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Field Demonstration Trial on the Effect of Nitrogen Application for Growth and Yield of Nerica 4 Rice

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Abstract: In the Sahel and West Africa rice is staple food and widely grown in different agro-ecologies of low land and upland conditions. In crop production, nitrogen is an important nutrient element for the growth and development of rice. The application of nitrogen fertilizer has become one of the inevitable ways to increase the yield potentials of rice. In order to achieve high output farmers usually apply the required dosage of NPK. The application of appropriate nitrogen fertilizer promotes rapid plant growth, high tillering, which results better increment of rice quantity. The objective was to evaluate the efficiency of nitrogen fertilizer rates on the growth and performance of NERICA 4 variety. The field method was randomized complete block design in different treatments and replicates of 0kg/ha, 50kg/ha, 100kg/ha and150kg/ha of nitrogen fertilizer respectively. The application method of nitrogen was at basal (60%) and top dressing (panicle initiation stage 40%). The statistical software package excel and analysis of variance (ANOVA x) were used for data analysis and interpretation of results at least significant difference (LSD) of 5%. In conclusion, the experiment demonstrated that paddy growers of Nerica 4 obtained high yields at 50kg/ha- 150kg/ha of nitrogen with the use of the right cultivation techniques, However, the results further indicate a clear disparity between nitrogen 50kg/ha with regards to nitrogen 0kg. The demonstration trial recommend further research to explore the yield potentials of Nerica 4 variety.

Keywords: Nitrogen, growth, yield, field demonstration, rice, Nerica 4.

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Introduction

In Sub-Sahara Africa, agriculture provides food, income, nutrition, creates job, reduces poverty, and contributes to the overall maintenance of social stability. The sector accounts for about a quarter of gross domestic product (GDP), and up to 90 percent of the rural population depends on it for livelihood [1]. Rice is among the most important food for more than 1/3 of the world's population [2]. Efficient and effective use of NPK can increase crop physiology, growth and yield of rice. The physicochemical characteristics of rice including composition, gelatinization, and texture and so to determine their usage in food and non-food applications, so it is necessary to have them documented. The quality of rice depends on starch, protein and fat contents and the structure of starch. Starch is the major component of rice grain that mainly determines the physio-chemical and cooking properties. The United Nations' Sustainable Development Goals (SDGs) 1, and 2 is an international policy priority and strategy tailored for the attainment of food self-sufficiency in medium and long term. [4] . According to [3] 80% of producers are subsistence farmers in the wake of attaining food security through the adaption and application of best agronomy practices for livelihood sustainability. According to [5] production and high cost of inputs, poor land development and water management, post-harvest losses coupled with poor marketing system and transportation attributes low yields. There are agronomic potentials to improve yields in Sub-Saharan Africa but numerous challenges exacerbating low output as it may not be profitable to increase yield [6]. The researchers

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demonstrated that application of NPK particularly nitrogen and other nutrient elements can improve yield potentials of rice. According to [6-7] appropriate use of NPK, fertilizer can increase yield while attaining profitability. In the field of agronomy nitrogen deficiency, results to stunted growth and yellowish of leaves leading to premature flowering and shortening of the growth cycle [8]. The excessive use of nitrogen enhances vegetative growth against productive growth stages with relatively poor root growth [9]. This process increases the risk of lodging and reduces the plant's resistance to harsh climatic conditions and foliar diseases. Nitrogen contributes to carbohydrate accumulation in culms and leaf sheaths during the pre-heading stage and in the grain during the ripening stage of rice [10]. The yield is one of the most essential parameters of production and productivity of rice [11]. In production plant height, leaf color, tillering ability, panicle length, seed rate, and grains per panicle all indicators for yield improvement in short and medium terms [12]. The nitrogen application enhances photosynthesis process of root development and plant growth which is integral part of yield increment. In addition, rice variety Nerica 4 selected for this experiment because it belongs to the varieties that have good morphological, drought toleran and yield characteristics in all the rice ecologies. The objective of the field experiment is to identify the impact of nitrogen fertilizer on the growth and yield of the Nerica 4 Variety. The research will help farmers suitably use of appropriate nitrogen dosage in the growth and yield of Nerica 4 and to determine how best farmers can reduce production cost per unit area [11-12].

Materials and Method

The experiment conducted at RE-4 field in a randomized complete block design (RBD) with four (4) treatments and three (3) replications to 12 demonstration plots. The plot size was 0.5m between plots and 1m between blocks. The seed preparation and sowing, of Nerica 4 was clean by using winnowing machines and removing unwanted materials followed by seed selection and soaking. The floating grains were remove as per standard procedure and were soaked in hot water of 60 degree Celsius simmering to10 minutes and soaked in cold water for 5 minutes. The indicators like plant height, leaf color and stem numbers calibrated in centimeters (cm). The sampling method used was instructor's representative hills survey method. The field preparation and transplanting of 4m x3m. The micro-soft excels and analysis of variance (ANOVA) used for statistical data analysis.

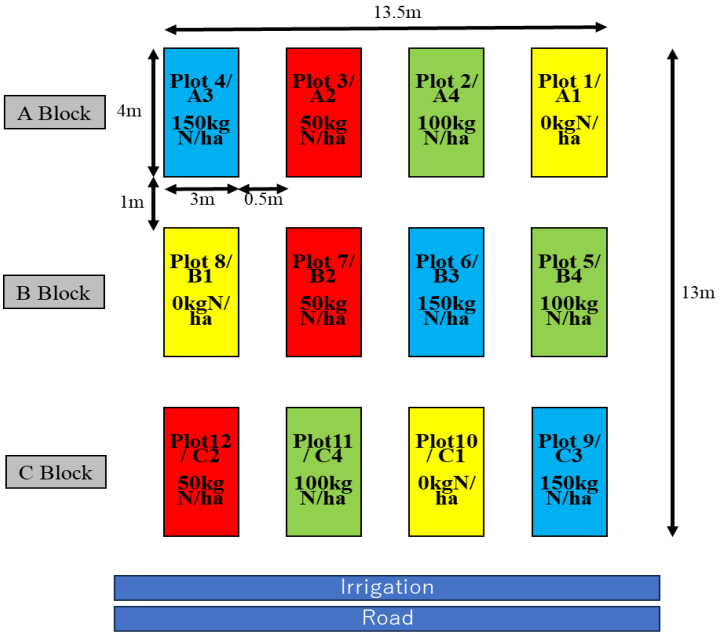

Figure 1: Shows Experimental Design.

Results and Discussion

The issue of data collection, analysis and interpretation of results is pivotal for social research and development. The interpretation of the results of parameters mainly focuses on plant length, stem number, leaf colour, and fertilizer response and yield. The results in Fig 2: Shows that plant length differed significantly with nitrogen amount N_{150} and N_0, while N_{150} showed more growth in plant length followed by N_{100} and N_0 respectively. The research indicates that there were no significant difference between nitrogen amount N_{100} and N_{150}. The Nerica-4, which is tolerant to drought and phosphorus deficiency as the most widely, adopted upland variety grown in many Sub Saharan African countries [13].

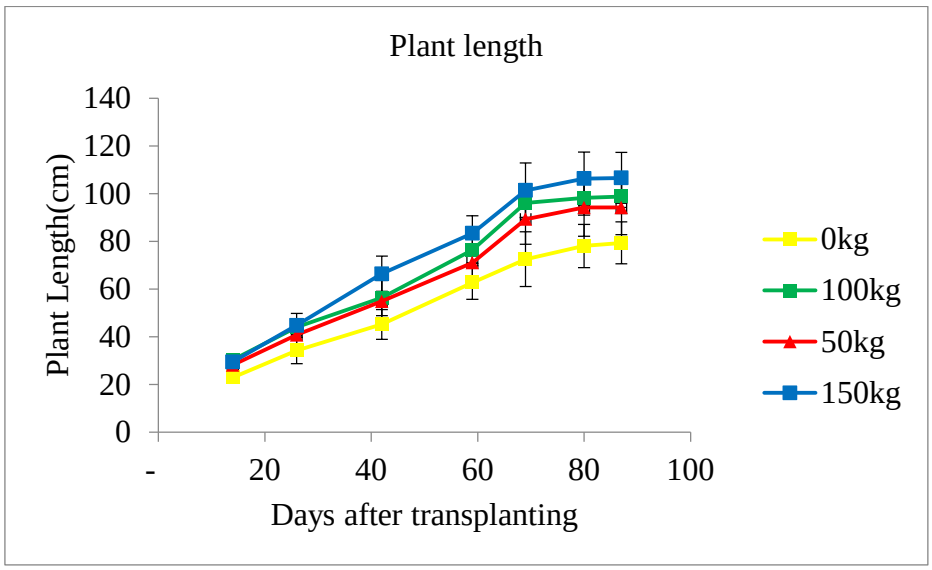

Figure 2**:** Shows plant Length

The result in Fig 3 shows the stem numbers of different treatments observed from the initial day of transplanting to seventeen (17) DAT, as there were no significant difference in the stem tillering because rice was recovering transplanting shock. Importantly at thirty- (30) DAT, it was observed that plants have started increasing number of stems. Furthermore, at 43 DAT maximum tillering stage observed where N_{150} had greater numbers of stem than all other treatments. Moreover, after panicle initiation (PI) and top dressing (TD) the number of stem stabilized with nutrients transitioning to productive growth while at seventy-two (72) DAT, full heading was observed with N_{150} and N_{100} having more tillers compared to 0kg and 50kg treatments. The process of tillering enhanced by nitrogen application at reproductive stage. The result was in agreement with the finding of [14] who reported that the number of tillers increases due to nitrogen application. This result is also in agreement with the findings of [15] who reported that application of NPK fertilizers increases the number of tillers resulting to better yields.

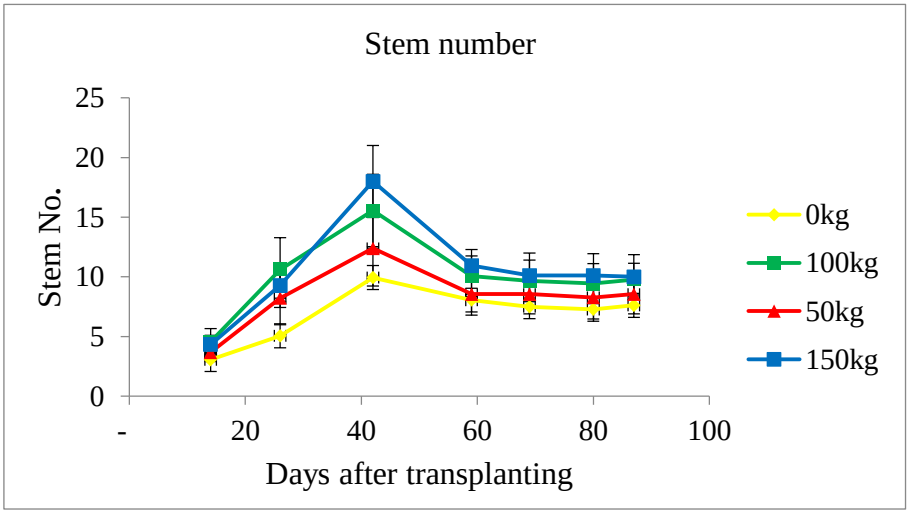

Figure 3: Shows Tiller Numbers

Reliability of data is an integral part of authentic analysis and interpretation for decisive in decision-making. The results in fig 4 shows how the different nitrogen levels effect on the leaf color of Nerica 4. The time of field demonstrations at 25 days after transplanting (DAT), there was an increment in leaf color due to proper establishment of seedlings roots. There was a significant increment in the leaf color of all treatments on 62 DAT due to the top dressing application except N_0. N_{150} shows more response to nitrogen up-take, followed by N_{100}, and N_{50} respectively. In day 4 after transplanting, there was equilibrium of leaf color response between N_{150} and N_{100}. According to [12] the application of nitrogen significantly enlarged the chloroplast, while the application of potassium changed the chloroplast shape from an irregular large oval to a regular spindle shapes. It is crucial to manage nitrogen application as it plays a vital role for plants growth [16]. The shortage of nitrogen decreases leaf size retarding the process of photosynthesis leading to low manufacturing of chemical food resulting to poor yields. In the absorption of plant nutrient, nitrogen is the main component of chlorophyll that enhance the photosynthesis process in building tissues and organs of plants. In the process of photosynthesis, chlorophyll content is vital for nitrogen absorptions that maintains the physiology stages until harvest [7].

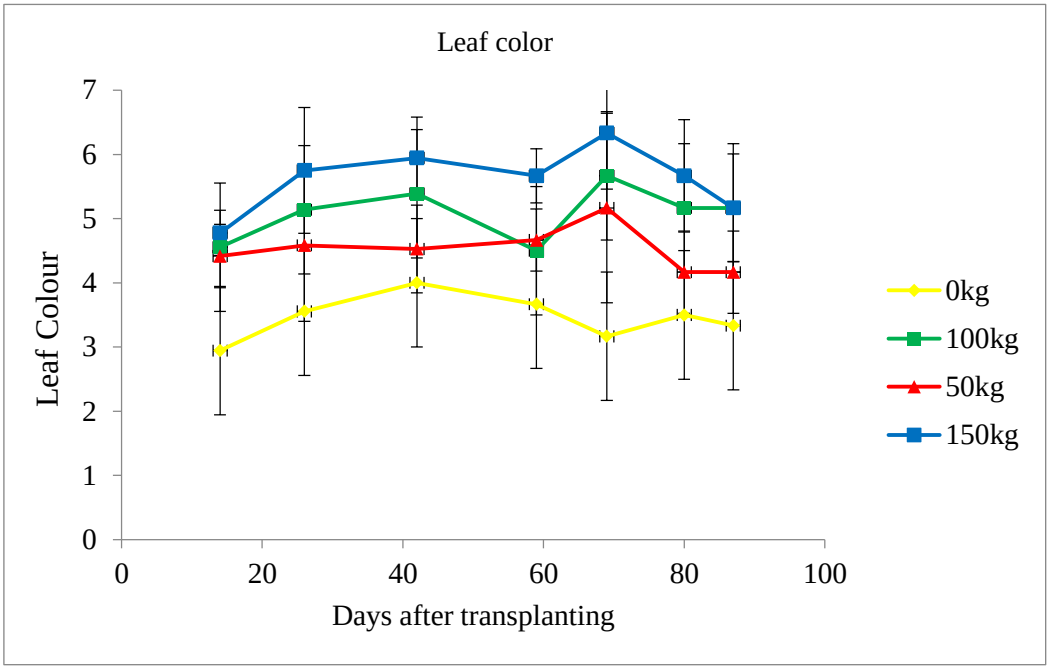

Figure 4**:** Shows the Leaf Color

Conclusion and Recommendations

The field experiment on rice is pivotal to determine yield potentials in the process of attaining food and nutritional security. In most of the countries, particularly Sub- Saharan Africa rice is a staple food for the population. Research for development is key and fundamental in the generation of new agricultural technologies, local knowledge that contributes to socio-economic development of a nation. The experiment demonstrated that different nitrogen amount have varying effects on the growth and yield of Nerica 4 while the results further indicating a clear disparity between N50kg/ha-N150kg/ha with regards to N0kg/ha. The field experiment recommends to conduct further research to explore the yield potentials of Nerica 4.

Conflict of Interest

The author declare(s) that there is no conflict of interest regarding the publication of this article.

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