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ORIGINAL ARTICLE **OPEN ACCESS**

Effect of Different establishment Methods, varieties with N levels on energetics of Rice as influenced under late sown conditions in Northern Telangana zone

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ABSTRACT
A field experiment was carried out during kharif, 2017 on clay loam soil at Regional Agricultural Research Station, Polasa, Jagtial, Telangana. The experiment was laid out in a split plot design with three replications and twelve treatments with three main plots viz., M_1: Sowing of nursery (July 20th) and transplanting of seedlings at 25 DAS (August 16th), M_2: Direct seeding by Broadcasting on August 16th, M_3: Direct seeding by Drum seeder on August 16th and four subplots viz., S_1: RNR-15048 with 100% Recommended N, S_2: RNR-15048 with 150% Recommended N, S_3: JGL-18047 with 100% Recommended N and S_4: JGL-18047 with 150% Recommended N. Grain and straw yield was significantly higher in drum seeding over broadcasting which was again significantly superior over transplanting method. JGL-18047 recorded significantly higher grain and straw yield at both levels of nitrogen over RNR-15048. Higher energy ratio, energy productivity, productivity day^{-1} was obtained in drum seeding over other establishment methods. JGL-18047 with 100% recommended nitrogen recorded higher energy ratio, energy productivity, while higher productivity day^{-1} was observed in JGL-18047 at both levels of nitrogen over RNR-15048.
Keywords: *Crop establishment, direct seeding, transplanting, broadcasting, productivity day^{-1} .*

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INTRODUCTION

Rice is the staple food crop for people living in Asia. In India rice is cultivated in an area of 44.10 M ha, with a production and productivity of 104.3 MT and 2.38 t ha^{-1}, respectively [1-4, 6]. Rice yields are highly variable due to aberrations in weather like late onset of monsoon, heavy continuous rains, intermittent dry spell and heavy rains at the time of harvesting, etc. Time of sowing is the most important factor in influencing the crop yield. Another reason for low profitability of rice cultivation is increased cost of cultivation. Traditional method of rice cultivation involves seedbed preparation, nursery raising, care of seedlings in nursery, uprooting of seedlings and transplanting operations which is usually done by hired labour, and is becoming increasingly difficult due to massive migration of labour. A shortage of labour during peak periods increase labour wages and make transplanting operation costly [13]. The event of delayed release of water from the canal, invariably causes delay in farm operations. This situation is forcing the farmers to deviate from normal date of sowing to delayed sowing. But the late planted rice takes more time to reach the maturity, which not only reduces the rice yield but also delays sowing of succeeding crop particularly wheat but direct seeding of rice can reduce the labour and water requirement, shorten the duration of crop by 7-10 days and provide comparable yield with transplanted rice [15].

Nitrogen is one of the most important nutritional elements contributing for higher productivity of paddy and a major factor that limits agricultural yields [3]. Recommendation of best establishment method and nitrogen requirement for recently released high yielding medium duration varieties under late sown conditions is necessary in order to achieve optimum yields. Keeping in view of these aspects, an experiment was planned with an objective to find out the best crop establishment method and nitrogen level for two popular rice varieties in Northern telangana zone under late sown conditions.

MATERIAL AND METHODS

Field experiment was carried out during *kharif,* 2017 at Regional Agricultural Research Station, Polasa, Jagtial which is geographically situated at an altitude of 243.4 m above mean sea level on 18º49'40" N latitude and 78º56'45" E longitude in the Northern Telangana Zone of Telangana State. A rainfall of 254.2 mm was received in 17 rainy days during the entire crop growth period. The experimental soil was clay loam texture with slightly alkaline pH (8.2), EC (0.20 d Sm^{-1}) and low in OC (0.40 %). The soil was medium in available N (441 kg ha^{-1}), high in available P (43.1 kg ha^{-1}) and K (380 kg ha^{-1}). The cultivars RNR-15048 and JGL-18047 were used in the experiment. The experiment was laid out in a split plot design with three replications and twelve treatments with three main plots *viz.,* M_1: Sowing of nursery (July 20th) and transplanting of seedlings at 25 DAS (August 16th), M_2: Direct seeding by Broadcasting on August 16th and M_3: Direct seeding by Drum seeder on August 16th, and four subplots *viz.,* S_1: RNR-15048 with 100% Recommended N, S_2: RNR-15048 with 150% Recommended N, S_3: JGL-18047 with 100% Recommended N and S_4: JGL-18047 with 150% Recommended N.

In case of conventional transplanting method (M_1), nursery was raised by broadcasting the seeds @ 50 kg ha^{-1}. Transplanting was done using twenty five day old seedlings. Seedlings were uprooted and transplanted @ 2-3 seedlings $hill^{-1}$ about 2-3 cm deep in soil at 15 x 15 cm spacing manually. In direct seeding by broadcasting method (M_2), the seeds @ 37.5 kg ha^{-1} were broadcasted into the puddled field manually. In direct seeding by drum seeder (M_3), the seeds @ 37.5 kg ha^{-1} were sown into the puddled field by using a manually operated drum seeder consisting of drums made of fibre with a spacing of 20 cm between the rows and 8 cm between the plants of the rows. The drums were filled with the seed upto three fourth of their capacity. About 3-4 seeds can be placed in a hill with the help of the drum seeder at all row spacing. In all the planting methods, the seeds were soaked in water, drained and incubated for 24 hours before sowing.

For control of weeds, pretilachlor @ 1250 ml in 50 kg of sand ha^{-1} was applied. The left over weeds are removed by hand weeding was done at 15 days interval. Irrigation was applied as per requirement to the plots. It was withheld 15 days before harvesting of the crop. A fertilizer dose of 60 kg ha^{-1} P_2O_5 was applied to all the plots as basal dose in the form single super phosphate and 40 kg ha^{-1} K_2O was applied in two equal splits *viz.,* as basal at the time of transplanting/sowing and panicle initiation stage in the form of muriate of potash, respectively. Nitrogen (120 and 150 kg ha^{-1}) was applied in the form of urea as per the treatments. It was applied in three equal splits *viz.,* as basal at the time of transplanting/sowing, 30 DAS (maximum tillering) and panicle initiation stage. Zinc was applied in the form of $ZnSO_4$ as foliar spray @ 2g lt^{-1} to the plots at 20 DAS. Carbofuran 3G @ 25 kg ha^{-1} were applied at 30 DAS. Other plant protection measures were taken up as and when required.

The crop was harvested manually with the help of sickles. After harvesting the crop in each net plot of all treatments, threshing, cleaning and drying of the grain was done and weight of the grain and straw of each treatment was recorded and expressed as kg ha^{-1}.

Energy from inputs and outputs were calculated by converting the physical units of inputs and outputs into respective energy units by using appropriate energy equivalents as given by Mittal and Dhawan, [16], Devasenapathy *et al*., [7], Alipour *et al*., [2], and Yadav *et al*., [23] and ratio is worked out. The crop yield obtained was divided by the input energy to get the energy productivity. It was expressed as kg MJ^{-1}. The grain yield obtained was divided by the crop duration to get the productivity day^{-1}. It was expressed as kg ha^{-1} day^{-1}. The duration of the crop from sowing to harvest was calculated and expressed as days.

$$\text{Energy ratio} = \frac{\text{Output energy (MJ)}}{\text{Input energy (MJ)}}$$

$$\text{Energy productivity} = \frac{\text{Crop yield (kg)}}{\text{Input energy (MJ)}}$$

$$\text{Productivity day}^{-1} = \frac{\text{Grain yield (kg)}}{\text{Crop duration (days)}}$$

All the data were subjected to analysis of variance (ANOVA) as per the standard procedures. The comparison of treatment of means was made by critical difference (CD) at P=0.05.

RESULTS AND DISCUSSION

Yield:

Direct seeding by drum seeder has recorded significantly higher grain and straw yield over direct seeding of sprouted seeds on puddled soil by broadcasting which was again significantly superior over

conventional transplanting method. With respect to varieties at different levels of nitrogen, JGL-18047 recorded significantly higher grain and straw yield over RNR-15048 with both the levels of nitrogen. The harvest index was not significantly influenced by either crop establishment methods or varieties at different levels of nitrogen (Table 1).

Energetics

The energy ratio and energy productivity was significantly higher for direct seeding by drum seeder (M_3) over direct seeding by broadcasting method (M_2). While significantly lowest was observed in conventional transplanting method (M_1) over other methods (M_2 and M_3). Lower energy ratio and energy productivity in transplanting method was due to more energy consumed for nursery management, transplanting and higher seed rate coupled with less output energy obtained. These results are in agreement with the findings of Gangwar *et al.* [9], Jha *et al*. [11], Mohanty *et al.* [17], Kumar *et al.* [12] and Bohr and Kumar [5]. Among varieties at different nitrogen levels highest energy ratio and energy productivity was observed in JGL-18047 with 100% nitrogen (S_3) over RNR-15048 with 100% nitrogen (S_1) and JGL-18047 with 150% nitrogen (S_4) which were at par with each other. While, the lower energy ratio and energy productivity was observed in RNR-15048 with 150% nitrogen (S_2) over other subplots. It was due to more usage of nitrogen fertiliser coupled with lower output energy obtained.

Table 1. Yield of rice as influenced by different establishment methods and varieties at different levels of nitrogen

Treatment	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest index (%)
Main plots: Establishment methods			
M_1	3901	5066	44.0
M_2	4520	5863	43.9
M_3	4949	6307	44.3
SEm±	103.1	107.9	0.7
CD (P = 0.05)	404.9	423.7	NS
Sub Plots: Varieties at different levels of nitrogen			
S_1	3975	5139	43.6
S_2	4010	5157	43.7
S_3	4815	6228	44.4
S_4	5027	6458	44.5
SEm±	152.1	162.3	0.3
CD (P = 0.05)	451.9	482.3	NS
Interaction			
S at same level of M			
SEm±	263.4	281.3	0.8
CD (P = 0.05)	NS	NS	NS
M at same or different level of S			
SEm±	250.4	266.3	0.8
CD (P = 0.05)	NS	NS	NS

Main plots:

M_1 : Sowing of nursery (July 20th) and transplanting of seedlings at 25 DAS (Aug 16th)

M_2 : Direct seeding by Broadcasting on August 16th

M_3 : Direct seeding by Drum seeder on August 16th

Sub plots:

S_1 : RNR-15048 with 100% Recommended N; S_2 : RNR-15048 with 150% Recommended N

S_3 : JGL-18047 with 100% Recommended N; S_4 : JGL-18047 with 150% Recommended N

Crop duration varied with different establishment methods, but not varied with varieties at different nitrogen levels and their interaction with establishment methods. Among three different establishment methods, the crop matured 11 days earlier in direct seeding by drum seeder method (M_3) and 9 days earlier in direct seeding by broadcasting method (M_2) compared to conventional transplanting method (M_1). The reason attributed is the transplantation shock which might have prolonged the crop duration (121 days) in conventional transplanting method over other methods. Gill *et al.* [10] also reported that direct seeded rice matured 10 days earlier than transplanted crop. Productivity day^{-1} was significantly higher for direct seeding by drum seeder (M_3) over direct seeding by broadcasting method (M_2). Significantly lowest productivity day^{-1} was observed in conventional transplanting method (M_1) over other methods (M_2 and M_3). Higher productivity day^{-1} in drum seeding method was due to lesser crop duration and higher grain yield obtained. Among the varieties at different levels of nitrogen, significantly highest productivity day^{-1} was observed in JGL-18047 with 150% recommended nitrogen (S_4) compared to RNR-15047 with both levels of nitrogen (S_1 and S_2) and at par with JGL-18047 with 100%

recommended nitrogen (S_3). The variation in productivity day^{-1} among varieties is due to higher grain yield obtained.

However, there was no significant interaction effect between different establishment methods and rice varieties at different nitrogen levels on yield, economics and energetics.

Table 2. Energetic of rice as influenced by different establishment methods and varieties at different levels of nitrogen

Treatment	Energy ratio	Energy productivity (kg MJ^{-1})	Productivity per day (kg ha^{-1} day^{-1})	Crop duration (days)
Main plots: Establishment methods				
M_1	5.9	0.44	32.2	121
M_2	7.1	0.52	40.4	112
M_3	7.6	0.57	45.0	110
SEm±	0.11	0.01	0.9	0.5
CD (P = 0.05)	0.42	0.04	3.6	2.1
Sub Plots: Varieties at different levels of nitrogen				
S_1	6.8	0.50	34.8	113
S_2	5.7	0.42	35.2	114
S_3	8.1	0.60	42.4	115
S_4	7.0	0.52	44.2	114
SEm±	0.18	0.01	1.3	0.7
CD (P = 0.05)	0.55	0.05	3.9	NS
Interaction				
S at same level of M				
SEm±	0.37	0.03	2.3	1.3
CD (P = 0.05)	NS	NS	NS	NS
M at same or different level of S				
SEm±	0.36	0.03	2.2	1.2
CD (P = 0.05)	NS	NS	NS	NS

Main plots:

M_1 : Sowing of nursery (July 20th) and transplanting of seedlings at 25 DAS (Aug 16th)

M_2 : Direct seeding by Broadcasting on August 16th

M_3 : Direct seeding by Drum seeder on August 16th

Sub plots:

S_1 : RNR-15048 with 100% Recommended N

S_2 : RNR-15048 with 150% Recommended N

S_3 : JGL-18047 with 100% Recommended N

S_4 : JGL-18047 with 150% Recommended N

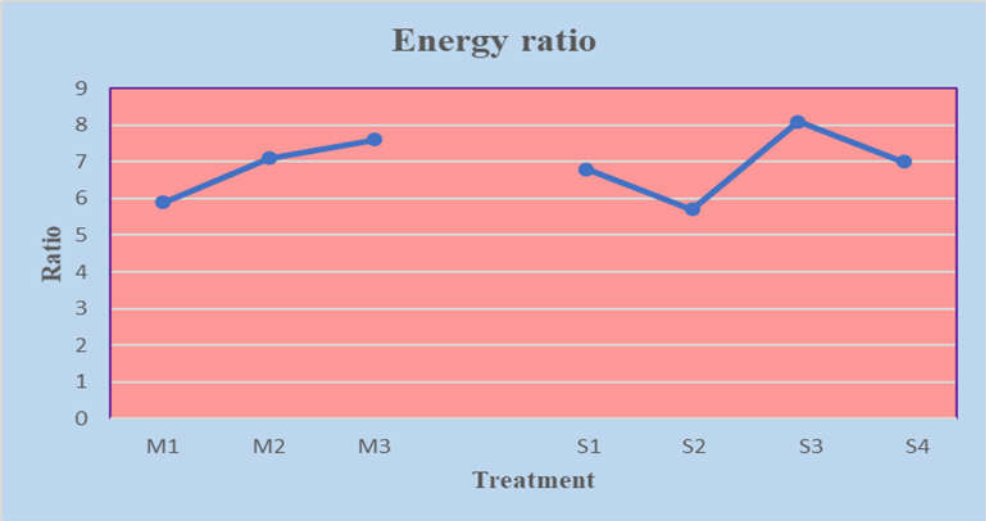

Fig 1. Energy ratio as influenced by different treatments

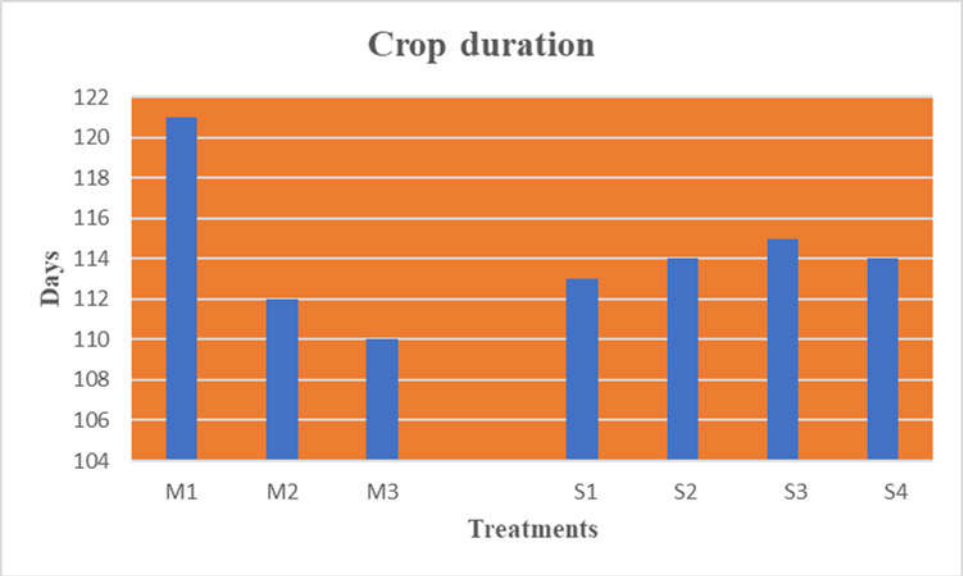

Fig 2. Crop duration as influenced by different treatments

CONCLUSIONS

From this study it can be concluded that under late sown conditions, direct seeding by drum seeder was found to be superior to direct seeding by broadcasting and conventional transplanting in yield, energy saving and profit and application of 100 % recommended nitrogen i.e., (120 kg ha^{-1}) for both the varieties (RNR-15048 and JGL-18047) was found to be optimum even under late sown conditions.

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APPENDIX - I

Energy conversion factors used in the present study

Energy source	Equivalent energy	References
Input energy		
Man	1.96 MJ h^{-1}	Mittal and Dhawan, [16]
Women	1.57 MJ h^{-1}	Mittal and Dhawan, [16]
Paddy seeds	15.20 MJ kg^{-1}	Yadav *et al*., [24]
Farm machinery (Tractor)	64.80 MJ h^{-1}	Devasenapathy *et al*.,[7]
Diesel	56.31 MJ lt^{-1}	Devasenapathy *et al*., [7]
Chemical fertilizers		
N	60.60 MJ kg^{-1}	Devasenapathy *et al*., [7]
P_2O_5	11.10 MJ kg^{-1}	Devasenapathy *et al*., [7]
K_2O	6.70 MJ kg^{-1}	Devasenapathy *et al*., [7]
$ZnSO_4$	20.9 MJ kg^{-1}	Devasenapathy *et al*., [7]
Other chemicals	120 MJ kg^{-1}	Devasenapathy *et al*., [7]
Water	0.63 MJ 1000 lt^{-1}	Alipour *et al*., [2]
Output energy		
Grain	14.70 MJ kg^{-1}	Devasenapathy *et al*., [7]
Straw	12.50 MJ kg^{-1}	Devasenapathy *et al*., [7]

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