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Short Communication

Response of rice (*Oryza sativa*) varieties to nitrogen under direct-seeded condition

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Rice (*Oryza sativa* L.*)* is one of the most important food crop of India and belongs to the family Poaceae. In Madhya Pradesh, rice is grown in15.59 lac ha area with the production of 14.62 lac tonnes and productivity of 989 kg ha^{-1}. Rice cultivars differ in their potential to respond under high fertility conditions. Infact, genetic character of a variety limits the expression of yield. Selection of suitable varieties and their nutrient requirements have great relevance in boosting up productivity of low land rice. Therefore the selection of proper variety suitable to the specific ecological situation may prove to be a boon to the farmers. Nitrogen is the key element in the production of rice and gives by far the largest response. It is also a fact that improper use of nitrogenous fertilizer, instead of giving yield advantage, may reduce the productivity. The different varieties may have varying responses to N-fertilizer depending on their agronomic traits. Many workers have reported a significant response of rice to nitrogen (Sudhakara *et al.* , 2012 and Para *et al.,* 2018). Almost every farmer has tendency to apply costly N fertilizer in excess to get a desirable yield of rice but imbalance use of N fertilizer causes harm to the crop and decreases the grain yield .In recent years, the development of hybrid rice varieties have shown better yield potential than the existing varieties mainly due to presence of larger sink. Nutrient management of improved rice differs considerably from the conventional varieties. It is, therefore, essential to evaluate the location-specific nutrient management to restore the nutrient balance in soil and to sustain the crop productivity. Therefore, keeping these points in view, the present investigation was conducted during rainy season of 2018 using rice as test crop.

A field experiment was conducted at the Instructional Farm, College of Agriculture, Rewa (M.P.). The soil of the experimental field was sandy having pH 7.1, available N, P_2O_5 and K_2O 238, 18.8 and 357 kg ha^{-1}, respectively. The electrical conductivity was 0.31 dS m^{-1} and organic carbon 6.7 g kg^{-1}. The treatments comprised three nitrogen levels (.N_{40}, N_{80} and N_{120}) in main plots. Twelve rice varieties (IET 26348, IET 26365, IET 25103 (R), IET 26356, IET 26337, IET 25121 (R), Sahbhagidhan, Vandana, Govind (NW), Narendra 97 (E),Varalu and IR-64) in sub-plots. The experiment was laid out in a split-plot design with three replications. The experiment was sown on 3 July, 2018 keeping a seed rate of 50 kg ha^{-1} and row spacing 20 cm and plant spacing 10 cm. Nitrogen levels were applied through urea as per treatments under recommended basal and split applications. The common dose of 60 kg P_2O_5 and 20 kg K_2O ha^{-1} was applied to all the treatments. The crop was grown under rainfed condition. The rainfall received during the crop season was 845.4 mm with 43 rainy days. The crop was harvested on 25 November, 2018. Growth characters, yield attributes and yield were recorded at harvest.

The data (Table 1) reveal that amongst the rice varieties, IET26337 and IET 26348 were found highest in plant height (86.5-87.2 cm), IET26348 was highest in tillers 372.3/m^2 and 43.5 leaves $plant^{-1}$. On the other hand, Narendra was found lowest in plant height (54.0 cm), Vandana was lowest in tillers count (266.6/m^2) and Govind and Varalu in case of leaves (33.0 to 34.5 $plant^{-1}$). So much variation in growth parameters in different varieties was owing to variations in their genetic inheritance in these characters. In fact, the growth parameters among the varieties are genetically governed. Such type of observations among the rice varieties have also been reported by Tripathi *et al.* (2014),Yadav and Meena (2014), Prafull Kumar *et al.* (2015) and Para *et al.* (2018).The maximum nitrogen level (N_{120}) recorded maximum plant height (84.6 cm), tillers (410.8/m^2) and leaves (45.2 $plant^{-1}$). On the other hand, the corresponding values in case of N_{40} were almost significantly lowest (66.6 cm

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Table 1: Growth, yield-attributes, yield and economics from rice varieties grown under different nitrogen levels

Treatments	Plant height (cm) at harvest	Tillers/m^2 at harvest	Leaves $plant^{-1}$ at harvest	No. of panicles/ m^2	Length of panicle (cm)	Weight of panicle (g)	No. of grains $panicle^{-1}$	Test weight (g)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvest index (%)	Net income (Rs. ha^{-1})	B:C ratio
N-levels (kg/ha)													
40	66.6	390	32.3	353	11.7	1.49	10.0	9.12	26.40	55.24	31.8	29942	2.05
80	74.0	400	38.7	374	18.2	2.05	14.1	13.42	32.05	66.62	31.8	41789	2.43
120	84.6	410	45.2	392	22.4	2.44	20.8	20.87	38.10	77.05	32.8	54319	2.83
SEm+	3.81	2.46	2.80	6.43	1.91	0.22	1.94	2.09	2.08	2.17	0.26	--	--
CD (P=0.05)	11.75	7.60	8.62	19.83	5.87	0.67	5.97	6.43	6.43	6.68	0.81	--	--
Varieties													
IET 26348	86.5	472	43.5	399	19.4	2.87	14.0	10.53	52.36	100.54	34.3	85787	3.94
IET 26365	79.9	463	40.2	357	16.8	1.99	14.3	15.71	46.44	88.99	34.2	72792	3.46
IET 25103 (R)	78.5	464	41.5	359	18.6	1.83	19.7	12.42	49.88	95.71	34.3	80357	3.75
IET 26356	76.1	453	41.6	376	18.9	1.83	15.8	13.24	25.94	55.42	31.6	28435	1.97
IET 26337	87.2	390	38.2	402	18.9	1.96	12.4	16.33	24.23	53.81.	31.0	24854	1.85
IET 25121 (R)	76.9	365	40.2	392	18.7	2.37	16.1	19.57	22.09	51.69	30.8	20369	1.69
Sahbhagidhan	78.4	305	36.3	391	18.6	2.24	18.9	14.98	28.74	60.65	32.0	34565	2.18
Vandana	76.4	266	38.1	350	17.9	2.43	18.8	11.93	26.39	58.59	31.2	29659	2.01
Govind (NW)	59.1	343	33.0	385	15.4	1.40	11.7	14.60	21.33	47.93	30.8	18453	1.63
Narendra 97 (E)	54.0	427	36.2	388	14.5	1.28	12.9	14.22	30.76	64.59	31.7	38992	2.33
Varalu	71.8	395	34.5	348	14.8	1.34	10.4	15.58	17.78	41.25	30.2	10699	1.36
IR-64	75.8	461	41.1	329	16.9	2.27	14.1	14.58	40.29	76.51	33.3	59236	3.03
SEm+	4.67	3.02	3.43	7.88	2.33	0.27	2.37	2.56	2.55	2.66	0.32	--	--
CD (P=0.05)	14.40	9.30	NS	24.28	NS	0.82	7.37	7.87	7.87	8.198	0.99	--	--

height and 390.5 tillers/m^2 and 32.3 leaves $plant^{-1}$ at harvest stage. This may be owing to the immediate availability of nitrogen in the requisite amount from the higher dose of N fertilizers. The increase height and tillering might be due to role of N in rapid multiplication of tissues and increase in amount of growth substances such as normally occurring phyto-homones and increase in auxin supply with higher N level. These results corroborate with those of Singh and Kumar (2014), Vinod Kumar *et al.* (2015), Tiwari *et al.* (2015), Pandey and Namdeo (2016) and Para *et al.* (2018).

Out of twelve varieties, IET 26348 and IET 26337 brought about significantly and higher number of panicles 399 to 402/m^2 and panicle length (18.93-19.40 cm) over all the remaining varieties. However, the other yield-attributing characters were in the variable range among the different rice varieties. The panicle weight was higher in varieties IET 26348, Vandana and IET 25121 (2.37 to 2.87 g). The grains/panicle were higher in case of IET 25103, Sahbhagidan,and Vandana (18.82 to 19.77 $panicle^{-1}$). The test weight was foun highest (19.57g) in case of IET 25121. This type variations may be owing to variations in the genetic build up among the varieties. Such type of variability in the yield-attributing characters in the rice varieties have been reported by many research workers (Singh *et al.,* 2014; Gohain, 2014; Yadav and Meena, 2014; Prafull Kumar *et al.,* 2015 and Para *et al.,* 2018).The highest nitrogen level (N_{120}) resulted in significantly higher yield attributes over the lower nitrogen levels. The number of panicles was 392/m^2, panicle length 22.48 cm, weight of panicle 2.44 g, number of grains (20.81/panicle) and 1000-grains weight 20.87 g. This might be attributed to the maximum increase in growth parameters due to applied N_{120} nitrogen level . The increased photosyntghetic surface due to increased leaves/plant brought about increased production of photosynthates and thereby increased translocation of photosynthates from source to the sink. The present results corroborate with those of many research workers (Vinod Kumar *et al.,* 2015; Tiwari *et al.,* 2015; Pandey and Namdeo, 2016 and Sudhakara *et al.,* 2017).

Amongst the varieties, IET 26348 recorded significantly higher grain yield (52.36 q ha^{-1}) over the remaining varieties. This was equally followed by IET 25103 and IET 26365 (46.44 to 49.88 q ha^{-1}). The grain yield was further lowered down significantly in case of IR-64 (40.29 q ha^{-1}) and then Narendra (30.76 q ha^{-1}). The significantly maximum straw yield was secured IET 26348 (100.54 q ha^{-1}), closely followed by IET 25103 (95.71 q ha^{-1}), IET 26365 (88.99 q ha^{-1}) and then IR-64 (76.51 q ha^{-1}) and Narendra 97 (64.59 q ha^{-1}). The lowest straw yield (41.25 q ha^{-1}) was obtained from Varalu and then from Govind (47.93 q ha^{-1}). The higher productivity of rice varieties might be owing to increased yield-attributing characters. Such trend hasbeen also been reported by several researchers (Tripathi *et al.,* 2014; Yadav and Meena, 2014; Prafull Kumar *et al.,* 2015 and Para *et al.,* 2018). The highest nitrogen level (N_{120}) resulted in highest grain yield (38.10 q ha^{-1}). and straw yield (77.05 q ha^{-1}), being higher by 11.70 and 21.81 q ha^{-1}, respectively over N_{40}. The present results agree with those of other workers (Vinod Kumar *et al.,* 2015; Tiwari *et al.,* 2015; Pandey and Namdeo, 2016 and Para *et al.,* 2018).

Amongst the varieties, IET 26348 registered maximum net income upto Rs.85787 ha^{-1} with 3.94 B:C ratio. The second best variety was IET 25103 which gave up to Rs. 80357 ha^{-1} with 3.75 B:C ratio. The third best genotype was IET 26365 (Rs.72792 ha^{-1}, 3.46 B:C ratio). The lowest net income of Rs.10699 ha^{-1} was obtained from Varalu with lowest B:C ratio 1.96. The highest nitrogen level (N_{120}) resulted in highest net income of Rs.54319 $ha^{-1}$with B:C ratio 2.83. This was followed by N_{80} nitrogen level, the net income being Rs.41789 $ha^{-1}$with B:C ratio 2.43. The lowest net income (Rs.29942 and B:C ratio 2.05) was obtained from N_{40} nitrogen level. The findings conclude that the best rice variety was IET 26348 and the most optimum nitrogen level was 120 kg ha^{-1} which gave maximum net returns under direct - seeded condition.

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