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# Performance of Semi-dry Rice as Affected by Graded Levels and Time of Application of Nitrogen

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**ABSTRACT**

An investigation was conducted on nitrogen management for Semi-dry Rice (*Oryza sativa* L.) at Agricultural College farm, Naira during *kharif* 2011 with four graded levels of nitrogen and five varied timings of nitrogen application. Application of 120 kg N $ha^{-1}$ ($N_4$) resulted in the highest stature of growth parameters viz., plant height, total number of tillers $m^{-2}$ and dry matter production and yield attributes viz., total number of panicles $m^{-2}$, total number of filled grains $panicle^{-1}$ and yield as well as the highest nitrogen uptake and was significantly superior to other graded levels of nitrogen. All the growth parameters as well as yield attributes, yield and nitrogen uptake of rice were the lowest with $N_1$ (60 kg N $ha^{-1}$). Application of nitrogen in four splits ¼ each at basal, conversion to wet, PI and flowering ($T_4$) recorded the highest stature of all these growth parameters, yield attributes and yield along with highest nitrogen uptake and it was at par with LCC based nitrogen application ($T_5$) and nitrogen application in four splits ¼ each at basal, AT, PI and flowering ($T_2$). From the study it can be concluded that under semi-dry situation, rice can be successfully grown with supply of 120 kg N $ha^{-1}$ applied in four splits ¼ each at basal, conversion to wet, PI and flowering ($T_4$) resulting in the highest productivity.

**Key words :** Growth parameters, N levels, Semi-dry rice, Time of N application, Yield nitrogen uptake

In India, rice is the principle food crop grown in an area of 42.56 m.ha with a production of 95.33 m.t and productivity of 2.24 t $ha^{-1}$. In Andhra Pradesh, it is grown in an area of 3.44 m.ha with a production of 10.54 m.t and productivity of 3.06 t $ha^{-1}$ (Directorate of Economics and Statistics, 2010-2011). Semi-dry system successfully exploits the pre monsoon showers ensuring high water use efficiency; it often confronts moisture stress due to inadequate and ill distributed rainfall leading to low productivity. Dry seeding with early showers has been found to produce similar grain yield as that of transplanting with aged seedlings (Reddy and Krishna, 1998). Specific management practices like optimum dose and time of nitrogen application are required to obtain good yields under semi-dry system. The area under semi-dry rice is increasing rapidly due to scarcity of labour in the North Coastal districts of Andhra Pradesh. At present, the nitrogen management recommended and adopted for semi-dry rice is similar to that of conventionally grown lowland rice. Improvement in nitrogen management can be achieved only by planning strategies responsive to the requirement and temporal variations in crop nitrogen demand specific to the growing environment and location. Hence, keeping this in view, the present investigation was taken up to evolve a suitable and efficient nitrogen management for semi-dry rice.

## MATERIAL AND METHODS

A field experiment was conducted during *kharif,* 2011 at the Agricultural College Farm, Naira with variety Vasundhara (RGL-2538). The soils were sandy clay loam in texture, low in organic carbon and available nitrogen, medium in available phosphorous and potassium. Treatments mainly comprised of four graded levels of nitrogen [$N_1$ (60 kg N $ha^{-1}$), $N_2$ (80 kg N $ha^{-1}$), $N_3$ (100 kg N $ha^{-1}$), $N_4$ (120 kg N $ha^{-1}$)] assigned to main plots and five varied timings of nitrogen application [$T_1$ (S! at basal + S! at active tillering + S! at panicle initiation), $T_2$ (¼ at basal + ¼ at active tillering + ¼ at panicle initiation + ¼ at flowering), $T_3$ (¼ at basal + ½ at active tillering + ¼ at panicle initiation), $T_4$ (¼ at basal + ¼ at conversion to wet + ¼ at panicle initiation + ¼ at flowering), $T_5$ (LCC based application)] allotted to sub plots. As per the standard procedure for applying nitrogen based on LCC ($T_5$) in rice, first application of nitrogen (S! of the nitrogen dose) was given at 21 DAS. Thereafter, the observations were made at every 7 days and the top dressing was scheduled whenever the colour of the youngest fully expanded leaf fell below critical value 4 of the LCC. A fertilizer dose of 60 kg $P_2O_5$ & 50 kg $K_2O$ $ha^{-1}$ was applied commonly to all plots. Crop was sown by adopting a spacing of 20 cm × 10 cm. Pre and post harvest observations in respect of both growth and yield parameters were recorded. The data recorded on various growth and yield parameters were analysed following standard statistical analysis of variance technique suggested by Panse and Sukhatme (1978).

## RESULTS AND DISCUSSION

### Growth parameters

Highest stature of growth parameters, plant height, total tillers $m^{-2}$ and dry matter production was observed with application at 120 kg N $ha^{-1}$ ($N_4$) and was superior to the rest of the levels of nitrogen studied. Shortest stature of all these growth parameters was observed with nitrogen application at 60 kg $ha^{-1}$ ($N_1$).

With respect to the time of application of nitrogen, plants of tallest stature was observed with the application of nitrogen in three splits S! each at basal, active tillering and panicle initiation ($T_1$) and was however, comparable with nitrogen application in three splits and application of nitrogen based on Leaf Colour Chart based nitrogen application ($T_5$). Increase in plant height might be due to the increased cell division and cell elongation associated with nitrogen application and also due to the increased response of the plant under the semi-dry growing situation in which the system was converted to wet after an initial 46 days of growing under aerobic situation.

Total tillers $m^{-2}$ were the highest with either LCC based nitrogen application ($T_5$) or in treatments receiving four splits (¼ at each growth stage) in which nitrogen was applied beyond panicle initiation stage indicating the uniform supply of nitrogen in these treatments throughout the crop growth period as compared to the other timings of nitrogen application. Similar findings were reported by Sathiya and Ramesh (2009) and Lampayan *et al.* (2009).

Application of nitrogen in four splits ¼ at basal + ¼ at conversion to wet + ¼ at PI + ¼ at flowering ($T_4$) produced the highest quantity of dry matter and was comparable with Leaf Colour Chart based nitrogen application ($T_5$) and nitrogen application in four splits ¼ at basal + ¼ at AT + ¼ at PI + ¼ at flowering ($T_2$). Application of nitrogen in three splits S! at basal + S! at AT + S! at PI ($T_1$), recorded significantly higher quantity of dry matter than nitrogen application in three splits ¼ at basal + ½ at AT + ¼ at PI ($T_3$), which produced the lowest dry matter. According to Ashok Kumar *et al.* (1994), the increased levels of nitrogen increases cell volume, meristematic activities and formation and functioning of protoplasm, which consequently increased the crop growth rate and therefore dry matter production was also enhanced.

### Yield attributes and Yield

The highest number of panicles $m^{-2}$ and number of filled grains $panicle^{-1}$ were recorded with the highest level of nitrogen (120 kg N $ha^{-1}$) than any of the remaining nitrogen levels studied. The highest number of panicles $m^{-2}$ and number of filled grains $panicle^{-1}$ with 120 kg N $ha^{-1}$ might be due to adequate nitrogen supply during reproductive phase and probably responsible for conversion of the highest number of total tillers to productive tillers and efficient translocation of photosynthates and amino acids from source to sink helped in improved filling of grains .The present findings were in accordance with those of Vishram Ram *et al.* (2002), while the lowest number of panicles $m^{-2}$ and number of filled grains $panicle^{-1}$ with 60 kg N $ha^{-1}$ might be due to insufficient nitrogen supply and poor translocation leading to inadequate supply of photosynthates to grain.

The highest number of panicles $m^{-2}$ and number of filled grains $panicle^{-1}$ were noticed with supply of nitrogen in four splits $T_4$ (¼ each at basal, conversion to wet, PI and flowering) and was comparable with $T_5$ (LCC based application) and $T_2$ (¼ each at basal, AT, PI and flowering) which might be due to timely availability of nitrogen in right proportion at critical stages resulting in continuous supply of nitrogen in splits from sowing to flowering. The highest productive tillers with $T_4$ might also be due to the scheduling of one of the split doses of nitrogen at the time of conversion to

Table 1. Growth and yield attributes of semi-dry rice as influenced by graded nitrogen levels and varied time of nitrogen application

| Treatments | Plant height (cm) at flowering | Total tillers $m^{-2}$ at harvest | Dry matter production (kg $ha^{-1}$) at harvest | Panicles $m^{-2}$ | Number of filled grains $panicle^{-1}$ | Thousand grain weight (g) |
|---|---|---|---|---|---|---|
| Nitrogen levels | | | | | | |
| $N_1$ - 60 kg $ha^{-1}$ | 84.14 | 245 | 9864 | 226 | 124 | 22.7 |
| $N_2$ - 80 kg $ha^{-1}$ | 96.40 | 278 | 11140 | 248 | 142 | 22.8 |
| $N_3$ - 100 kg $ha^{-1}$ | 96.42 | 280 | 11429 | 247 | 147 | 23.5 |
| $N_4$ - 120 kg $ha^{-1}$ | 108.60 | 306 | 12148 | 266 | 157 | 23.6 |
| SEm ± | 3.48 | 7.42 | 183.98 | 5.11 | 2.80 | 0.20 |
| CD (P = 0.05) | 12.06 | 26 | 637 | 18 | 10 | NS |
| CV (%) | 14.01 | 10.37 | 8.75 | 8.02 | 7.23 | 3.42 |
| Time of nitrogen application | | | | | | |
| $T_1$ - S$\frac{1}{3}$ at basal + S$\frac{1}{3}$ AT+ S$\frac{1}{3}$ PI | 105.86 | 263 | 10636 | 242 | 136 | 22.9 |
| $T_2$ - ¼ at basal + ¼ AT + ¼ PI + ¼ flowering | 84.02 | 289 | 11475 | 255 | 147 | 23.2 |
| $T_3$ - ¼ at basal + ½ AT + ¼ PI | 102.04 | 241 | 9947 | 224 | 126 | 22.8 |
| $T_4$ - ¼ at basal + ¼ at conversion to wet + ¼ PI + ¼ at flowering | 89.41 | 302 | 12025 | 257 | 155 | 23.3 |
| $T_5$ - LCC based application | 100.61 | 292 | 11644 | 256 | 150 | 23.4 |
| SEm ± | 2.37 | 7.39 | 221.86 | 4.35 | 3.36 | 0.27 |
| CD (P = 0.05) | 6.83 | 21 | 668 | 13 | 10 | NS |
| CV (%) | 9.52 | 9.23 | 9.86 | 6.10 | 7.75 | 4.09 |

wet. The results were in agreement with those of Jayanthi *et al.* (2007) and Sathiya and Ramesh (2009).

However, thousand grain weight was not influenced either by graded levels of nitrogen or by varied timing of nitrogen application.

Highest grain and straw yield was recorded with the application of nitrogen at 120 kg $ha^{-1}$ ($N_4$) which was significantly higher than all the other nitrogen levels tried. Application of nitrogen at 100 kg $ha^{-1}$ ($N_3$) recorded the next best grain and straw yield but was, however, comparable with application of nitrogen at 80 kg $ha^{-1}$ ($N_2$). The lowest grain and straw yield was recorded with the application of nitrogen at 60 kg $ha^{-1}$ ($N_1$).With regard to the nitrogen application timings, application of nitrogen in four splits ¼ each at basal, conversion to wet, PI and flowering ($T_4$) recorded the highest grain and straw yield and was comparable with Leaf Colour Chart based nitrogen application ($T_5$) and application of nitrogen in four splits ¼ each at basal AT, PI and flowering ($T_2$). As yield is a manifestation of the individual yield components, in this case also the nitrogen dose and time of its application at critical stages resulted in highest grain yield which in turn was due to the highest number of panicles $m^{-2}$, number of filled grains $panicle^{-1}$ and thousand grain weight coupled with higher nitrogen uptake and efficient translocation to sink. Similar results in graded levels of nitrogen were noticed by various researchers viz., Kayam Singh and Tripathi (2007) and Sudhakar *et al.* (2003).

**Nitrogen Uptake:**

The highest nitrogen uptake by grain and straw at harvest was recorded with nitrogen application at 120 kg $ha^{-1}$ and the lowest with 60 kg N $ha^{-1}$ obviously due to their corresponding grain and straw yield respectively. Similarly, with regard to timing of N application, highest uptake by grain

Table 2. Yield and nitrogen uptake studies of semi-dry rice as influenced by graded nitrogen levels and varied time of nitrogen application.

| Treatments | Grain yield (kg ha$^{-1}$) | Straw yield (kg ha$^{-1}$) | Nitrogen uptake (kg ha$^{-1}$) | |
|---|---|---|---|---|
| | | | Grain | Straw |
| Nitrogen levels | | | | |
| $N_1$ - 60 kg ha$^{-1}$ | 3734 | 5130 | 20.46 | 30.92 |
| $N_2$ - 80 kg ha$^{-1}$ | 4275 | 5825 | 23.78 | 35.41 |
| $N_3$ - 100 kg ha$^{-1}$ | 4400 | 6030 | 24.05 | 36.55 |
| $N_4$ - 120 kg ha$^{-1}$ | 4695 | 6454 | 26.35 | 38.92 |
| SEm ± | 80.42 | 11.12 | 0.51 | 0.66 |
| CD (P = 0.05) | 278 | 384 | 1.76 | 2.29 |
| CV (%) | 7.28 | 7.34 | 8.34 | 7.25 |
| Time of nitrogen application | | | | |
| $T_1$ - S$\frac{1}{3}$at basal + S$\frac{1}{3}$AT+ S$\frac{1}{3}$PI | 4063 | 5573 | 22.54 | 33.86 |
| $T_2$ - ¼ at basal + ¼ AT + ¼ PI + ¼ flowering | 4413 | 6062 | 24.38 | 36.78 |
| $T_3$ - ¼ at basal + ½ AT + ¼ PI | 3769 | 5178 | 20.64 | 30.97 |
| $T_4$ - ¼ at basal + ¼ at conversion to wet + ¼ PI + ¼ at flowering | 4649 | 6375 | 25.83 | 38.56 |
| $T_5$ - LCC based application | 4484 | 6109 | 24.91 | 37.08 |
| SEm ± | 97.89 | 131.84 | 0.55 | 0.85 |
| CD (P = 0.05) | 282 | 380 | 1.59 | 2.44 |
| CV (%) | 7.93 | 7.79 | 8.10 | 8.26 |

and straw was obtained with nitrogen application at $T_4$ (¼ each at basal, conversion to wet, PI and flowering) followed by, $T_5$ (LCC based application) and $T_2$ (¼ each at basal, AT, PI and flowering) and the lowest with $T_3$. According to Patel *et al.* (1997)- nutrient uptake by the crop was higher with increased nitrogen levels which might be due to the fact that plant absorbed the nitrogen proportionately as the pool of available nitrogen increased in soil by addition of higher dose of nitrogen. Similar findings were reported by Dhurandher and Tripathi (1999).

In conclusion, the study has revealed that semi-dry rice can be successfully grown in North Coastal Zone of Andhra Pradesh with 120 kg N ha$^{-1}$ in four splits ¼ each at basal, conversion to wet, PI and flowering for higher productivity.

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