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Research Communication

Effect of varieties and nitrogen management on nematodes infestation and productivity of aerobic rice (*Oryza sativa*)

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ABSTRACT

Influence of integrated nitrogen application and varieties under aerobic rice (*Oryza sativa* L.) was evaluated during wet season of 2010 at New Delhi. Treatment included four rice varieties *viz.,* 'Jaldi Dhan 13'; 'Pusa Sugandh 5'; 'Anjali' and 'Pusa 834' and four nitrogen (N) application options including N control (N_0), recommended dose of N (120 kg N/ha) through urea and two combinations (60:60 and 90:30) of urea and vermicompost (VC). Results showed that 'Pusa Sugandh 5' superseded other varieties in growth and yield parameters. Maximum grain yield (3.98 t/ha) was recorded with 90 kg N through urea + 30 kg N/ha through VC. 'Anjali' showed maximum tolerance to root knot nematodes, while 'Pusa sugandh 5' was most susceptible. N application through chemical fertilizer significantly reduced the nematode population over control. Highest net returns (₹61,885/ha) obtained from 'Pusa Sugandh 5' and 90 kg N (urea) + 30 kg N (VC)/ha (₹61,273/ha).

***Key words**:* Aerobic rice, Economics, Integrated N management, Nematode infestation, Rice varieties

Irrigated 'aerobic rice' system is being developed for lowland areas with water shortage and for favourable upland areas with access to supplementary irrigation. It entails the cultivation of nutrient responsive cultivars in non-saturated soil with sufficient external inputs to reach yields of 70–80% of high input flooded rice. Peng *et al.* (2006) reported a yield gap between aerobic and flooded rice and to narrow this gap development of varieties more adapted to aerobic conditions was suggested. Achieving high yields under irrigated aerobic soil conditions requires new varieties of aerobic rice that combine the drought-resistant characteristics of upland varieties with the high-yielding characteristics of lowland varieties (Lafitte *et al.*, 2002). Under aerobic conditions, average fertilizer N recovery was 22% compared to 36% in flooded conditions (Belder *et al.*, 2004). Thus growth of rice cultivars is likely to differ under aerobic conditions. With this background an experiment was conducted to obtain an insight into the agronomic performance and economics of aerobic rice under different rice varieties and nitrogen application.

A field experiment was conducted during wet season at research farm of Indian Agricultural Research Institute, New Delhi. The soils of experimental field was sandy clay loam and having 0.05% total N, 13.46 kg/ha available P, 242 kg 1N ammonium acetate exchangeable K, 0.54 % organic carbon, 10.0 mg/kg DTPA-extractable Fe and 7.8 pH. The experiment was laid out in a factorial randomized block design with 16 treatment combinations and three replications. Treatment combinations included four rice varieties *viz.,* 'Jaldi Dhan 13'; 'Pusa Sugandh 5'; 'Anjali' and 'Pusa 834' and four nitrogen application options *viz*., Control N ($N_0P_{60}K_{40}$); 120 kg N/ha through urea; 60 kg N/ha through urea + 60 kg N/ha through vermicompost (VC) and 90 kg N/ha through urea + 30 kg N/ha through VC. VC contained 2.3% N, 1.0% P and 1.4% K. The seed was sown on 24 June, 2010 and before sowing, the field was ploughed, harrowed, leveled and furrowed. Rice seeds @ 60 kg/ha were manually drilled in plots with a row spacing of 25 cm. A common dose of 60 kg P_2O_5/ha and 40 kg K_2O/ha was applied as basal through SSP and MOP, respectively. N was applied as per treatments and given through urea and VC. Dose of VC was calculated on the basis of its N concentration and applied as basal. N given through urea was applied in 3 equal splits *i.e.* basal, active tillering and panicle initiation stage. The field was kept under non-saturated aerobic condition throughout the growing season. Supplemental surface irrigations were applied on a few occasions when crop leaves started to roll due to drought stress and drainage, whenever heavy rains oc-

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curred. Only five irrigations were applied during the crop cycle since there was a very good rainfall in this season. For weed-management pre-emergence pendimethalin @ 1.5 kg/ha was sprayed two days after seeding and it was followed by hand weeding twice at 15 and 40 DAS. Observations on plant growth and yield were recorded through standard procedures. Root knot nematode population was counted from the root sample taken from 50 cm row length and presented in m^2 basis. Gross and net returns were calculated based on the prevailing market prices of input/output during the respective crop season.

Results showed significantly higher plant height, numbers of tillers and dry matter accumulation in 'Pusa Sugandh 5' compared to 'Jaldi Dhan 13', 'Anajli' and 'Pusa 834' at harvest stage (Table 1). 'Pusa Sugandh 5' showed highest root volume also. N application in three combinations from two sources (urea and VC) significantly increased the plant height, numbers of tillers and dry matter accumulation over control. The highest plant height, numbers of tillers and dry matter accumulation were recorded with the application of 90 kg + 30 kg N/ha provided through urea and VC, respectively. Sathia and Ramesh (2009) also reported positive influence on growth parameters like plant height, tillers and dry matter production of aerobic rice due to different nitrogen management practices. Highest number of effective tillers and filled grains/panicle were recorded in 'Pusa Sugandh 5'. Highest number of effective tillers and filled grains/panicle were produced by the application of 90 kg N (urea) + 30 kg N (VC)/ha followed by 60 kg N (urea) + 60 kg N (VC)/ha and 120 kg N through urea. There was significant influence on number of effective tillers, number of filled and total grains/panicle due to the application of N by combinations of urea and VC as well as sole chemical N application over control. There was no significant difference between two combinations of VC (30 and 60 kg N) with 90 and 60 kg N through urea. Highest spikelet fertility was recorded by 'Pusa Sugandh 5' and boldest grains were produced by 'Jaldi Dhan 13' followed by 'Anjali'. Application of 90 kg N (urea) + 30 kg N (VC)/ha produced heaviest grain. Sathiya and Ramesh (2009) also reported significant difference on yield attributes of aerobic rice under various nitrogen management practices.

'Pusa Sugandh 5' produced significantly higher grain and straw yields as compared to 'Pusa 834', 'Anjali' and 'Jaldi Dhan 13' (Table 2). Significantly higher grain and straw yields was recorded by application of 90 kg N (urea) + 30 kg N (VC)/ha as compared to other treatments. Interaction effect on grain yield due to varieties and N application was found significant and N application at 90 kg N (urea) + 30 kg N (VC)/ha in 'Pusa Sugandh 5' produced highest grain yield. Harvest index (HI) was at par among rice varieties. However, there was significant difference in HI due to the N application over the control. Positive responses on yield of improved varieties to a modest N application have been reported (Saito *et al.,* 2007).

The root knot nematode population was lowest in variety 'Anjali' and no plant of this variety was infested due to the root knot nematode at 30, 60 and 90 DAS (Table 2). On the contrary, 'Pusa Sugandh 5' showed maximum number of nematode knots at 60 DAS followed by 'Jaldi Dhan 13' and 'Pusa 834'. N application through chemical fertilizer significantly reduced the nematodes population over control and integrated use of N. Interaction effect between variety and N application on nematodes infestation was found significant at all growth stage. Reduction in yield under continuous aerobic rice has been predicted to be related to the build–up of nematodes and soil patho-

Table 1. Effect of rice varieties and integrated nitrogen management on plant growth at harvest stage and yield attributes.

Treatment	Plant height (cm)	No. of tillers/m^2	Dry matter accumulation (g/m^2)	Root volume (cc/m^3)	No. of panicles/m^2	No. of filled grains/ panicle	Spikelet fertility (%)	1,000–grains weight (g)
Variety								
'Jaldi Dhan 13'	79	246	300	113	234	107	73	27
'Pusa Sugandh 5'	115	356	786	148	342	123	76	24
'Anjali'	104	334	750	140	322	117	75	25
'Pusa 834'	108	341	773	146	323	122	77	24
SEm±	2.4	8	11	3	8	3	1	1
CD (P=0.05)	7	24	33	8	24	9	3	2
Integrated nitrogen management (INM)								
Control	90	270	564	136	255	97	72	24
120 kg N/ha(urea)	101	293	666	136	280	111	76	25
60 kg N (urea)+ 60 kg N (VC)/ha	105	351	686	138	336	129	76	25
90 kg N (urea) + 30 kg N (VC)/ha	111	363	694	136	350	132	78	26
SEm±	2.4	8	11	3	8	3	1	1
CD (P=0.05)	7	24	33	NS	24	9	2	NS

Table 2. Effect of varieties and integrated nitrogen management on yield, nematode infestation and economics of rice.

Treatment	Grain yield (t/ha)	Straw yield (t/ha)	Harvest Index (%)	Root knot nematode population/m^2 (× 10^3/ha)			Cost of cultivation (×10^3₹/ha)	Net return ratio (×10^3₹/ha)	B:C ratio (₹)
				30 DAS	60 DAS	90 DAS			
Variety									
'Jaldi Dhan 13'*	2.14	6.39	25.0	0.65	1.04	*	22.6	29.9	1.3
'Pusa Sugandh 5'	3.69	10.14	26.5	0.77	1.15	0.92	23.2	61.9	2.6
'Anjali'	2.74	8.00	25.4	0.11	0.17	0.20	22.6	39.9	1.7
'Pusa 834'	3.55	10.12	25.8	0.58	1.02	0.81	22.6	53.3	2.3
SEm±	0.06	0.13	0.46	0.03	0.02	0.02	-	0.84	0.04
CD (P=0.05)	0.18	0.39	NS	0.07	0.06	0.05	-	2.44	0.10
Integrated nitrogen management (INM)									
Control	2.14	6.65	24.2	0.96	1.41	0.95	19.3	32.8	1.6
120 kg N/ha (urea)	2.80	8.14	25.3	0.22	0.48	0.49	22.0	42.8	1.9
60 kg N (urea) + 60 kg N (VC)/ha	3.21	9.02	26.3	0.56	0.84	0.77	25.7	48.0	1.8
90 kg N (urea) + 30 kg N (VC)/ha	3.98	10.84	26.7	0.38	0.64	0.60	23.9	61.3	2.5
SEm±	0.06	0.13	0.46	0.03	0.02	0.02	-	0.84	0.04
CD (P=0.05)	0.18	0.39	1.32	0.07	0.06	0.05	-	2.44	0.10

*Jaldi Dhan 13 was harvested at 67 DAS.

gens under aerobic conditions (Lafitte *et al.,* 2002). Highest net returns (₹61,885) and B: C ratio was obtained from 'Pusa Sugandh 5'. Among N management practices, highest net returns (₹61,273) and B: C ratio were obtained due to the application of 90 kg N (urea) + 30 kg N (VC)/ha.

It was concluded that rice variety 'Pusa Sugandh 5' was superior to other varieties in plant growth, yield attributes, yield and net returns. Combinations of 90 kg N through urea + 30 kg N/ha through vermicompost gave higher plant growth, yield and net returns than other treatments. 'Anjali' was most tolerant to root knot nematodes but 'Pusa Sugandh 5' was most susceptible.

REFERENCES

Belder, P., Bouman B.A.M., Cabangon, R, Lu G, Quilang E.J.P., Li, Y., Spiertz, J.H.J. and Tuong TP. 2004. Effect of water–saving irrigation on rice yield and water use in typical lowland conditions in Asia. *Agricultural Water Management* **65**: 193–10.

Lafitte, H.R., Courtois, B., Arrandeau, M. 2002. Genetic improvement of rice in aerobic systems: Progress from yield to genes. *Field Crop Research* **75**: 171–90.

Peng, S., Bouman, B., Visperas, R.M., Castaòeda, A., Nie, L. and Park, H.K. 2006. Comparison between aerobic and flooded rice in the tropics: agronomic performance in an eight–season experiment. *Field Crops Research* **96**: 252–59.

Saito, K., Atlin, G.N., Linquist, B., Phanthaboon, S.T. and Horie, T. 2007. Performance of traditional and iomproved upland rice cultivars under nonfertilized and fertilized conditions in northern Laos. *Crop Science* **47**(6): 2473–81.

Sathiya, K. and Ramesh, T. 2009. Effect of split application of nitrogen on growth and yield of aerobic rice. *Asian Journal of Experimental Sciences* **23**(1): 303–06.