability considered (P≤0.05). **T1** (0 kg NPKSB+100 Kg Urea/ha); **T2** (150 kg NPKSB+100 Kg Urea/ha); **T3** (200 kg NPKSB+100 Kg Urea/ha); **T4** (250 kg NPKSB+100 Kg Urea/ha). **Density 1** (20 cm x 20 cm), **Density 2** (25 cm x 25 cm), **Density 3** (30 cm x 30 cm).

III.2.2 Weight of 1000 seeds

Table 10 shows the weight of 1000 gains according to doses and densities. In comparison, within different amounts formulated, no significant difference(P≤0.05) was recorded between the amounts for all densities considered.

Table 10: Weight of 1000 seeds according to doses and densities.

Treatments	Weight of 1000 seeds		
	Density 1	**Density 2**	**Density 3**
T1	26.67 ± 0.85a	26.77 ± 0.50a	26 ± 0.88a
T2	26.43 ± 0.51a	26.33 ± 0.57a	26.70 ± 1.0a
T3	26.33 ± 0.35a	26.43 ± 0.51a	26.67 ± 0.35a
T4	26.10 ± 0.17a	27.13 ± 0.51a	26.77 ± 0.68a

NB: The column data for a variable followed by the same letter are not significantly different at the level of probability considered (P≤0.05). **T1** (0 kg NPKSB+100 Kg Urea/ha); **T2** (150 kg NPKSB+100 Kg Urea/ha); **T3** (200 kg NPKSB+100 Kg Urea/ha); **T4** (250 kg NPKSB+100 Kg Urea/ha). **Density 1** (20 cm x 20 cm), **Density 2** (25 cm x 25 cm), **Density 3** (30 cm x 30 cm).

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III.2.3 Potential yields

Table 11 presents the potential yields according to doses and densities. In comparison among the different quantities formulated, doses 2, 3 and 4 were significant in potential outcomes of the variety Nerica L36 for all the densities 1, 2, 3 (20 cm x 20 cm; 25 cm x 25 cm and 30 cm x 30 cm). This permits us to deduce that dose 2, 3 and 4 increases the productivity for the three densities considered of the variety Nerica L36.

Table 11: Potential yields according to doses and densities.

Treatments	Potential yields		
	Density 1	**Density 2**	**Density 3**
T1	3.83±0.50b	4.53±0.81b	4.30±1.58b
T2	6.57±1.30a	7.50±1.08a	5.60±0.36ab
T3	6.80±1.77a	7.43±0.30a	6.13±0.72a
T4	6.60±0.55a	6.83±0.57a	5.93±1.12ab

NB: The column data for a variable followed by the same letter are not significantly different at the level of probability considered (P≤0.05). **T1** (0 kg NPKSB+100 Kg Urea/ha); **T2** (150 kg NPKSB+100 Kg Urea/ha); **T3** (200 kg NPKSB+100 Kg Urea/ha); **T4** (250 kg NPKSB+100 Kg Urea/ha). **Density 1** (20 cm x 20 cm), **Density 2** (25 cm x 25 cm), **Density 3** (30 cm x 30 cm).

IV. Discussions

Results of our study showed that within different doses formulated on the field, the doses 2, 3 and 4 affected significantly (P≤0.05) the height of plant Rice of the variety Nerica L36 for the three densities (1, 2, 3) considered (20 cm x 20 cm; 25 cm x 25 cm and 30 cm x 30 cm). These different doses improve the growth of plants on the field and the height of plants was highest with the different amounts formulated. Works of Amedep *et al.* (2022) showed that the height of plants of the variety Nerica 60 responds well to fertilization with organic manure during their growing stages. Similarly, works of Moussa *et al.* (2021) on mineral fertilization (cereals complex and urea) of the Nerica Rice variety with different doses showed the highest height of rice plants during their growth.

The numbers of tiller's for the variety Nerica L36 were significantly (P≤0.05) highest with the uses of different doses of fertilizers formulated. The numbers of tiller's were improved with doses 2, 3 and 4 for all densities considered. However, tiller stages of plants were good for the three densities considered. Works of Amedep *et al.* (2022), showed the highest number of tiller's for the variety ITA 300 during the growth of plants with the dose of organic manure. Similarly, Moussa *et al.* (2021) found significant growth of tiller's of the variety Nerica 4 and 8 with mineral fertilizers (cereals complex and urea). In the same, the works of Raholimboahangy (2015) showed that the uses of different NPK treatments were significant in the number of tiller's. Soils of Riziculture are mostly deficient in Nitrogen elements for a good growth of plants (Raholimboahangy, 2015).

Uses different doses of NPK fertilizers increased the number of panicles of the variety Nerica L36. The quantities 2, 3 and 4 significantly (P≤0.05) improve the number of panicles for density 2 (25 cm x 25 cm). Works of Moussa *et al.* (2021) on different doses of mineral fertilizers based on cereals complex and urea also showed a significant number of panicles of plants Rice. Our study corroborates with the works of Lacharme *et al.* (2001) and Akintayo and Zadji (2008), who found that the use of mineral fertilizers on the variety Nerica 4 and 8 favors a good density of panicles during growth.

Results of the study showed that the uses of different amounts of mineral fertilizers were significantly (P≤0.05) highest on the length of panicles with the doses 2, 3 and 4 of the variety Nerica L36, compared within the quantities for density 1 and 3. These different doses improve the size of panicles with the density 1 and 3. The works of Nadjilom *et al.* (2020) showed positive responds on size of panicles of two varieties of Rice with mycorrhized than non-mycorrhized treatment in South-Chad.

Results on heading date at 80 % of plants showed that for all doses and densities considered, dose 1 and 2 were necessary for density 1 (20 cm x 20 cm). There were followed by dose 2 with a thickness equal to 25 cm x 25 cm. Dose 1 and 2 were considered as a good heading of plants, but dose 2, 3 and 4 respond well to a heading of plants with density 1 and 3, contrary to dose one, which answers well for all densities considered of the variety Nerica L36. The maturity of plants at harvest was significant for dose 1 (20 cm x 20 cm) and 2 (25 cm x 25 cm). This permits deducing that dose 1 was favorable for a good maturation of plants of the variety Nerica L36 at the harvest for the two densities. Contrary, the works of Asmamaw (2015) showed that plant density was not affected the full heading at 74 DAT and physiological maturity (104 DAT) of Rice (*Oryza sativa*).

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Our results of the number of seeds per panicle with uses of different doses and density showed that the number of seeds per panicle were significantly (P≤0.05) highest with dose 2, 3 and 4 with all the densities. The number of seeds per panicle of the variety Nerica L36 increased for all the densities considered. The same results were found by Nadjilom *et al.* (2020), which showed significant seeds number per panicle of two varieties of Rice with mycorrhized than non-mycorrhized treatment in South-Chad.

The weight of 1000 seeds for the variety Nerica L36 was not significantly (P≤0.05) affected using of different doses of mineral fertilizers for all density considered. Contrary, the works of Dieng (2021) showed a significant effect of dose of organo-mineral on the weight of 1000 seeds of Rice.

Potential yields recorded by using of different dose of mineral fertilizers and densities showed that doses 2, 3 and 4 were significantly highest (P≤0.05) on potential yields of the variety Nerica L36 for all densities considered. These different doses increased the productivity of plants for the three densities of Nerica L36. The same results were also found by Dieng (2021) on grain yields of Rice with uses of dose of organo-mineral on growth and outcomes of Rice. The works of Saidou *et al.* (2014), showed a significant difference among different forms of fertilizers applied concerning grain yields of the variety Rice IR841 and Nerica-L14.

V. Conclusion

The objective of this study was to determine the doses and densities which responds well to the degraded soils of the north, especially with the variety of Nerica L36 on growth and yield parameters at the experimental place of Institute of Agricultural Research for Development (IRAD), Cameroon. Concerning growth, amounts 2, 3 and 4 are recommended to increase and improve the productivity of culture for all densities considered. The study permits us to conclude that densities 1, 2 and 3 are good for- optimizes the yield of culture of the variety of Nerica L36.

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