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GROWTH AND YIELD RESPONSE OF LOWLAND RICE L – 34 (*ORYZA SATIVA L.*) TO UREA FERTILIZER AND TIME OF APPLICATION

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ABSTRACT: *Accessibility of plants to nutrient depends largely on the ease of contact between the soil and the crop. An experiment on the forms of urea fertilizer and time of application effects on the growth and yield of lowland rice (Oriza sativa) was carried out during 2013 rainy season at the National Cereal Research Institute (NCRI) Moor Plantation, Ibadan. Urea fertilizer in granule and spray were applied at 2 weeks after transplanting (WAT) and 4 weeks after transplanting in 2 x 2 factorial experiments in a Randomized Complete Block Design (RCBD) while no fertilizer served as control. Data taken include number of leaves, number of tillers, and days to fifty percent (50%) panicle initiation, number of productive tillers and weight of seed (g/plant). The result showed that leaf production and tillering was best encouraged on fertilized plots than the untreated plants. Fertilizer granule at 2 WAT significantly initiated panicle development faster than other treatments, significantly had more productive tillers/plant and seed yield (22.5 g/plant) than other treatments. Consequently, application of urea fertilizer in granule form at 2weeks after transplanting, tend to reduce nitrogen lost to denitrification in waterlogged soil and make more nutrient available for growth, will be most suitable for lowland rice production under similar soil condition.*

KEYWORDS: Rice, Fertilizer, Granule, Spray, Denitrification

INTRODUCTION

Rice *Oryza sativa* is a grass which belongs to the family of *Gramineae*. It belongs to the genus *Oryza*, with more than 20 species. Rice is one of the most important cereal crops supplying 20 percent of the total food calories in the world (IRRI, 2004). It is also good source of thiamine, riboflavin niancin and dietary fibre. Unwilled rice (brown) has more nutritional value than white or polished rice. (Carney, 2001). It also ranks second after wheat and maize in production on a worldwide basis. The potential for rice production in Nigeria is about 4.6 -4.9 million hectare representing 22% of the total potential available area and can also be cultivated in about five different ecologies which are Rain-fed upland, rain fed lowland deep water flooded, irrigated lowland and swampy ecologies (Ukwungwu and Imolehin, 2001). With the expansion in cultivated land to rice, there has been steady increase in rice production and consumption in Nigeria. This steady increase has however not been enough to meet the consumption demand of the rapidly growing urban Nigeria population that has great preference for per boiled rice. An understanding of crop nutrient requirement, time of application and the use of best fertilizers are vital keys to growing healthy and high yielding rice crop (Bohnert *et al.* 1995). Rice plant requires a large amount of nitrogen at

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early stage and mid-tillering stages to maximize the number of panicles thus increase yield. According to NCRI, (20008) nitrogen must be available to the plant throughout the growing season, but there are basically three plant stages when sufficient nitrogen is critical. The first stage is tillering (stooling), when the number of panicles (heads) is determined. Nitrogen deficiency at this time reduces tillering and yield potential of rice. From internode elongation through the beginning of head formation, nitrogen must be available in sufficient quantity to promote the maximum number of grains. Nitrogen deficiency at this time reduces the number of potential grains (florets) and limits yield potential. From the beginning of flowering on to maturity, the rice plant needs enough nitrogen to fill the grains properly, but this nitrogen is primarily translocated within the plant from stems and leaves. Nitrogen applications at this time may have no effect, or even a detrimental effect, on yields. Sufficient nitrogen should be applied pre-plant or pre-flood to assure that the rice plant needs no additional nitrogen until the panicle initiation or the panicle differentiation (2 mm panicle) stage. Nitrogen fertilizer should be placed either on dry soil and flooded in immediately or shallow incorporated and flooded within 3-5 days. If urea nitrogen is left on the soil surface without flooding within 2-3 days, some may be lost to the atmosphere as a gas in a process called volatilization. When the soil is flooded, nitrate is broken down by bacteria and released to the atmosphere as a gas in a process called denitrification (IRRI, 2004). It is hereby necessary to investigate the effect of fertilizer form and time of application on the growth and yield of the improved lowland rice line.

The objectives of this study are to:

(i) Assess the impact of form of nutrient supplied on growth and yield of lowland rice.

(ii) To determine suitable time to apply fertilizer to lowland rice.

MATERIALS AND METHODS

This experiment was carried out at the National Cereals Research Institute (NCRI) Moor Plantation, Ibadan station between August-October, 2013. The experimental design used was 2 x 2 factorial experiments in a Randomized Complete Block Design (RCBD) with 3 replicates. The treatments comprise application of urea in form of granule and spray at 2 weeks after transplanting (2 WAT) and at 4 WAT while no fertilizer served as control. The rice variety used for the experiment was L – 34. It is a lowland rice variety which matures in the space of 4 months. Rice was raised in a nursery bed of 3m x 4m where 1kg of L – 34 was allowed to germinate and establish for 3 weeks. The seedlings were uprooted from the nursery into 1m x 1.5m plot separated by 1m margin where seedlings was transplanted at 20 x 30 cm. Urea fertilizer was applied at the rate of 320 kgN/ha in 2 different forms Granules and Spray at 2 weeks after transplanting and 4 weeks after transplanting. Urea was dissolved in 2 litres off water to achieve the spray form. Parameters taken include plant height (cm), number of tillers per plant, number of leaves per plant, leaf area index (cm^2), days to 50% panicle, number of productive tillers, seed weight. Data collected were subjected to statistical analysis using analysis of variance (ANOVA) while the means were separated using Duncan Multiple Range Test (DMRT).

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RESULTS AND DISCUSSION

Pre-planting soil analysis

The results of the physic-chemical analysis of the soil samples collected shows that the soil sample is loamy sand and moderately acidic.

Forms of urea fertilizer and time of application effect on number of leaves of rice

Except at 2weeks after transplanting (WAT) forms and time of fertilizer application had significant effect on the number of leaves produced by rice (Table 2). However, at 2weeks after transplanting (WAT), spray application at 4WAT had the highest number of leaves of 22 while granule application at 2WAT produced lowest number of leaves of 17 even though they are not significantly different. At 4WAT, granule at 2WAT produced the highest number of leaves which is significantly higher than other treatments. Control plot had the lowest number of leaves which is not different significantly from granules at 4WAT and spray at 4WAT. Also, at 6WAT, granules at 2WAT produced more leaves which are significantly different from other treatments except granules at 4WAT. However, at 8WAT and 10WAT, treatment effects were better than the control plot. Even though granules at 4WAT gave the highest value of 37 leaves, it is not different significantly from other treatments. An adequate supply of nitrogen to the crop plants

during their early growth period is very important for the initiation of leaves and florets primordia (Tisdale and Nelson, 1984).

Forms of urea fertilizer and time of application effect on number of tillers

Fertilizer forms and time of application had significant effects on the number of tillers produced except at 2weeks after transplanting (WAT) and 10weeks after transplanting (WAT) (Table 3). It was observed that 2WAT, spray application at 4WAT had the highest number of tillers of 4.83 while control and spray application at 2WAT had the lowest number of tillers of 4.50, even though they are not different significantly. At 4WAT, granules at 2WAT produce the highest number of tillers of 8 which is significantly different from other treatment, which is closely followed by spray at 2WAT while the least was from the control plot. Also at 6WAT, granules at 2WAT produced more tillers than other treatments except granules at 4WAT. But at 8WAT, granules at 4WAT gave the highest number of tillers of 9 which is comparable to other treatments except the control plot. However, at 10WAT, treatment application had no significant effect on all plots probably because of the approach to reproductive phase**.** This report was supported by Indira, (2005) where the fertilizer treatment had significant effect on the plant

growth at different growth stages where tillers production was increased with N fertilizer application significantly than the plants that received lowest fertilizer.

Effect of treatment on days to fifty percent (50%) panicle initiation, number of productive tillers and seed yield (g/plant) at 12weeks after transplanting (WAT)

Application of fertilizer in different forms and at different times had significant effect on the numbers of days to 50% panicle initiation, number of productive tillers and seed yield of rice (Table 4). Panicle initiation was best enhanced by application of fertilizer granules at 2weeks after transplanting (WAT), followed by granule application at 4WAT and was mostly delayed

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in the control plot. Early panicle initiation by the application of urea granules at 2WAT significantly produced more tillers upon which panicles are borne than other treatments (IRRI, 2004). While the numbers of tillers produced by other treatments are comparable, they are significantly higher than the control plot. According to Risgaard-Petersen. (2006), denitrification is the process by which nitrates are reduced to gaseous nitrogen (N2) and lost to the atmosphere enhanced by facultative anaerobes in anaerobic environments like waterlogged rice fields and soils that have high clay content are especially vulnerable to nitrogen losses due to denitrification, which may have been reduced in nitrogen held in granule form than in spray form. Highest grain yield of 22.5g/plant was from the application of granule at 2WAT which is different significantly from other treatments which are comparable with each other except the control plot which had the lowest seed yield of 13.8g/plant. The increase in plant growth in response to application of N fertilizers granule is probably due to enhanced availability of nitrogen which enhanced more leaf area resulting in higher photo assimilates and thereby resulted in more dry matter accumulation (Indira, 2005).

CONCLUSION AND RECOMMENDATION

The result of this experiment showed that application of fertilizer in different forms and at different times had significant effects on the growth and yield of lowland rice. Leaf production was best enhanced by the application of urea fertilizer in granule form irrespective of time of application, it was also observed that tiller production was best encouraged in plot where fertilizer was applied in granule form even though they are not different significantly from spray form but is better than the control plot. Moreover, fertilizer granule at 2weeks after transplanting (WAT) significantly initiated panicle development faster than other treatments, produced the highest number of productive tillers/plant and subsequently the seed yield. Consequently, there seems to be a direct relationship between the number of tillers produced by rice and the productivity of the crop. Therefore, application of urea fertilizer in granule form at 2weeks after transplanting, which reduced nitrogen loss due to denitrification in waterlogged soil, will be suitable for lowland rice production under similar soil condition.

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APPENDIX

Table 1: Pre-planting soil analysis

Properties	Value
pH	6.48
Sand (g/kg)	824
Silt (g/kg)	44
Clay (g/kg)	132
Available phosphorous mg/kg	3.83
Exchangeable Na cmol/kg	0.27
Exchangeable K cmol/kg	0.13
Exchangeable Ca cmol/kg	2.6
Exchangeable Mg cmol/kg	1.42
Organic C (g/kg)	1.6
N (g/kg)	0.2

Table 2: Effect of different forms of Urea and time of application on the number of Leaves of Rice

Fertilizer	2 WAT	4 WAT	6 WAT	8 WAT	10WAT
Control	17.50	21.92c	24.88c	25.50b	25.50b
Granule @ 2WAT	16.50	30.25a	34.75a	36.67a	36.67a
Spray @ 2WAT	17.58	25.50b	32.00bb	33.58a	33.58a
Granule @ 4WAT	18.50	22.67bc	34.33ab	37.00a	37.00a
Spray @ 4WAT	21.92	23.83bc	31.92b	33.25a	33.25a
	Ns				

ns, ANOVA not significant at P = 0.05 WAT = weeks after transplanting

Means with same letter(s) in a column are not significantly different at 5% level of probability by Duncan Multiple Range Test (DMRT).

Table 3: Effect of different forms of Urea and time of application on the number of Rice tillers

Fertilizer	2 WAT	4 WAT	6 WAT	8 WAT	10WAT
Control	4.50	5.58c	6.38c	6.33b	7.08
Granule @ 2WAT	4.58	7.67a	9.08a	9.08a	8.33
Spray @ 2WAT	4.50	6.50b	8.08b	8.33a	8.33
Granule @ 4WAT	4.75	5.83bc	8.67ab	9.17a	8.00
Spray @ 2WAT	4.83	6.08bc	8.00b	8.25a	8.25
	Ns				Ns

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ns, ANOVA not significant at P = 0.05 WAT = weeks after transplanting

Means with same letter(s) in a column are not significantly different at 5% level of probability by Duncan Multiple Range Test (DMRT).

Table 4: Effect of treatment on days to 50% panicle initiation, number of productive tillers and seed yield of Rice (g/plants)

Fertilizer	Days to 50% panicle Initiation	Number of productive tillers/plant	Seed yield (g/plant)
Control	20.5a	3.2d	13.8c
Granule @ 2WAT	19.4d	5.0a	22.5a
Spray @ 2WAT	20.1bc	4.4bc	18.7b
Granule @ 4WAT	19.8d	4.6b	19.8b
Spray @ 2WAT	20.3ab	4.1c	17.8b

WAT = weeks after transplanting

Means with same letters in a column are not significantly

Different at 5% level of probability by Duncan Multiple Range Test (DMRT).

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