The Andhra Agric. J 65 (3): 551-554, 2018

Productivity and Quality of Rice as Influenced by Crop Establishment Techniques and Nitrogen Levels

P Amara Jyothi, M Martin Luther, A Upendra Rao, K L Narasimha Rao and P Ratna Prasad
Department of Agronomy, Agricultural College, Bapatla,

ABSTRACT

A field investigation was carried out during 2015-16 and 2016-17 at Agricultural Research Station, Ragolu, Andhra Pradesh, with four establishment techniques (Dry direct sown rice, aerobic rice, planting with machine and normal planting) as main plots and five nitrogen levels (90, 120, 150, 180 and 210 kg ha^{-1}) as sub plots in split plot design on sandy clay loam soil. The study revealed that planting with machine technique was stastically on par with normal planting and resulted in significantly higher rice grain yield. Quality parameters like protein content, milling per cent, hulling per cent, head rice recovery and volume expansion ratio were not affected by establishment techniques but significantly influenced by nitrogen levels. The grain and straw yield and quality parameters were significantly higher with application of nitrogen @ 210 kg N ha^{-1} and it was comparable with 180 and 150 kg N ha^{-1} during both the years of the study.

Key words : *Crop establishment techniques, Grain yield, N levels, Quality parameters, Rice.*

In recent years the rural agricultural labour has migrated towards the industrial sector, which has lead to the non availability of labour for transplanting at the appropriate time. It results in delayed transplantation of rice there by resulting in yield reductions. Flooded rice cultivation has increasingly experienced shortages in irrigation water, labour and higher labour wages. Rice growers across the country seek increased levels of productivity to counter balance ever increasing cost of production. These conditions emphasize the need for shift to labour and water saving rice cultivation methods, which can shorten the duration of crop and increase yields. Good crop establishment is one of the vital components for efficient use of resources and desired level of productivity in rice. In order to reduce the manpower requirement and cost of production, a need has been felt to replace the manual transplanting with some scientifically sound, technically feasible, economically viable and environmentally safe establishment technique (Sanjay *et al*., 2006). Direct seeding of dry seed, aerobic rice and planting with machine transplanter are some of the methods of crop establishment which may ensure better plant population and less dependence on labour compared to conventional practice of manual transplanting (Mankotia *et al*., 2009) and are gaining popularity among the farmers with the advent of highly efficacious herbicides.

The productivity and quality of rice depends on environmental conditions and the agronomic management practices of the area. Nitrogen is considered as the quality and quantity limiting factor for paddy. It is the nutrient that most often limits crop production worldwide. Apart from promoting vegetative growth it also helps in increasing crop yield and protein content in grains. High grain yield can only be obtained by ensuring adequate nitrogen assimilation by plants in the course of growing season. Application of appropriate quantity of nitrogen is therefore one of the most important factor to realize high yield and quality.

MATERIAL AND METHODS

The present investigation was conducted during 2015-16 and 2016-17 at Agricultural Research Station, Ragolu (North Coastal Agro Climatic Zone of Andhra Pradesh). The experimental site is situated at $18^0.24^`$ N latitude, $83^0.84^`$ E longitude and at an altitude of 27.0 m above the mean sea level. The experimental soil was sandy clay loam in texture, neutral in reaction, low in organic carbon, low in available nitrogen, medium in available phosphorus and available potassium. The experiment was laid out in a split plot design, replicated thrice with four crop establishment techniques as main plots and five nitrogen levels as sub plots. The main plot treatments consisted of (i) Dry direct sown rice (DDS) (ii) Aerobic rice (iii) Planting with machine and (iv) Normal planting**.** The subplot treatments consisted of five nitrogen levels (90, 120, 150, 180 and 210 kg N ha^{-1}). The cultivar used in the study for rice was MTU 1001(Vijetha).

Nitrogen in the form of urea was applied as per the treatments in three equal splits as one third basal, one third at active tillering and one third at panicle initiation stage. A common dose of 60 kg P_2O_5 and 50 kg K_2O ha^{-1} was applied through single super phosphate and muriate of potash, respectively, to all the plots. Entire dose of phosphorus was applied as basal, while potassium was applied in 2 splits as basal and 1/3 at

panicle initiation stage along with urea. A common dose of $ZnSO_4$ @ 20 kg ha^{-1} was applied to all the treatments uniformly as basal.

The sowing of dry direct sown rice and aerobic rice was done in lines in un puddled and non flooded soil at a spacing of 20 cm x10 cm. Nursery was raised in trays for planting with machine on the same day of sowing of dry direct sown rice and aerobic rice. Seedlings from tray nursery of 14 days age were transplanted to ensure uniform depth and seedlings per hill at a spacing of 30 cm x 18 cm. Nursery was raised on thoroughly puddled and levelled nursery bed for normal planting method of establishment, on the same day of sowing of dry direct sown rice and aerobic rice. Nursery was raised upto the age of 25 days and transplanted manually at a spacing of 20 cm x 15 cm. In direct seeded rice and transplanted rice, weeds were controlled by applying pendimethalin @ 2.5 L ha^{-1} within 2 days of sowing and transplanting of rice and bispyribac sodium @250 ml ha^{-1} at 30 days after sowing and 25 days after transplanting of rice respectively. The left over weeds were removed by two hand weedings in direct seeded rice and with one hand weeding in transplanted rice, respectively. The observations on yield and quality parameters of rice were analysed by using standard procedures.

RESULTS AND DISCUSSIONS

Grain yield

Grain yield of rice was significantly influenced by both crop establishment techniques and nitrogen levels during both the years and their interaction was non significant during both the years (Table 1). Among the crop establishment techniques, the highest grain yield was recorded in planting with machine, but it was comparable with normal planting and DDS rice and significantly superior to aerobic rice. The grain yield was significantly lowest with aerobic rice over other crop establishment techniques during both the years of study. It was observed that different planting methods caused marked variations in grain yield. Higher yield under transplanting methods might be due to better enhanced stature of yield attributing characters through optimum utilisation of resources which had direct bearing on the production of higher grain yield. Lower yields under direct seeding (aerobic rice and dry direct sowing) is attributed to excessively higher competition with weeds and dense population per unit area. Plant density plays a major role in determining the efficiency of solar energy conversion to plant product per unit of land area. Excess plant population than required creates competition for various growth resources, either spatially or temporally and thus results in sub-optimal performance of the crop under a given environment. These results are in confirmation with the findings of Senthil kumar (2015), Islam *et al.,* (2016) and Meena *et al.,* (2017).

Irrespective of various crop establishment techniques, there was a progressive increase in grain yield with the increase in nitrogen levels from 90 to 210 kg N ha^{-1}. Among N levels, the highest grain yield was recorded with 210 kg N ha^{-1}. However the difference in grain yield between the N levels was measurable upto application of N@150 kg N ha^{-1} only and further increase in N level did not augment the grain yield conspicuously. However, the grain yield was lowest with the application of N @ 90 kg N ha^{-1}. The linear response observed with grain yield was supported by similar trends recorded with all growth and yield attributing characters studied. This suggests that nitrogen nutrition is important for both source and sink development.

Straw yield

It was significantly influenced by both crop establishment techniques and nitrogen levels during both the years of study. However their interaction was not significant (Table 1). Among the crop establishment techniques, highest straw yield was associated with the crop transplanted by machine which was significantly higher over aerobic rice and comparable with normal planting and DDS rice during 2015, while, in the second year of study, it was significantly superior to aerobic rice and DDS rice and comparable with normal transplanting. The straw yield was significantly lowest with aerobic rice over other crop establishment techniques . The increase in straw yield with these transplanting techniques might be due to better growth reflected in those treatments in terms of plant height, drymatter production and tillering.

Among N levels the highest straw yield was recorded with 210 kg N ha^{-1}. However, the difference in straw yield between the N levels was measurable upto application of N@150 kg N ha^{-1} only and further increase in N level did not influence the straw yield and it was lowest with the application of N@ 90 kg N ha^{-1}. Higher straw yield with higher levels of nitrogen might be attributed to higher drymatter accumulation and plant height. Nitrogen is the constituent of chlorophyll, which inturn, might have resulted in accumulation of photosynthates in vegetative portion of plants and ultimately enhanced the plant growth in transplanting techniques. These results are in conformity with those of Singh *et al*., (2015) and Prathibhasree *et al*., (2016).

Quality parameters

Protein content (%), hulling per cent, milling per cent, head rice recovery per cent and volume expansion ratio of rice grain, was significantly influenced

Table 1: Yield and quality of rice as influenced by crop establishment techniques and N levels

Treatments	Grainyield (kg ha^{-1})		Strawyield (kg ha^{-1})		Protein content (%)		Hulling per cent		Milling per cent		Head rice per cent		Volume expansion ratio	
	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
Crop establishment techniques														
M1:Dry direct sown rice	6194	6421	7341	7511	6.73	6.91	75.4	75.3	67.1	66.9	60.8	61	3.12	3.16
M_2 : Aerobic rice	5283	5645	6631	6820	6.44	6.59	74.5	73.7	66.7	66	60.3	60.1	3.08	3.11
M_3 : Planting with machine	6572	6954	7728	8177	7.00	7.17	77.1	77.4	67.8	67.8	62.3	62.6	3.31	3.37
M_4 : Normal planting	6308	6636	7441	7739	6.81	7.03	76.1	76.4	67.3	67.4	61.6	62.3	3.29	3.3
SEm±	147	155	158	179	0.12	0.12	1.3	1.4	0.7	0.8	0.5	0.4	0.1	0.1
CD (0.05)	508	536	547	618	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV%	9.3	9.4	8.4	9.2	6.6	6.5	6.7	7.3	4.1	4.5	3.4	3.1	9.5	7.2
Nitrogen levels (kg ha^{-1})														
N1 : 90	4848	4947	6074	6367	6.33	6.52	73.3	72.8	66	65.6	60.1	59.3	3.03	3.03
N2 : 120	5881	6262	7128	7342	6.65	6.82	75.2	74.4	66.6	66	60.7	60.3	3.13	3.14
N3 : 150	6409	6722	7578	7820	6.82	7.01	76.6	76.6	67.5	67.4	61.2	61.9	3.23	3.25
N4 : 180	6597	6984	7763	8043	6.96	7.11	76.7	77.2	67.9	68	61.9	62.8	3.28	3.33
N5 : 210	6713	7155	7883	8238	6.97	7.16	77.1	77.6	68.1	68.2	62.2	63.1	3.35	3.42
SEm±	140	158	152	166	0.13	0.12	1.3	1.2	0.5	0.7	0.5	0.5	0.1	0.1
CD (0.05)	404	455	438	477	0.37	0.3	NS	3.6	1.4	2.1	1.3	1.5	0.2	0.2
CV%	8	8.7	7.2	7.6	6.6	6.1	6	5.7	2.6	3.9	2.9	3	8	7.4
Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

by nitrogen levels only but, these were not affected by the crop establishment techniques (Table 1).

There was a linear increase in protein content by rice grain with the increase in nitrogen levels from 90 to 210 kg N ha^{-1}. Highest protein content was recorded with 210 kg N ha^{-1}. However the difference in protein content between the N levels was measurable upto application of N @150 kg N ha^{-1} only during both the years of study. Further increase in N level did not influence the protein content conspicuously, and the lowest was with the application of N@ 90 kg N ha^{-1}. The increase in protein content with increased nitrogen application might be due to increase in nitrogen uptake by grain. Similar results are reported by Singh *et al.,* (2015) and Zhu *et al*., (2017)

Irrespective of crop establishment techniques, rice crop supplied with adequate quantity of nitrogen resulted in better quality parameters such as hulling percent. Maximum hulling per cent was recorded with 210 kg N ha^{-1} which was significantly superior to lowest level of 90 kg N ha^{-1} and was comparable with other levels of N in 2016 only. Increase in hulling per cent

might be attributed to increase in boldness of rice grain due to adequate fertilizer nitrogen. Similar results were also reported by Yadav *et al.* (2010) and Singh *et al.* (2015).

Milling per cent was significantly influenced by nitrogen levels only during both the years of study (Table 1). The highest milling per cent was recorded with the highest level of nitrogen (210 kg N ha^{-1}), which was comparable with that of 150 kg N ha^{-1} but it was significantly superior to that of other levels. Lowest milling per cent was recorded with 90 kg N ha^{-1} during both the years of study. Increase in milling per cent might be attributed to increase in boldness of rice grain as reflected in test weight. Similar results are also reported by Zhu *et al.* (2017)

The highest head rice recovery of 62.2% and 63.1% was recorded in 2015 and 2016, respectively, with 210 kg N ha^{-1} which was on par with that of 180 kg N ha^{-1} and 150 kg N ha^{-1} but significantly superior to other levels. The lowest head rice recovery of 60.1% and 63.1% was recorded with 90 kg N ha^{-1} during the first and second years of study, respectively. Similar results are also reported by Yadav *et al*. (2010).

Volume expansion ratio increased significantly with increasing level of nitrogen upto 150 kg N ha^{-1}. This might be due to dense packing of grain as reflected in 1000 grain weight, and protein content. Similar results are reported by Priyadarsini and Prasad (2003).

CONCLUSION

It can be concluded that from the two years study that the rice yields and quality parameters was superior in planting with machine along with 150 kg N ha^{-1} and it was statistically at par with normal planting and DDS rice and significantly higher than aerobic rice. There was a linear increase in yield and quality parameters of rice with the increase in nitrogen levels from 90 to 210 kg N ha^{-1}. Highest yield and quality parameters was recorded with 210 kg N ha^{-1}, which was comparable with that of 150 kg N ha^{-1} but it was significantly superior to that of other lower levels only during both the years of study.

LITERATURE CITED

Islam MD M, Rahman MD H, Islam MD S, Saha M, Kamruzzaman MD, Bir MD SH,Roh S, Wand Park K W 2016 Effect of different transplanting methods on yield of Binadhan-14 (Oryza sativa) at late boro season under climate change. *Research on crops.* 17(4): 652-656.

Mankotia B S, Sekhar J and Negi S C 2009 Effect of crop establishment techniques on productivity of rice-wheat cropping system. *Oryza.* 46 (3): 205-208.

Meena H N, Bohra J S, Meena R N, Arvind Kumar Ashok Kumar and Jat S L 2017 Influence of tillage and crop establishment methods on system productivity and economics in rice-wheat cropping system. *Annals of Agricultural Research Journal*.38(1):50-54.

Prathibha Sree S, Raghavaiah R V, Subbaiah G, Ashoka Rani Y and Sreenivasa Rao V 2016 Growth, yield attributes, yield and nutrient uptake of rice (Oryza sativa) as influence by organic manures and zinc supplementation at different nitrogen levels. *The Andhra Agricultural Journal* 63(1): 34-39.

Priyadarsini J and Prasad P V N 2003 Evaluation of nitrogen-use –efficiency of different rice varieties supplied with organic and inorganic sources of nitrogen. *The Andhra Agricultural Journal.* 50(3&4): 207-210.

Sanjay M T, Setty T K P and Nanjappa H V 2006 Productivity, energetics and economics of different systems of crop establishment in rice. *Crop Research*. 31 (3): 350-353.

Senthil Kumar N 2015 Enhancing rice productivity by adopting different cultivation methods . *International Journal of Pure and Applied BioScience*. 3(6): 76-80.

Singh D K, Pandey P C, Priyanker Qureshi A and Shilpi Gupta 2015 Nitrogen management strategies for direct seeded aerobic rice (Oryza sativa L.) grown in mollisols of Uttarakhand (India). *International Journal of Applied and Pure Science and Agriculture*.130-138.

Yadav G S, Dinesh Kumar Shivay Y S and Harmandeep Singh 2010 Zinc enriched urea improves grain yield and quality of aromatic rice. *Better Crops*. 94(2): 6-7.

Zhu D W, Zhang Hong-cheng, GUO Bao-Wei, XU Ke, DAI Qi-gen, WEI Hai-yan, GAO hui, HU Ya-jie, CUI Pei-yuan and HUO Zhong-yang, 2017 Effect of nitrogen levels on yield and quality of Japonica soft super rice. Journal of Integrative Agriculture. 16(5): 1018-1027.

Received on 07.12.2017 and revised on 14.02.2018