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Response of method of planting and integrated nutrient management on growth and nutrient uptake of rice (*Oryza sativa* L.)

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Abstract
The present investigation entitled "Response of method of planting and integrated nutrient management on rice (*Oryza sativa* L.)"A field experiment was conducted at Agronomy Research Farm of, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.) during Kharif season of 2020. The experiment was laid out in Randomized block design with two method of planting transplanted rice and drum seeded rice and four treatments 100% RDF (120N:60P2O5 :60K2O Kg/ha.) through IF, 75% RDF through IF + 25% RDN through FYM, 75% RDF through IF + 25% RDN through compost, 50% RDF through inorganic + 50% RDN through FYM. Results revealed that method of planting transplanted rice found superior over drum seeder rice. Application of 100% RDF (120N:60P2O5:60K2O Kg/ha.) through IF found superior over rest of the treatment.

Keywords: transplanted rice, drum seeder rice, compost, FYM

Introduction
Rice belongs to the family Poaceae (Gramineae), and it is C_3, self-pollinated crop and having diploid chromosome number *i.e.*, 2n= 24. The word *Oryza* is most likely of Indian origin ('Vrihi'= Sanskrit, and 'arise'= Tamil). Grown in India and South East Asia, is a plant of Asian origin.

Transplanting is the most popular way of growing a rice crop in India. However this strategy is not very profitable for a variety of reasons, includes the fallowing, requirement of huge labour force for raising nurseries, uprooting, transporting of seedlings, require large quantity of water to carry out the operation, non availability of labour in time, drudgery to farm worker, high production cost, etc.. Transplanting alone costs about 15 per cent of total rice production cost and enhances crop duration by 7-10 days. Land preparation for transplanted rice consumes large quantity of water i.e., about 20-40 per cent of total water required by rice crop. Direct seeding, however, offers certain advantages like labour saving, timely sowing, less drudgery, early crop maturity by 7-10 days, low water requirements, high tolerance to water deficit, timely sowing, low production cost, less methane emission, etc. In direct seeding, there are two methods (dry and wet seeding) based on the physical condition of seedbed and seed (pre germinated or dry). Dry seeding is practiced on rainfed lowland, upland and flood prone areas. Drum seeding is another option to transplantation, as it requires less labour and performs as well as transplanting in many situations (Yadav and Singh, 2006) [1]. Integrated nutrient management approach is flexible and minimizes use of chemicals but maximize use careful and efficient use of all key sources of plant nutrients and improve the soil health. To meet ever demand of increasing population INM is the best option. INM has been found to boost rice yields significantly by reducing fertilizer losses to environment and regulating nutrient delivery, resulting in high nutrient use efficiency (Parkinson *et al*., 2013) [2]**.** Integrated application of organics and inorganic exhibited higher grain and straw yields of rice with high nutrient uptake over application of inorganic only. Integrating nutrient management (INM) aims for careful and efficient use of all key sources of plant nutrient in a holistic way (Farouque and Takeya, 2007) [3]**.**

Materials and methods
The experiment was conducted at Agronomy Research Farm of Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Ayodhya (Uttar Pradesh).

Geographically, experimental site (Kumarganj) is located at $26^{0}47$ North latitude and $82^{0}12^{`}$ East longitude and altitude of about 113 meters above from mean sea level in Indo-Gangetic regions of Uttar Pradesh. The experiment was carried out in Randomized Block Design with eight different treatment combinations and replicated four times. Transplanted rice with 100% RDF (120N:60P2O5 :60K2O Kg/ha.) through IF, Transplanted rice with 75% RDF through IF + 25% RDN through FYM, Transplanted rice with 75% RDF through IF + 25% RDN through compost, Transplanted rice with 50% RDF through inorganic + 50% RDN through FYM, Drum seeded rice with 100% RDF (120N:60P2O5 :60K2O Kg/ha.) through IF, Drum seeded rice with 75% RDF through IF + 25% RDN through FYM, Drum seeded rice with 75% RDF through IF + 25% RDN through compost and Drum seeded ricewith50% RDF through inorganic + 50% RDN through FYM. Nursery raising for transplanting and DSR through drum seeder was done at the same day. Incorporation of FYM, compost and basal dose of fertilizer were applied by placement method and incorporated well prior to sowing. Top dressing of urea was done at 40 DAS/DAT and 80 DAS/DAT respectively. Soil samples were taken before the experiment and after the harvest of crop. Plot-wise analysis of soil samples for organic carbon, available phosphorus and potassium were conducted for each of the treatment. Yield parameters and biological yield and is expressed as per cent on dry weight basis, economic indices were calculated as per the standard procedure.

Results and Discussion

Growth parameters

Plant height (cm)

Plant height (Table-1) was significantly influenced by different methods of planting on rice crop as well as Integrated nutrient management. Plant height was significantly higher under M1 Transplanted rice (86.13 cm) followed by M2-DSR-wet (78.70 cm) and M3-DSR-dry (99.6 cm). Application of 100% RDF (120N:60P_2O_5:60K_2O Kg/ha.) achieved higher plant height which was significantly taller than all the treatment. This was might be due to rapid growth and development of plant cells due to adequate supply of nutrient to the growing plants. The findings of present investigation are supported by Jaiswal and Singh 2000 [4].

Number of shoots hill^{-1}

The scrutiny of result for number of shoots hill^{-1} indicates that the crop with transplanted rice recorded higher number of shoots hill^{-1} because of better soil condition and puddling which led increasing number of shoots.

The result reveals that number of shoots hill^{-1} of crop fertilized with 100% RDF (120N:60P_2O_5:60K_2O Kg/ha.) recorded higher number of tillers might be due to better availability of the nutrients and other growth input required for plants. Higher availability of nutrient facilitated proper synchronized tillering. Similar results were reported Singh *et al.* 2008 [5]. Azad and Lehriya (2001) [6], and Verma *et al.* (2017) [7].

Leaf area index

Higher LAI was found under the transplanted rice was mainly because of increase number of leaf expansion produced due to higher dry matter and more number shoots available for photosynthesis. Application of 100% RDF (120N:60P_2O_5:60K_2O Kg/ha.) produced higher LAI because of higher number of expended leaves was available for photosynthesis as the rest of available nutrients. Similar result were reported by Yadav and Singh 2006 [8].

Dry matter accumulation (g m^{-2})

Transplanted rice recorded significant higher dry matter accumulation over drum seeded rice. Dry-matter accumulation was slow initially. It was recorded significantly higher under 100% RDF (120N:60P_2O_5:60K_2O Kg/ha.) through IF over rest of the INM. At 90 DAS/DAT RDF 100% (120N:60P_2O_5 :60K_2O Kg/ha.) recorded higher dry matter accumulates over 50% RDF through inorganic + 50% RDN through FYM (N_4) and at par with rest INM practices. These results are in close conformity with of Gill *et al.* 2006 [9], Shan *et al.* 2012 [10], Awang *et al* (2016) [11] and Moe *et al.* (2017) [12].

Day Taken to 75% Flowering and maturity

It is evident from data that the 75% flowering and maturity in rice was affected significantly due to various treatments. Transplanted rice recorded significantly higher days to 75% flowering and maturity over drum seeded rice.

There was significant increase in 75% flowering and maturity with 100% RDF (120N:60P_2O_5:60K_2O Kg/ha.) over rest INM practices. The finding of present investigation is in close proximity of those obtained by Shanti *et al.*, 1998 [13]. and Budhar and Tamil selvan, 2001 [14]. Verma *et al.* (2017) [15].

Table 1: Growth parameters influenced by planting method and integrated nutrient management

Treatment	Growth parameters				
	Plant height (cm)	Number of shoots hills^{-1}	Dry matter accumulation (gm^{-2})	Leaf area index	Day Taken to 75% Flowering
Method of planting					
Transplanting	1261.38	8.28	1261.38	3.97	88.60
Drum seeder	1129.68	7.28	1129.68	3.53	86.95
SEm±	17.48	0.14	17.48	0.062	0.30
CD at 5%	51.43	0.41	51.43	0.184	0.88
Integrated nutrient management					
100% RDF (120N : 60 P_2O_5 : 60K_2O Kg/ha.) through IF (N_1)	1335.35	8.40	1335.35	3.97	89.80
75% RDF through IF + 25% RDN through FYM (N_2)	1192.15	8.00	1192.15	3.53	88.9
75% RDF through IF + 25% RDN through compost (N_3)	1159.05	7.80	1159.05	0.062	87.40
50% RDF through inorganic + 50% RDN through FYM (N_4)	1095.55	7.00	1095.55	0.184	86.00

SEm±	24.73	0.20	24.73	3.97	0.84
CD at 5%	72.74	0.58	72.74	3.53	2.73

Nutrient uptake

It is evident from the data that N, P and K uptake in rice grain and straw was affected significantly due to various treatments. Transplanted rice has significant more N, P and K uptake over drum seeded rice. Among integrated nutrient practices 100% RDF (120N:60P_2O_5:60K_2O Kg/ha.) through IF (N_1) recorded significantly superior over rest of INM practices. The higher N, P and K uptake in grains and straw was found under transplanted rice.

The higher N, P and K uptake in grains and straw was found under transplanted rice. Similar responses were observed by Kumar *et al*. (2007) [16], Kumar *et al.* (2008) [17].

Table 2: Nutrient uptake influenced by planting method and integrated nutrient management.

Treatment	N Uptake		P2O5 Uptake		K2O Uptake	
	Grain	Straw	Grain	straw	Grain	Straw
Method of planting						
Transplanting	63.85	63.62	22.65	16.62	26.05	98.87
Drum seeder	55.85	55.78	19.92	14.88	22.91	87.85
SEm±	1.06	1.04	0.43	0.25	0.34	1.66
CD at 5%	3.12	3.07	1.27	0.74	1.00	4.90
Integrated nutrient management						
100% RDF (120N:60P_2O_5 :60K_2O Kg/ha.) through IF (N_1)	67.73	67.34	24.47	17.77	28.15	105.68
75% RDF through IF + 25% RDN through FYM (N_2)	60.01	59.76	21.27	15.78	24.45	93.12
75% RDF through IF + 25% RDN through compost (N_3)	57.50	57.86	20.44	15.25	23.50	90.33
50% RDF through inorganic + 50% RDN through FYM (N_4)	54.14	53.85	18.97	14.20	21.81	84.32
SEm±	1.50	1.48	0.61	0.35	0.48	2.36
CD at 5%	4.42	4.35	1.80	1.05	1.42	6.94

Conclusion

Transplanted Method of planting was found suitable for higher Plant height (cm), number of shoots hills^{-1}, Dry matter accumulation (gm^{-2}), Leaf area index and Day Taken to 75% Flowering of rice. Application of 100% RDF (120 N: 60 P2O5 :60 K2O Kg/ha.) was found suitable for higher nutrient uptake of rice.

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