Int.J.Curr.Microbiol.App.Sci (2018) *7*(6): 1982-1993

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 7 Number 06 (2018)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2018.706.235

Influence of Different Establishment methods, Varieties and N levels on Growth and Yield of Late Sown Rice in Telangana State

N. Lavanya*, M. Malla Reddy, P. Revathi and G. Padmaja

Department of Agronomy, College of Agriculture, Prof. Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad-030, Telangana State, India

**Corresponding author*

Keywords

Crop establishment, direct seeding, transplanting, broadcasting, drum seeder, varieties

Article Info

Accepted:
18 May 2018
Available Online:
10 June 2018

A B S T R A C T

A field experiment was carried out during *kharif*, 2017 on clay loam soil at Regional Agricultural Research Station, Polasa, Jagtial. 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. Results of the experiment revealed that, higher growth parameters and yield were observed in direct seeding by drum seeder over direct seeding by broadcasting and the least were observed in conventional transplanting under late sown conditions. Application of 100 % recommended nitrogen i.e., (120 kg ha^{-1}) for both varieties (RNR-15048 and JGL-18047) was found to be optimum even under late sown conditions.

Introduction

Rice (*Oryza sativa* L.), is the most important cereal crop and staple food for one third of the world population. The total area of rice in India is 44.10 M ha, with a production and productivity of 104.3 MT and 2.38 t ha^{-1}, respectively. (Directorate of Economics and Statistics, GOI, 2015-16). Rice yields are highly variable due to aberration 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. Performance of a genotype entirely depends upon the time of planting. Delay in planting generally results in yield reduction which cannot be compensated by any other means.

Another reason for low profitability of rice cultivation is increased cost of cultivation. Rice transplanting 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 (Mahajan *et al.*, 2009). The event of delayed release of water from the canal, invariably causes delay in farm operations. The late planted crop has low productivity per plant due to restricted vegetative growth. In water scarce areas, the farmers prefer direct seeding method as an alternative to traditional method of transplanting. Direct-seeded rice occupies 26% of the total rice area in South Asia (Gupta *et al.,* 2006). Direct seeding of rice avoids transplanting and nursery maintenance, and crop also matures 7-12 days earlier thus reduces the overall water demand for rice culture and also saves the time, labour and energy. Recently, an effort has been made to fabricate very simple machine like manually operated drum seeder which helps in reducing the investment on labour for planting as it does not consume huge labour force. Nitrogen is one of the most important nutritional elements contributing for higher productivity of cereal crops and a major factor that limits agricultural yields (Balasubramanian *et al.*, 2000 and Islam, 2009). The application of nitrogen fertilizer either in excess or less than optimum rate affects both yield and quality of rice to remarkable extent, hence proper management of crop nutrition is of immense importance (Manzoor *et al.*, 2006).

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 this in view, the present study was undertaken to investigate the effect of establishment methods, varieties and N levels on growth and yield of late sown rice in Telangana State.

Materials 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.

Data on the plant height (cm), number of tillers m^{-2}, dry matter production (kg ha^{-1}) at 30, 60, 90 DAS and harvest, SPAD and LCC readings at 50% flowering stage were recorded. 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}.

Results and Discussion

Plant height

Among three different establishment methods, maximum plant height (48.9 cm) was recorded in conventional transplanting method (M_1) at 30 DAS/DAT (Table 1) over direct seeding by broadcasting (M_2) and direct seeding by drum seeder methods (M_3) i.e., 31.4 and 30.4 cm, respectively which were on par with each other. However at 60, 90 DAS/DAT and harvest the plant height among all different establishment methods remained non-significant. Increase in average plant height was rather slow up to 30 DAS in direct seeded plots, thereafter it increased linearly up to 60 DAS and after that although it continued to increase until maturity it occurred at a diminishing rate.

The plant height was not significantly influenced by the varieties at different nitrogen levels at 30 DAS/DAT. But the data collected at 60, 90 DAS/DAT and harvest revealed that maximum plant height was observed in JGL-18047 with 150 % recommended nitrogen (S_4) over RNR-15048 with both levels of nitrogen (S_1 and S_2) and was at par with JGL-18047 with 100% recommended nitrogen (S_3). This variation in plant height among varieties might be genetically inherent character of these varieties (Sharath) 2017.

No. of tillers m^{-2}

Number of tillers m^{-2} were significantly influenced by different establishment methods during the crop growth period (Table 2). Number of tillers m^{-2} produced were statistically higher in conventional transplanting method (M_1) at 30 DAS/DAT (274) over other establishment methods (M_2 and M_3) (205 and 239, respectively). But, at 60 DAS/DAT the number of tillers m^{-2} produced in conventional transplanting method (M_1) (334) were at par with direct seeding by drum seeder (M_3) (340). At 90 DAS/DAT and harvest maximum number of tillers were produced in direct seeding by drum seeder (M_3) (392 and 379, respectively) over direct seeding by broadcasting method (M_2) (353 and 340, respectively) and the least were produced in conventional transplanting method (M_1) (318 and 308, respectively).

Closer spacing of sprouted seeds which increased number of plants m^{-2} with early establishment of seedlings due to avoidance of root injury and transplantation shock coupled with higher root growth and activity and quicker tiller initiation leading to longer tillering period in direct sown sprouted seeds might be the reason for higher number of tillers m^{-2} than conventional method. These are in line with the findings of Manjunatha *et al.*, (2009), Dange *et al.*, (2014), Rana *et al.*, (2014) and Kumari and sudheer. (2015). Among the varieties at different nitrogen levels, the number of tillers m^{-2} remained non-significant during all the growth stages of the crop.

Dry matter production (kg ha^{-1})

Drymatter production (kg ha^{-1}) at various stages of the cropwas significantly influenced by different establishment methods (Table 3). At 30 and 60 DAS/DAT among the different establishment methods conventional transplanting method (M_1) recorded significantly higher drymatter production (1104, 4978 kg ha^{-1}, respectively) over direct seeding by broadcasting (M_2) and direct seeding by drum seeder (M_3) which were at par with each other (732, 3051 and 728, 3324, kg ha^{-1}, respectively). At 90 DAS/DAT, dry matter produced in conventional transplanting method was at par with direct seeding by drum seeder (7548 and 6905 kg ha^{-1}, respectively). However the data collected at harvest revealed that drum seeded plotsproduced significantly higher dry matter (11113 kg ha^{-1}) over broadcasted plots (10259 kg ha^{-1}) which was again superior to transplanted plots (8748 kg ha^{-1}). Consequence of favourable growing environment, earlier establishment of seedlings due to absence of transplantation shock which resulted in uptake of nutrients and water at faster rate helped the plants to boost their growth leading to produce more tillers (Table 2) through supply of more synthates towards sink lead to production of higher dry matter under direct seeded methods (M_2 and M_3) over conventional transplanting method (M_1). Similar results of higher dry matter production from direct seeding by drum seeder and broadcasting method over conventional transplanting were recorded by Gangwar *et al.,* (2009), Halder *et al.,* (2009), Rana *et al.,* (2012) and Rana *et al.,* (2014).

Among the varieties at different nitrogen levels, dry matter production was not significantly influenced at 30 DAS/DAT but at, 60 and 90 DAS/DAS and harvest, JGL 18047 with 150% recommended nitrogen (S_4) recorded highest dry matter production (4107, 7167 and 11297 kg ha^{-1}, respectively) over RNR-15048 at both nitrogen levels (S_1 and S_2) (3417, 6573, 9042 kg ha^{-1} and 3615, 6659, 9041 kg ha^{-1}, respectively) which was at par with JGL 18047 with 100 % recommended nitrogen (S_3) (3998, 7052 and 10847 kg ha^{-1}, respectively). Variation in dry matter production among varieties might be due to higher plant height (Table1) and genetically inherent character of the variety JGL-18047. These findings were in conformity with Sharath (2017).

Leaf colour chart (LCC) readings

The Leaf Colour Chart (LCC) readings were significantly influenced by the different crop establishment methods (Table 4). Lower LCC reading (3.13) was observed in direct seeding by broadcasting method (M_2) compared to other methods. This might be due to higher population and uneven distribution of nitrogen fertiliser among the plants. The LCC ratings in conventional transplanting (M_1) and direct seeding by drum seeder (M_3) method were at par with each other (3.35 and 3.50, respectively). The LCC ratings were significantly low (3.28) in RNR-15048 with 100% recommended nitrogen (S_1) over all other treatments.

Table.1 Plant height (cm) at 30, 60, 90 DAS/DAT and harvest as effected by different establishment methods and varieties with different levels of nitrogen in rice

Treatment	30 DAS/DAT	60 DAS/DAT	90 DAS/DAT	Harvest
Main plots: Establishment methods				
M_1	48.9	85.8	89.7	90.2
M_2	31.4	72.8	86.7	88.7
M_3	30.4	74.8	87.4	90.5
SEm±	1.4	1.8	1.9	1.8
CD (P = 0.05)	5.5	7.3	NS	NS
Sub Plots: Varieties at different levels of nitrogen				
S_1	35.1	73.8	83.3	85.0
S_2	36.5	76.9	86.7	87.2
S_3	37.3	78.7	89.9	92.8
S_4	38.5	81.8	91.7	93.4
SEm±	0.8	1.4	1.9	1.9
CD (P = 0.05)	NS	4.3	5.9	7.6
Interaction				
S at same level of M				
SEm±	1.5	2.5	3.4	4.4
CD (P = 0.05)	NS	NS	NS	NS
M at same or different level of S				
SEm±	1.9	2.8	3.6	3.9
CD (P = 0.05)	NS	NS	NS	NS

Main plots:
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

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

Table.2 No. of tillers m^{-2} at 30, 60, 90 DAS/DAT and harvest as effected by different establishment methods and varieties at different levels of nitrogen in rice

Treatment	30 DAS/DAT	60 DAS/DAT	90 DAS/DAT	Harvest
Main plots: Establishment methods				
M_1	274	334	318	308
M_2	205	300	353	340
M_3	239	340	392	379
SEm±	7.6	7.6	8.3	8.3
CD (P = 0.05)	29.8	29.8	32.6	33.2
Sub Plots: Varieties at different levels of nitrogen				
S_1	224	312	346	327
S_2	236	321	358	340
S_3	240	326	351	346
S_4	256	337	363	356
SEm±	9.2	9.2	11.2	11.2
CD (P = 0.05)	NS	NS	NS	NS
Interaction				
S at same level of M				
SEm±	16.0	16.0	19.3	19.3
CD (P = 0.05)	NS	NS	NS	NS
M at same or different level of S				
SEm±	15.8	15.8	18.7	18.7
CD (P = 0.05)	NS	NS	NS	NS

Main plots:
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

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

Table.3 Dry matter accumulation (kg ha^{-1}) 30, 60, 90 DAS/DAT and harvest as effected by different establishment methods and varieties at different levels of nitrogen in rice

Treatment	30 DAS/DAT	60 DAS/DAT	90DAS/DAT	Harvest
Main plots: Establishment methods				
M_1	1104	4978	7548	8748
M_2	732	3051	6135	10259
M_3	728	3324	6905	11113
SEm±	27.8	120.2	161.2	209.0
CD (P = 0.05)	109.3	471.9	635.4	820.9
Sub Plots: Varieties at different levels of nitrogen				
S_1	838	3417	6573	9042
S_2	856	3615	6659	9041
S_3	852	3998	7052	10847
S_4	873	4107	7167	11297
SEm±	27.2	109.7	155.4	308.2
CD (P = 0.05)	NS	325.9	460.2	915.7
Interaction				
S at same level of M				
SEm±	47.2	190.0	268.6	533.8
CD (P = 0.05)	NS	NS	NS	NS
M at same or different level of S				
SEm±	49.4	203.7	283.5	507.4
CD (P = 0.05)	NS	NS	NS	NS

Main plots:
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

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

Table.4 SPAD meter and LCC readings at 50% flowering stage as effected by different establishment methods and varieties at different levels of nitrogen in rice

Treatment	SPAD meter readings	LCC readings
Main plots: Establishment methods		
M_1	34.5	3.35
M_2	33.2	3.13
M_3	34.7	3.50
SEm±	0.6	0.05
CD (P = 0.05)	NS	0.20
Sub Plots: varieties at different levels of nitrogen		
S_1	33.9	3.28
S_2	34.1	3.39
S_3	34.2	3.26
S_4	34.6	3.35
SEm±	0.3	0.03
CD (P = 0.05)	NS	0.09
Interaction		
S at same level of M		
SEm±	0.6	0.05
CD (P = 0.05)	NS	NS
M at same or different level of S		
SEm±	0.8	0.07
CD (P = 0.05)	NS	NS

Main plots:
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

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

Table.5 Yield as influenced by different establishment methods, varieties at different levels of nitrogen in rice

Treatment	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
Main plots: Establishment methods		
M_1	3901	5066
M_2	4520	5863
M_3	4949	6307
SEm±	103.1	107.9
CD (P = 0.05)	4040.9	423.7
Sub Plots: Varieties at different levels of nitrogen		
S_1	3975	5139
S_2	4010	5157
S_3	4815	6228
S_4	5027	6458
SEm±	152.1	162.3
CD (P = 0.05)	451.9	482.3
Interaction		
S at same level of M		
SEm±	263.4	281.3
CD (P = 0.05)	NS	NS
M at same or different level of S		
SEm±	250.4	266.3
CD (P = 0.05)	NS	NS

Main plots:
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

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

This might be due to the poor uptake of nitrogen over other treatments.

SPAD Chlorophyll Meter Readings

SPAD meter readings indicate chlorophyll content. SPAD chlorophyll meter readings at 50% flowering stage were not significantly influenced by the different establishment methods, varieties at different nitrogen levels (Table 4). These observations were in line with of Prathiksha (2016).

Grain yield

Among different establishment methods, direct seeding by drum seeder (M_3) has recorded significantly higher grain yield (4949 kg ha^{-1}) over direct seeding by broadcasting (M_2) (4520 kg ha^{-1}), which was again superior over conventional transplanting method (M_1) (3901 kg ha^{-1}) (Table 5).

Higher yield in direct seeding by drum seeder (M_3) might be attributed to row sowing facilitated optimum plant population, more space, sunlight, avoidance of root injury and transplantation shock, quicker establishment, effective tillering, more absorption of nutrients and reduced pest and disease incidence due to the improved microclimate over transplanting and broadcasting method. Line sowing in drum seeding method also facilitates to take up fertilizer application, plant protection measures and weed control in an efficient manner. These results are in accordance with the findings of Singh and Singh (2010), Dange *et al.*, (2014), Murumkur usha (2014) and Muralidharan *et al.*, (2015).

Higher yield in direct seeding by broadcasting of sprouted seeds (M_2) over conventional transplanting method (M_1) might be due to higher plant population, avoidance of root injury and transplantation shock, quicker tiller initiation leading to longer tillering period. This impact has made it possible to record more number of effective tillers m^{-2} with heavier panicles, which might have contributed to higher grain yield. These results were in agreement with the findings of Manjunatha *et al.,* (2009) and Rana *et al.*, (2014). Further, both the direct sown methods ($M_1$and M_2) escaped the cloudy weather and heavy rainfall during flowering which might have affected the fertilization and early grain development in conventional transplanting method.

Grain yield was also significantly differed among varieties at different nitrogen levels. Highest grain yield (5027 kg ha^{-1}) was recorded in JGL-18047 with 150% recommended N (S_4) over RNR-15048 at two different nitrogen levels (S_1 and S_2) (3975 and 4010 kg ha^{-1}) which was at par with JGL-18047 with 100% recommended N (S_3) (4815 kg ha^{-1}). The lower yield of RNR-15048 might be due to lower test weight as compared to JGL-18047. Similar results were reported by Sharath (2017).

Straw yield (kg ha^{-1})

The straw yield of rice was significantly influenced by different establishment methods and varieties with different nitrogen doses (Table 5). Significantly higher straw yield (6307 kg ha^{-1}) was realized from direct seeding by drum seeder (M_3) over direct seeding by broadcasting (M_2) (5863 kg ha^{-1}). Lowest straw yield (5066 kg ha^{-1}) was observed in conventional transplanting method (M_1). Higher straw yield was attributed to higher dry matter accumulation caused by better nutrient absorption from the soil, and the increased rate of metabolic processes, rate of light absorption and photosynthetic activity as well as more number of tillers. These results are in tune with the findings of Sandhyakanthi *et al.*, (2014) and Kaur and Singh (2015).

Among the varieties with different doses of nitrogen, JGL-18047 with 150% recommended N (S_4) has recorded significantly higher straw yield (6458 kg ha^{-1}) over RNR-15047 at two different nitrogen levels (S_1 and S_2) and was at par with JGL-18047 with 100% recommended N (S_3) (6228 kg ha^{-1}). The lower straw yield of RNR-15047 might be due to lower plant height (Table 1) and low dry matter accumulation (Table 3) as compared to JGL-18047. These results are agreed with the findings of Sharath (2017).

There was no significant interaction effect between different establishment methods and rice varieties at different nitrogen levels with respect to growth parameters and crop yield.

Harvest Index

The harvest index was not significantly influenced by either of the individual factors nor their interaction (Table 5). Similar findings were reported by Barla and Kumar (2011) and Prathiksha *et al.*, (2017).

Acknowledgements

My earnest acknowledgment must go to Dr. M. Malla Reddy and Dr. B. Padmaja for their scholastic guidance, unceasing interest, valuable knowledge and technical advice.

References

Agriculture statistics at a Glance. 2016-17. *Directorate of Economics and Statistics*. Ministry of Agriculture. Government of India

Balasubramanian, V., Morales, A.C., Cruz, R.T., Thijagaran, T.M., Nagarajan, R., Babu, M., Abdulrachaman, S and Hai, L.H. 2000. Adaptation of chlorophyll meter (SPAD) technology for real-time nitrogen management in rice a review. *International Rice Research. Notes.* 25 (1): 4-8.

Barla, S and Kumar, S.S. 2011. Evaluation of rice establishment techniques in Jharkhand plateau. *Oryza*. 48 (1): 79-80.

Dange, A., Birbal Sahu., Rathore, A.L and Devchand Salam. 2014. Comparative performance of different methods of rice establishments in Kanker district of Chhattisgarh State. *Environment and Ecology*. 32 (4): 1748-1752.

Gangwar, K.S., Chaudary, V.P., Gangwar, B and Pandey, D.K. 2009. Effect of crop establishment and tillage practices in rice (*Oryza sativa*) - based cropping systems. *Indian Journal of Agricultural Sciences*. 79 (5): 334-339.

Gupta, R.K., Ladha, J.K., Singh, S., Singh, R., Jat, M.L., Saharawat, Y., Singh, V.P., Singh, S.S., Singh, G., Sah, G., Gathala, M and Sharma, R.K. 2006. Production technology for direct seeded rice. *Technical Bulletin Series 8*. In “rice–wheat consortium for the Indo-Gangetic plains, New Delhi, India,” 14.

Halder, J., Sahoo, K.C., Karmaker, S.K and Nayak, R.N. 2009. Productivity and sustainability of different crop establishment methods for cultivation of rabi rice in western Orissa. *Annals of Agricultural Research*. 30 (3): 82-86.

Islam, M.S.H., Bhuiya, M.S.U., Rahman, S and Hussain, M. 2009. Evaluation of SPAD and LCC based nitrogen management in (*Oryza sativa* L.). *Bangladesh Journal of Agricultural Research.* 34 (4): 661-672.

Kaur, S and Singh, S. 2015. Impact of crop establishment methods and weed control on weeds, insect pest and disease infestation in rice in north-western Indo-gangetic plains. *International Journal of Agriculture Sciences.* 7 (4): 487-491.

Kumari, R.C and Sudheer, J.M. 2015. On-farm evaluation of paddy drum seeder (8 row) in farmers fields. *Advance Research Journal of Crop Improvement.* 6(2): 139-143.

Mahajan, G., Bharaj, T.S and Timsina, J. 2009. Yield and water productivity of rice as affected by time of transplanting in Punjab, India. *Agricultural Water Management.* 96: 525-532.

Manjunatha, M.V., Masthana Reddy, B.G and Joshi, V.R. 2009. Performance of rice (*Oryza sativa*) under different methods of establishment in Tungabhadra canal command, Karnataka. *Karnataka Journal of Agricultural Sciences.* 22(5): 1151-1152.

Manzoor, Z., Awan, T.H., Zahid, M.A and Faiz, F.A. 2006. Response of rice crop to different nitrogen levels. *Journal of Plant Sciences.* 16: 52-55.

Muralidharan, P., Rajeev, M.S., Anand, R and Nathan, A.R., 2015. Drum seeder is an effective mean for timely sowing of rice. *Journal of Tropical Agriculture.* 53(1): 66-69.

Murumkar Usha, R.P., Dongarwar, R., Pisalkar, P.S and Phad, D.S. 2014. Evaluation of field performance of eight row paddy drum seeder. *International Journal of Innovative Science, Engineering and Technology.* 1(9): 536-540.

Prathiksha, G.J. 2016. Performance of rice under different crop establishment methods. *M.sc. Dissertation,* PJTSAU, Hyderabad.

Rana, I.A., Nadeem Iqbal., Muhammad Usman Saleem and Muhammad Akhtar. 2012. Effect of different planting methods on economic yield and grain quality of rice. *International Journal of Applied Agricultural Research.* 4(1): 28-34.

Rana, M., Md. Abdullah Mamun., Afruz Zahan., Md. Nayeem Ahmed and Md. Abdul Jalil Mridha. 2014. Effect of planting methods on the yield and yield attributes of short duration aman Rice. *American Journal of Plant Sciences*. 5: 251-255.

Sandhya Kanthi, M., Ramana, A.V and Ramana Murthy, K.V. 2014. Effect of different crop establishment techniques and nutrient doses on nutrient uptake and yield of rice (*Oryza sativa* L.). *Karnataka Journal Agricultural Sciences.* 27 (3): 293-295.

Sharath, M. 2017. Performance of different rice varieties under alternate wetting and drying method of water management. *M.sc. Dissertation,* PJTSAU, Hyderabad.

Singh, M and Singh, R.P. 2010. Influence of crop establishment methods and weed management practices on yield and economics of direct seeded rice (*Oryza sativa*). *Indian Journal of Agronomy.* 55 (3): 224-229.

How to cite this article:

Lavanya N., M. Malla Reddy, P. Revathi and Padmaja, G. 2018. Influence of Different Establishment methods, Varieties and N levels on Growth and Yield of Late Sown Rice in Telangana State. *Int.J.Curr.Microbiol.App.Sci.* 7(06): 1982-1993.
doi: https://doi.org/10.20546/ijcmas.2018.706.235