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# Effect of Different Crop Establishment Techniques and Nutrient Doses on Growth, Yield and Economics of Rice (*Oryza sativa* L.)

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**ABSTRACT**

A field experiment was conducted during *kharif*, 2011 on sandy loam soils of Agricultural College Farm, Naira to find out the best crop establishment technique and the optimum nutrient dose for rice. The experiment was laid out in split-plot design with four crop establishment techniques assigned to main plots and five nutrient doses assigned to sub-plots, each replicated thrice. Distinct disparities were noticed with regard to growth parameters, yield attributes and yields of rice due to establishment techniques and nutrient doses. As regards growth stature and yield structure, significantly superior performance of rice was observed with transplanting ($C_4$) which was however, in parity with semi-dry system ($C_1$). While the grain yield was significantly higher with transplanting ($C_4$) which was however, in parity with semi-dry system ($C_1$) and drum seeding of sprouted seed ($C_2$).The grain yield was the lowest with broadcasting of sprouted seed ($C_3$). Although maximum gross returns $ha^{-1}$ was recorded with transplanting method ($C_4$), the return per rupee invested was the highest with semi-dry system ($C_1$). Among the nutrient doses tried, maximum grain yield, net returns and B:C ratio were associated with application of the highest dose of N P K ($F_5$- 140-105-95 kg N, $P_2O_5$, $K_2O$ $ha^{-1}$) which was however, comparable with $F_4$ (120-90-80 kg N, $P_2O_5$, $K_2O$ $ha^{-1}$).

**Key words :** Drum seeding, Nutrient doses, Semi-dry rice,Transplanting.

Manual transplanting of rice, done usually by hired labour is increasingly becoming a difficult proposition due to shortage of labour during the peak periods of operation, escalating labour wages and inadequate plant population obtained due to hired labour. Direct seeding of rice is becoming a popular alternative to transplanting system as it reduces labour requirement, cost of cultivation, shortens the duration of crop and provide comparable grain yield with transplanting (Sharma *et al*., 2005).

Balanced fertilization right from the very beginning of crop growth is utmost essential to achieve better harvest of crop (Singh and Namdeo, 2004). Nutrient requirement may however differ under various seeding methods. Hence, there is every need to evaluate non conventional systems of rice crop establishment together with optimal nutrient dose to realize the production potential of alternate systems of crop establishment.

## MATERIAL AND METHODS

A field experiment was conducted during *kharif,* 2011 at the Agricultural College farm, Naira, Andhra Pradesh. The experimental field was sandy loam in texture with a pH of 6.7 and EC of 0.10 $dSm^{-1}$, low in organic carbon (0.27%) and available nitrogen (155 kg $ha^{-1}$), medium in available phosphorus (31 kg $ha^{-1}$) and potassium (222 kg $ha^{-1}$). The experiment was laid out in split-plot design with four crop establishment techniques *viz*., semi-dry ($C_1$), drum seeding of sprouted seed ($C_2$), broadcasting of sprouted seed ($C_3$) and transplanting ($C_4$) assigned to main plots and five nutrient doses *viz*., Control ($F_1$), 80-60-50 ($F_2$), 100-75-65 ($F_3$), 120-90-80 ($F_4$), 140-105-95 kg N, $P_2O_5$, $K_2O$ $ha^{-1}$ ($F_5$) assigned to sub- plots and replicated thrice.

The data on growth parameters, yield attributes and yield as well as economics were recorded and subjected to statistical analysis as per Panse and Sukhatme (1967).

## RESULTS AND DISCUSSION

Crop establishment techniques exhibited distinct disparity with regard to plant height, tiller production and drymatter accumulation. At active tillering and panicle initiation, significantly taller plants were obtained with transplanting ($C_4$), which

was on a par with semi-dry ($C_1$). At flowering it was not influenced significantly due to crop establishment techniques. At all the stages of crop growth, significantly higher plant height was recorded with application of 140-105-95 kg N, $P_2O_5$, $K_2O$ ha$^{-1}$ ($F_5$), which was on a par with 120-90-80 kg N, $P_2O_5$, $K_2O$ ha$^{-1}$ ($F_4$) , which in turn comparable with 100-75-65 kg N, $P_2O_5$, $K_2O$ ha$^{-1}$ ($F_3$) .

Significantly higher number of tillers m$^{-2}$ and dry matter accumulation were obtained all the stages of sampling with transplanting ($C_4$) which was in parity with semi-dry system ($C_1$). Application of 140-105-95 kg N, $P_2O_5$, $K_2O$ ha$^{-1}$ ($F_5$) registered significantly higher number of tillers m$^{-2}$, dry matter at different stages, which was in parity with 120-90-80 kg N, $P_2O_5$, $K_2O$ ha$^{-1}$ ($F_4$) and this in turn was comparable with 100-75-65 kg N, $P_2O_5$, $K_2O$ ha$^{-1}$ ($F_3$).

At active tillering, panicle initiation and flowering, semi- dry ($C_1$) system recorded significantly higher LAI, which was on a par with broadcasting of sprouted seed ($C_3$). A progressive increase in LAI was observed with increasing levels of nutrients, the highest being associated with 140-105-95 kg N, $P_2O_5$, $K_2O$ ha$^{-1}$ ($F_5$), which was however in parity with 120-90-80 kg N, $P_2O_5$, $K_2O$ ha$^{-1}$ ($F_4$) and this in turn comparable with 100-75-65 kg N, $P_2O_5$, $K_2O$ ha$^{-1}$ ($F_3$). Taller plants coupled with larger number of tillers m$^{-2}$ observed in transplanting method ($C_4$) resulted in higher drymatter accumulation. The larger growth stature except LAI, registered with semi-dry system ($C_1$), broadcasting of sprouted seed ($C_3$) can be attributed to higher plant population per unit area compared to transplanting ($C_4$) and drum seeding of sprouted seed ($C_2$). Gangwar *et al*., 2008; Mahajan *et al*., 2012 also reported the similar results.

Significantly more number of productive tiller m$^{-2}$, total and filled grains panicle$^{-1}$ were observed with transplanting ($C_4$), which was comparable with semi- dry system ($C_1$). Similar views were also expressed by Sheela Barla and Kumar, 2011, Mahajan *et al*., 2012 As regards the panicle production, total and filled grains panicle$^{-1}$, significantly superior performance was observed with the application of 140-105-95 kg kg N, $P_2O_5$, $K_2O$ ha$^{-1}$ ($F_5$), which was on a par with 120-90-80 kg N, $P_2O_5$, $K_2O$ ha$^{-1}$ ($F_4$) and this in turn was in a parity with 100-75-65 kg N, $P_2O_5$, $K_2O$ ha$^{-1}$ ($F_3$). Similar results have been obtained in the present investigation also corroborating the earlier findings of several researchers (Singh and Namdeo, 2004; Kundu *et al*., 2004.) confirming the outcome of the present study. Better growth stature in terms of maximum tiller production and greater accumulation of dry matter might have enabled the production of larger yield structure as evidenced by conversion of majority of total tillers in to productive tillers in transplanting method ($C_4$) while, higher photosynthetic surface as supported by greater LAI in semi-dry system might have been responsible for recording superior yield attributes in semi-dry system ($C_1$). Test weight was not influenced significantly due to different crop establishment techniques. Among the nutrient doses, it was found to be the highest with 140- 105-95 kg N, $P_2O_5$, $K_2O$ ha$^{-1}$ ($F_5$).

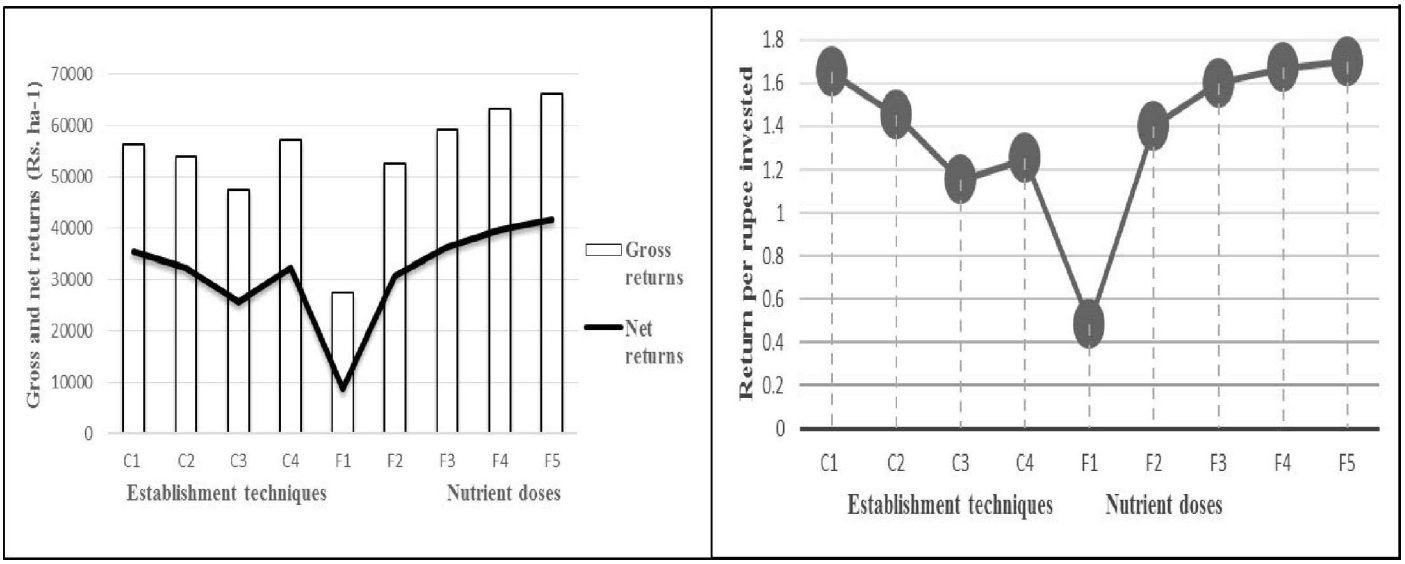
Maximum grain yield was recorded with transplanting ($C_4$), which was however on a par with semi- dry ($C_1$) and drum seeding of sprouted seed ($C_2$), while it was the lowest with broadcasting of sprouted seed ($C_3$). Comparable yields in rice through alternate systems of crop establishment with that of transplanting has been reported by Mankotia *et al*., 2009; Mahajan *et al*., 2012. Straw yield did not differ significantly due to crop establishment techniques. Maximum grain and straw yield was noticed with the application of 140- 105-95 kg N, $P_2O_5$, $K_2O$ ha$^{-1}$ ($F_5$), which was however in parity with 120-90-80 kg N, $P_2O_5$, $K_2O$ ha$^{-1}$ ($F_4$) , which in turn comparable with 100-75-65 kg kg N, $P_2O_5$, $K_2O$ ha$^{-1}$ ($F_3$). Higher growth parameters together with superior yield attributes resulted in higher grain yield in transplanting ($C_4$), semi- dry ($C_1$) and drum seeding of sprouted seed ($C_2$), and this might be due to better accumulation of photosynthates during vegetative growth and their effective translocation during the reproductive phase in to sink.

Gross returns were observed to be maximum with transplanting ($C_4$), which was however in parity with semi- dry system ($C_1$) and drum seeding of sprouted seed ($C_2$). The highest net returns were observed with semi- dry ($C_1$), which was on a par with drum seeding ($C_2$) and transplanting ($C_4$). Highest return per rupee invested was observed with semi-dry ($C_1$), which was comparable with drum seeding ($C_2$), while it

Table 1. Growth parameters (at flowering), yield attributes, grain and straw yield of rice as influenced by establishment techniques and nutrient doses

| Treatments | Plant height (cm) | Tillers ($m^{-2}$) | DMP (kg $ha^{-1}$) | LAI | Panicles $m^{-2}$ | Total grains $panicle^{-1}$ | Filled grains $panicle^{-1}$ | Test weight (g) | Grain yield (kg $ha^{-1}$) | Straw yield (kg $ha^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|
| Crop establishment techniques | | | | | | | | | | |
| $C_1$ – Semi-dry | 100.1 | 430 | 10145 | 4.38 | 407 | 134 | 125 | 24.24 | 5296 | 6855 |
| $C_2$- Drum seeding of sprouted seed | 98.7 | 375 | 9397 | 4.08 | 347 | 117 | 109 | 24.28 | 5071 | 6337 |
| $C_3$- Broadcasting of sprouted seed | 98.3 | 368 | 8783 | 4.37 | 320 | 111 | 102 | 24.30 | 4432 | 6520 |
| $C_4$- Transplanting | 101.2 | 434 | 10354 | 4.13 | 430 | 135 | 125 | 24.23 | 5406 | 6278 |
| S.Em ± | 1.58 | 13.56 | 276.76 | 0.07 | 15.75 | 1.90 | 2.22 | 0.03 | 255.82 | 272.40 |
| CD (P=0.05) | NS | 33 | 677 | 0.17 | 39 | 5 | 5 | NS | 626 | NS |
| Nutrient doses ($N$, $P_2O_5$ and $K_2O$ kg $ha^{-1}$) | | | | | | | | | | |
| $F_1$- Control | 83.4 | 167 | 7898 | 3.93 | 153 | 101 | 90 | 22.51 | 2555 | 3750 |
| $F_2$- 80-60-50 | 99.0 | 249 | 9145 | 4.11 | 237 | 113 | 102 | 23.45 | 4938 | 6568 |
| $F_3$- 100-75-65 | 102.8 | 492 | 9954 | 4.28 | 462 | 131 | 123 | 24.47 | 5564 | 7090 |
| $F_4$- 120-90-80 | 105.3 | 545 | 10617 | 4.42 | 499 | 136 | 129 | 25.33 | 5957 | 7447 |
| $F_5$- 140-105-95 | 107.1 | 556 | 10735 | 4.45 | 528 | 140 | 132 | 25.54 | 6244 | 7634 |
| S.Em ± | 1.64 | 27.28 | 372.96 | 0.07 | 19.29 | 3.52 | 3.13 | 0.09 | 242.46 | 252.51 |
| CD (P=0.05) | 3.3 | 56 | 760 | 0.14 | 39 | 7 | 6 | 0.19 | 494 | 514 |

Figure 1. Gross, net returns (Rs $ha^{-1}$) and return per rupee invested as influenced by crop establishment techniques and nutrient doses.




Main plots

C 1: Semi-dry rice

C 2: Broadcasting of sprouted seed

C 3: Drum seeding of sprouted seed

C 4: Transplanting

Sub plots

F 1: Control

F 2: 80-60-50 N, $P_2O_5$ and $K_2O$ kg ha-1

F 3: 100-75-65 N, $P_2O_5$ and $K_2O$ kg ha-1

F 4 : 120-90-80 N, $P_2O_5$ and $K_2O$ kg ha-1

F 5: 140-105-95 N, $P_2O_5$ and $K_2O$ kg ha-1

was the lowest with broadcasting of sprouted seed ($C_3$), which was however, in parity with transplanting ($C_4$). Similar results have been obtained by Manjappa *et al*., 2005; Sanjay *et al*., 2006.

From the present investigation, it can be concluded that comparable yields as that of transplanting ($C_4$) could be realized through semi dry system ($C_1$) as well as direct seeding of sprouted seed by drum seeder ($C_2$) besides being economically efficient and hence can be recommended in the situations of labour scarcity and also to reduce cost of cultivation. Irrespective of the method of crop establishment, split application of 120-90-80 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$ ($F_4$) was found to be the most optimum and economical dose to realize the best yields from *kharif* sown rice in North Coastal Zone of Andhra Pradesh.

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