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# Growth and Yield Performance of Nerica Rice in Aus Season under Integrated Nitrogenous Nutrient Management System

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**Abstract:** An experiment was conducted to assess the effect of integrated nutrient management on the growth and yield of NERICA 10 during Aus season (Mid March-July), 2012. Eleven treatments coded from $T_1$ to $T_{11}$ were used in the experiment. The maximum highest panicle length and effective tillers/hill was found in $T_{10}$ (40 kg N from urea + 80 kg N from cowdung), maximum filled grains/panicle and 1000-grains weight was recorded in $T_{11}$ (100% N from equal portion of cowdung and vermicompost). The maximum grain yield (4.4 t/ha) and straw yield (5.4 t/ha) was found from $T_3$ *i.e.*, 100 kg N form urea and 20 kg N substituted by vermicompost, while the minimum was found from $T_1$ (1.5 t/ha and 2.1 t/ha, respectively). $T_3$ increased of 190% grain yield and 154.8% straw yield over control which was the maximum than other treatments. The effect of vermicompost along with nitrogenous fertilizer was the most pronounced than that of cowdung or nitrogenous fertilizer alone. Application of 100 kg N from urea with 20 kg N from vermicompost was best for higher rice yield.

**Key words:** NERICA 10 · Nitrogenous Nutrient and Yield

## INTRODUCTION

In Bangladesh Aus is the fallow season and farmers cultivate vegetable crops. In Aus season, sufficient rainfall is not available for rice cultivation. Maximum high-yielding rice varieties require 140 to 160 days to fulfill their life cycle. If theses varieties are cultivated in Aus season, farmers will not cultivate Aman rice. So, rice cultivation in Aus season is low in Bangladesh and farmers cultivate vegetable crops. Moreover, the high-yielding rice varieties currently used in Bangladesh take between 140 and 160 days to harvest. NERICA is a drought tolerant short duration crop usually requires 100-120 days [1]. So it can be cultivated in rain fed Aus season and can save irrigation cost as well as time which are a good sign for ensuring food security of the nation. Integrated Nutrient Management (INM) maintains soils as storehouses of plant nutrients that are essential for vegetative growth. INM is, however, not a matter of conserving soil nutrient alone, but rather it combines organic and mineral methods of soil fertility management with physical and biological measures of soil and water conservation. It integrates technologies that are site-specific to agronomic and socio-economic conditions to redress nutrient imbalances and organic matter deterioration. The INM must essentially look into three main challenges: (I) judicious use of mineral fertilizers; (ii) maximize use of organic materials; and (iii) minimize negative environmental impacts. The organic manures viz. cowdung and vermicompost may be used as an alternative source of N which increases efficiency of applied N [2]. The study was conducted to observe the performance of NERICA 10 rice variety in Aus season of Bangladesh under INM.

## MATERIALS AND METHODS

**Experimental Site, Time and Genetic Material:** The experiment was conducted in the Sher-e-Bangla Agricultural University Farm, Dhaka, Bangladesh in *Aus* season of 2012. NERICA 10 cultivar was used in the experiment.

**Treatments of the Experiment:** Eleven different fertilizer combinations viz., $T_1$: No chemical fertilizer and organic manure (Control); $T_2$: 100% recommended N (120 kg

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nitrogen $ha^{-1}$); $T_3$: 100 kg N from urea + 20 kg N substituted by vermicompost; $T_4$: 100 kg N from urea + 20 kg N substituted by cowdung; $T_5$: 80 kg N from urea + 40 kg N substituted by vermicompost; $T_6$: 80 kg N from urea + 40 kg N substituted by cowdung; $T_7$: 60 kg N from urea + 60 kg N substituted by vermicompost; $T_8$: 60 kg N from urea + 60 kg N substituted by cowdung; $T_9$: 40 kg N from urea + 80 kg N substituted by vermicompost; $T_{10}$: 40 kg N from urea + 80 kg N substituted by cowdung; $T_{11}$: 100% N substituted by equal portion of vermicompost were used in the experiment as treatment. Urea contained 46% N, Cowdung contain 1% N and Vermicompost contain 2.1% N.

**Application of fertilizers:** The amounts of nitrogen, phosphorus, potassium and sulfur fertilizers required per plot were calculated from fertilizers rate per hectare. Triple super phosphate (TSP), muriate of potash (MP) and Gypsum were applied @ 80, 120, 55 kg/ha, respectively during final land preparation. A blanket dose of 16 kg P, 60 kg K and 10 kg S per ha was applied to all plots in the forms of triple super phosphate (TSP), muriate of potash (MP) and gypsum, respectively during final land preparation. Nitrogen was also applied as per treatment in the form of urea in three equal splits. The first split was applied after 15 days of sowing, the second split was applied after 35 days of sowing *i.e.*, at active vegetative stage and the third split was applied after 60 days of sowing *i.e.* at panicle initiation stage.

**Experimental Design:** Experiment was laid out by using randomized complete block design (RCBD) with three replications. The unit plot area was 3.5 m × 2 m, block to block distance was 2 m and plot to plot distance was 1 m.

**Data Collection:** The data were collected on different growth and yield contributing characters *i.e.*, plant height, number of effective and ineffective tillers, panicle length, number of unfilled and filled grains, 1000-grain weight, grain and straw yields. Grain and straw yields were recorded at 14% moisture level.

**Statistical Analysis:** The statistical analysis for different character including the nutrient content and uptake were done following the ANOVA technique and the mean results in case of significant F-values were adjusted by the Duncan's Multiple Range Test (DMRT) [3].

## RESULTS AND DISCUSSION

**Plant Height:** Plant height of NERICA 10 showed significant variation among the treatments. The tallest plant was found from $T_5$ (100.3 cm) followed by $T_2$ (98.7 cm) and $T_{10}$ (98.0 cm), while the shortest was found from $T_1$ (93.2 cm) at harvest (Table 1). The maximum plant height increase over control was found $T_5$ (7.6%) which was followed by $T_2$ (5.9%) and $T_{10}$ (5.1%), while the minimum from $T_3$ (1.3%) (Table 2). Plant height significantly increased with the application of cowdung along with chemical fertilizer [4]. The increased plant height through the application of FYM along with N, P, K and S was also reported Kobayashi *et al*. [5], Maskina *et al*. [6] and Mostofa *et al*. [7].

**Panicle Length:** Panicle length of NERICA 10 showed significant variation among the treatments. The longest panicle was found from $T_{10}$ (21.3 cm), while the shortest was found from $T_1$ (19.3 cm) (Table 1). The maximum panicle length increase over control was found in $T_{10}$ (10.6%) which was followed by $T_2$ (8.3%), while the minimum from $T_8$ (2.7%) (Table 2). Panicle length was increased with the application of inorganic fertilizers and manures [8]. Increasing K rates increased panicle length [9] so that $T_{10}$ may produce 10.45% higher panicle length than control.

**Number of Effective Tillers:** Number of effective tiller of NERICA 10 showed significant variation among the treatments. The maximum number of effective tillers was found from $T_{10}$ (12.9/hill), while the shortest was found from $T_1$ (8.3/hill) (Table 1). The maximum increase over control of number of effective tillers/hill was found in $T_{10}$ (38.0%) which was followed by $T_5$ (32.5%), while the minimum from $T_{11}$ (14.0%) (Table 2). Increased number of effective tiller/hill with the integrated use of manures and fertilizers [10].

**Number of Filled Grains:** Signification variation was found among the treatments in number of filled grains. The maximum number of filled grains was found in $T_{11}$ (95.0/panicle) which was statistically identical with $T_3$ (93.0/panicle) and $T_6$ (91.0/panicle) while the minimum was found from $T_1$ (80.0/panicle) (Table 1).The maximum increased number filled grains/panicle over control was found from $T_{11}$ (18.8%), while the minimum from $T_9$ (6.3%) (Table 2). Application of N, P and K fertilizer significantly increased the number of filled grains/panicle and the highest the number of filled grains/panicle was found under the combined application of N, P and K fertilizer [11]. Increased the number of filled grains/panicle was significant with the increased application of N, P, K and S [12].

Table 1: Effect of integrated nutrient management on growth and yield related attributes of NERICA 10

| Treatments | Plant height (cm) at harvest | Panicle length (cm) | Number of effective tillers/hill | Number of filled grains/panicle |
|---|---|---|---|---|
| $T_1$ | 93.2 f | 19.3 d | 8.3 e | 80.0 e |
| $T_2$ | 98.7 b | 20.9 ab | 10.0 d | 89.0 bcd |
| $T_3$ | 94.5 ef | 20.2 bcd | 10.2 d | 93.0 ab |
| $T_4$ | 95.2 de | 20.7 abc | 11.1 c | 87.0 cd |
| $T_5$ | 100.3 a | 20.1 bcd | 11.9 b | 88.0 cd |
| $T_6$ | 96.2 cd | 20.3 abcd | 11.8 b | 91.0 abc |
| $T_7$ | 95.5 de | 20.7 abc | 11.9 b | 89.0 bcd |
| $T_8$ | 96.5 cd | 19.8 cd | 12.1 b | 89.0 bcd |
| $T_9$ | 96.5 cd | 20.7 abc | 12.1 b | 85.0 d |
| $T_{10}$ | 98.0 b | 21.3 a | 12.9 a | 86.0 d |
| $T_{11}$ | 97.5 bc | 20.4 abc | 10.1 d | 95.0 a |
| LSD | 0.05 | 1.4 | 1.00.5 | 4.4 |
| CV (%) | 0.9 | 3.0 | 2.8 | 2.9 |

[x] In a column means having similar letter (s) are statistically identical and those having dissimilar letter (s) differ significantly as per 0.05 level of probability

Table 2: Effect of integrated nutrient management on percent increase/decrease on growth and yield related attributes over control of NERICA 10

| Treatments | Plant height (%) | Panicle length (%) | Number of effective tillers/hill (%) | Number of filled grains/panicle (%) |
|---|---|---|---|---|
| $T_1$ | -- | -- | -- | -- |
| $T_2$ | 5.9 | 8.3 | 20.5 | 11.3 |
| $T_3$ | 1.3 | 4.9 | 19.0 | 16.3 |
| $T_4$ | 2.2 | 7.3 | 27.5 | 8.8 |
| $T_5$ | 7.6 | 4.2 | 32.4 | 10.0 |
| $T_6$ | 3.2 | 5.3 | 29.4 | 13.8 |
| $T_7$ | 2.4 | 7.1 | 30.5 | 11.3 |
| $T_8$ | 3.5 | 2.7 | 31.9 | 11.3 |
| $T_9$ | 3.5 | 7.0 | 31.4 | 6.3 |
| $T_{10}$ | 5.1 | 10.6 | 38.0 | 7.5 |
| $T_{11}$ | 4.7 | 5.7 | 14.0 | 18.8 |

Table 3: Table 1: Effect of integrated nutrient management on yield related attributes and yield of NERICA 10

| Treatments | Number of unfilled grains/panicle | 1000-grains weight (g) | Grain yield (t/ha) | Straw yield (t/ha) |
|---|---|---|---|---|
| $T_1$ | 36.0 a | 26.0 f | 1.5 d | 2.1 g |
| $T_2$ | 34.0 abc | 26.5 ef | 3.8 abc | 4.7 cdef |
| $T_3$ | 29.0 d | 27.0 de | 4.4 a | 5.4 a |
| $T_4$ | 35.0 ab | 29.0 c | 4.0 abc | 4.9 abcd |
| $T_5$ | 29.0 d | 27.0 de | 3.8 bc | 4.4 ef |
| $T_6$ | 32.0 bcd | 27.5 d | 4.1 ab | 5.1 abc |
| $T_7$ | 31.0 cd | 30.5 b | 3.5 c | 4.5 def |
| $T_8$ | 29.0 d | 32.0 a | 4.2 ab | 4.9 bcde |
| $T_9$ | 35.0 ab | 31.0 b | 3.9 abc | 4.3 f |
| $T_{10}$ | 32.0 bcd | 29.0 c | 3.7 bc | 5.2 ab |
| $T_{11}$ | 34.0 abc | 32.5 a | 4.0 abc | 5.1 abc |
| LSD0.05 | 3.6 | 0.5 | 0.6 | 0.5 |
| CV (%) | 6.6 | 1.0 | 8.9 | 6.0 |

[x] In a column means having similar letter (s) are statistically identical and those having dissimilar letter (s) differ significantly as per 0.05 level of probability

Table 4: Table 2: Effect of integrated nutrient management on percent increase/decrease on yield related attributes and yield over control of NERICA 10

| Treatments | Number of unfilled grains (decreased) | 1000-grain weight (g) | Grain yield (t/ha) | Straw yield (t/ha) |
|---|---|---|---|---|
| $T_1$ | -- | -- | -- | -- |
| $T_2$ | -5.6% | 1.9% | 153.3% | 121.4% |
| $T_3$ | -19.4% | 3.8% | 190.0% | 154.8% |
| $T_4$ | -2.8% | 11.5% | 166.7% | 133.3% |
| $T_5$ | -19.4% | 3.8% | 150.0% | 109.5% |
| $T_6$ | -11.1% | 5.8% | 173.3% | 142.9% |
| $T_7$ | -13.9% | 17.3% | 133.3% | 111.9% |
| $T_8$ | -19.4% | 23.1% | 180.0% | 131.0% |
| $T_9$ | -2.8% | 19.2% | 156.7% | 104.8% |
| $T_{10}$ | -11.1% | 11.5% | 143.3% | 147.6% |
| $T_{11}$ | -5.6% | 25.0% | 163.3% | 140.5% |

**Number of Unfilled Grains:** Signification variation was found among the treatments in number of unfilled grains. The minimum number of unfilled grains was found in $T_3$, $T_5$ and $T_8$ (29.0/panicle), whereas the maximum was found from $T_1$ (36.0/panicle) (Table 3). The minimum decreased in number of unfilled grains over control was found from $T_3$, $T_5$ and $T_8$ (-19.4%), while the maximum decreased in $T_4$ and $T_9$ (2.8%) (Table 4). Decreased the number of unfilled grains/panicle was significant with the increased application of N, P, K and S [12].

**1000-Grains Weight:** 1000-grains weight varied significantly among the treatments. The maximum 1000-grains weight was found in $T_{11}$ (32.5 g) which was statistically identical with $T_8$ (32.0 g), whereas the minimum was found from $T_1$ (26.0 g) which was statistically identical with $T_2$ (26.5 g) (Table 3). The maximum increased of 1000-grains yield over control was found from $T_8$ (23.1%), while the minimum increased was found from $T_2$ (1.9%) (Table 4). Application of 120 kg N $ha^{-1}$ through chemical fertilizer with the combination of press mud and cowdung increased 1000-grain weight [13].

**Grain Yield:** Grain yield varied significantly among the treatments. The maximum grain yield was found in $T_3$ (4.4 t/ha), whereas the minimum was found from $T_1$ (1.5 t/ha) (Table 3). Maximum increased of grains yield over control was found from $T_3$ (190.0%), while the minimum increased was found from $T_2$ (153.3%) (Table 4). Grain yield of NERICA 10 was 4.1 t/ha in Bangladesh [1]. Grain yield was significantly increased due to application of chemical fertilizers and residual effects of organic manures [14].

**Straw Yield:** Straw yield showed significant variation among the treatments. The maximum straw yield was found in $T_3$ (5.4 t/ha), whereas the minimum was found from $T_1$ (2.1 t/ha) (Table 3). The maximum increased of straw yield over control was found from $T_3$ (154.8%), while the minimum increased was found from $T_9$ (104.8%) (Table 4). Straw yield was significantly increased due to application of chemical fertilizers and residual effects of organic manures [15].

## CONCLUSION

Total time required from sowing to harvesting of NERICA 10 was 108 days is Aus season. So, farmers can easily cultivate Aman rice after harvesting of NERICA 10. From the present study it can be concluded that the organic manures (cowdung and vermicompost) along with nitrogenous fertilizer had varying degree of integrated effects on NERICA 10. Combined application of 100 kg N as the source of urea along with 20 kg N as the source of vermicompost performed the best in recording yield and yield contributing characters of NERICA 10.

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