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Influence of different nutrient management approaches on growth parameters of dry direct seeded rice (Dry- DSR) in TBP command area

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Abstract
An experiment was conducted during *kharif*-2016 at ARS, Dhadesugur with ten treatments and three replications to evaluate the response of dry direct seeded rice to major nutrients in a *vertisol* of Tunga Bhadra Project command area. The Results revealed that significantly higher plant height and number of tillers were recorded with nutrients applied through Site Specific Nutrient Management approach fallowed by Soil Test Crop Response approach compared to absolute control. Whereas, the treatments Soil Test Laboratory method and farmer's practice showed on par with each other at 60 DAS, 90 DAS,120 DAS and Harvest. Significantly higher dry matter production was recorded at 120 DAS of crop. The higher dry matter was recorded in site specific nutrient management followed by recommended dose of fertilizer K Omission with recommended dose of N and P as per Soil Test Laboratory method.

Keywords: Site specific nutrient management, soil test crop response, plant height, dry matter

Introduction
Rice is a vital food to more than half of the world's population. It is the most important food grain in the diets of hundreds of millions of people in Asia, Africa and Latin America living in the tropics and subtropics. In India, rice is grown under 4 major ecosystems *viz*., irrigated (21.0 m ha), rainfed lowland (14 m ha), rainfed upland (6 m ha) and flood prone area (3 m ha). More than half of rice area (55%) is rainfed and distribution wise 80 per cent of the rainfed rice areas are in eastern India, making its cultivation vulnerable to vagaries of monsoon (Anonymous, 2006) [1].

In India, DSR is becoming a popular rice cultivation practice among the farmers of command areas of Tungabhadra (TBP) in Ballery, Raichur and Koppal districts of Karnataka. The tail end farmers do not get sufficient water at right time to cultivate the rice. Due to declining resources, farmers are forcing to complete transplanting within this period which is not possible with limited labour, machinery *etc*. Under late onset of monsoon conditions and insufficient water in barrages, canal water may become erratic and untimely leading to delayed transplanting (beyond August).

The actual yield potentiality of dry-DSR practice had not been achieved because of existing fertilizer recommendation; it consists of fixed rates and timing of N, P and K for vast areas of production. Such recommendations are in practice over the years in large areas. But crop growth and crop need for supplemental nutrients are strongly influenced by genotype, soil type and climate which can vary greatly among fields, seasons and years. The nutrient requirement of direct-seeded rice is probably lower than that of transplanted rice during early growth stages. TBP areas in our state are known for using imbalance dose of nutrients with higher tendency for N application. For achieving a definite yield target of a crop, a definite quantity of nutrients must be applied to the crop and this requirement of nutrients can be calculated by taking into consideration the contribution of native soil available nutrients and applied fertilizer nutrients. Keeping this in view, the study on Response of dry Direct Seeded Rice (DSR) to major nutrients in TBP command area is planned.

Material and Methods
The experiment was carried out on clayey soil during *kharif*-2016 at ARS Dhadesugur to study the Response of dry Direct Seeded Rice (DSR) to major nutrients as influenced by different

nutrient approaches. Initially the soil of experimental plot had pH of 8.23, EC of 0.51 dS m^{-1}, organic carbon of 4.6 g kg^{-1} and available nitrogen, phosphorus and potassium were 167, 55 and 300 kg ha^{-1}, respectively.

The experiment was laid out in randomized block design with the ten treatments and three replications. Five plants from net plot were selected at random and tagged for the purpose of recording various observations. Observations on growth parameters at five distinct stages of crop growth *viz.*, 30, 60, 90, 120 DAS and at harvest were recorded. Based on observations recorded on five tagged plants, average per plant was calculated.

Results and Discussion

The data on growth parameters *viz*., plant height, number of tillers per hill and total dry matter production of dry DSR as influenced by different treatments at different growth stages are presented in fallowing headings.

Plant height (cm)

The data pertaining to plant height at different crop growth stages of dry DSR as influenced by the different nutrient management approaches presented in Tables 1 and Figure 1. Results indicate that, the dry DSR crop showed a good response in terms of plant height with different nutrient management approaches. The significant difference was noticed in 60, 90, 120 DAS and at harvest. At 30 DAS significantly difference was not observed.

At 60 DAS, the treatment T_2: SSNM method recorded significantly taller plants (57.1 cm) followed by STCR method (56.2 cm) compared to absolute control (52.3 cm). Whereas, the treatments STL method (55.7 cm) and farmer's practice (55.5 cm) showed on par with each other. The treatment T_2: SSNM method recorded significantly taller plants (97.2 cm) and T_9: STCR method (94.1 cm) followed by T_5: STL method (93.1 cm) compared to T_1: absolute control (80.2 cm) at 90 DAS. At 120 DAS, the treatment SSNM method recorded significantly taller plants (99.8 cm) followed by STCR method (97.7 cm) compared to absolute control (84.9 cm). Whereas, the treatments STL method (95.7 cm) and farmer's practice (95.0 cm) showed on par with each other. Similar trend was also observed at harvest. The plant height was found to be increasing from 86.3 cm in control (T_1) 101.1 cm in SSNM method (T_2) and in STCR method (T_9) 96.8cm followed by STL method (T_5) 94.7 cm at harvest.

Number of tillers per m^{-2}

The data pertaining to number of tillers at different stages of dry DSR crop as influenced by the different treatments are presented in Table 2 and Figure 2.

Among the treatment there was a significant variation were observed in number of tillers per m^{-2} as influenced by different treatments at all the growth stages. At 30 DAS, the treatment SSNM recorded higher number of tillers per m^{-2} (210.00) followed by STCR (200.00) compared to absolute control (156.67). At 60 DAS, the treatment SSNM method showed significantly higher number of tillers per m^{-2} (552.92) and STL method (504.48) followed by STCR approach (488.07) compared to control (392.29). Number of tillers per m^{-2} at 90 DAS was significantly higher with the SSNM method 690.00 followed by STCR approach 653.33, RDF (623.33) and STL method (603.33). SSNM method showed significantly higher number of tillers per m^{-2} (956.67) and STCR approach (916.67) followed by STL method (883.33) compared with a control (666.67) at 120 DAS. At harvesting stage, number of tillers per m^{-2} recorded significantly higher with the SSNM method (1083.33) followed by STCR approach (976.67), which was on par with farmer's practice (960.00).

Dry matter production (g $plant^{-1}$)

Dry matter production in dry-DSR at different crop growth stages as influenced by different nutrient management approaches was differed significantly and is presented in Table 3 and Figure 3.

At 60 DAS, significantly higher dry matter production (7.83 g $plant^{-1}$) was found with recommended dose of fertilizer followed by N Omission with recommended dose of P and K as per STL method (6.99 g $plant^{-1}$) as compared to absolute control (3.59 g $plant^{-1}$).At 90 DAS, significantly higher dry matter production was recorded in SSNM approach (29.9 g $plant^{-1}$) and it was found on par with recommended dose of fertilizer (29.9 g $plant^{-1}$) followed by K Omission with recommended dose of N and P as per STL method (28.1 g $plant^{-1}$). Lowest dry matter was recorded in absolute control (13.8 g $plant^{-1}$).Significantly higher dry matter production was recorded at 120 DAS of crop. The higher dry matter was recorded in SSNM (46.6 g $plant^{-1}$) followed by recommended dose of fertilizer K Omission with recommended dose of N and P as per STL method (44.4 g $plant^{-1}$) and lower dry matter production was recorded in absolute control (23.2 g $plant^{-1}$). At harvest, significantly higher dry matter production was noticed in SSNM approach (60.3 g $plant^{-1}$) followed by STCR approach (56.5 g $plant^{-1}$) and lowest dry matter production was recorded in absolute control (28.3 g $plant^{-1}$).

Table 1: Plant height as influenced by major nutrients at different growth stages of dry-DSR

Treatment	Plant height (cm)				
	30 DAS	60 DAS	90 DAS	120 DAS	At harvest
T_1	21.1	52.3	80.2	84.9	86.3
T_2	26.6	57.1	97.2	97.7	99.1
T_3	24.2	54.6	89.6	92.9	94.2
T_4	24.8	55.1	89.5	93.9	95.2
T_5	25.2	55.7	93.1	95.7	97.0
T_6	22.3	53.3	82.5	87.8	89.1
T_7	22.9	54.3	87.2	91.9	93.3
T_8	25.3	53.6	82.6	90.1	91.5
T_9	24.7	56.2	94.1	99.8	101.1
T_{10}	22.9	55.5	92.3	95.0	96.4
S.Em±	1.1	0.2	1.2	0.4	0.4
CD@5%	NS	0.6	3.4	1.3	1.2

T_1:	Absolute Control	T_6:	N Omission with Recommended Dose of P and K as per STL method*
T_2:	SSNM approach targeted yield of 70 q ha^{-1}	T_7:	P Omission with Recommended Dose of N and K as per STL method*

T_3:	Recommended Dose of Fertilizer (Urea, DAP and MoP)	T_8:	K Omission with Recommended Dose of N and P as per STL method*
T_4:	Recommended Dose of Fertilizer (Urea: SSP: MoP)	T_9:	STCR method approach targeted yield of 70 q ha^{-1}
T_5	Soil Test Ratings method (STL) (Urea: SSP: MoP)	T_{10}	Farmer's Practice
Note: * Fertilizers were applied using Urea: SSP: MoP			

Table 2: Number of tillers per m^{-2} as influenced by major nutrients at different growth stages of dry-DSR

Treatment	Number of tillers per m^{-2}				
	30 DAS	60 DAS	90 DAS	120 DAS	At harvest
T_1	156.67	392.29	503.33	666.67	673.33
T_2	210.00	552.92	690.00	956.67	1083.33
T_3	191.67	451.82	600.00	820.00	873.33
T_4	190.00	455.36	623.33	840.00	906.67
T_5	190.00	504.48	603.33	883.33	940.00
T_6	190.00	355.21	526.67	733.33	793.33
T_7	156.67	455.68	580.00	800.00	846.67
T_8	170.00	371.41	570.00	770.00	820.00
T_9	200.00	488.07	653.33	916.67	976.67
T_{10}	173.33	465.05	583.33	856.67	960.00
S.Em±	8.95	10.47	22.83	9.77	20.15
CD@5%	26.59	31.11	67.84	29.02	59.86

T_1:	Absolute Control	T_6:	N Omission with Recommended Dose of P and K as per STL method*
T_2:	SSNM approach targeted yield of 70 q ha^{-1}	T_7:	P Omission with Recommended Dose of N and K as per STL method*
T_3:	Recommended Dose of Fertilizer (Urea, DAP and MoP	T_8:	K Omission with Recommended Dose of N and P as per STL method*
T_4:	Recommended Dose of Fertilizer (Urea: SSP: MoP)	T_9:	STCR method approach targeted yield of 70 q ha^{-1}
T_5	Soil Test Ratings method (STL) (Urea: SSP: MoP)	T_{10}	Farmer's Practice
Note: * Fertilizers were applied using Urea: SSP: MoP			

Table 3: Total dry matter production (g $plant^{-1}$) as influenced by major nutrients at different growth stages of dry-DSR

Treatment	30 DAS	60 DAS	90 DAS	120 DAS	At harvest
T_1	2.20	3.59	13.78	23.21	28.30
T_2	3.80	5.57	29.89	41.85	60.25
T_3	2.80	7.83	29.89	46.57	41.80
T_4	3.30	6.26	24.33	37.20	47.09
T_5	3.40	4.90	19.04	33.01	52.96
T_6	2.40	6.99	21.63	30.22	38.28
T_7	2.60	6.68	25.97	39.99	50.61
T_8	3.20	7.70	28.05	44.38	45.33
T_9	3.40	6.02	23.40	36.73	56.48
T_{10}	2.90	6.03	23.43	37.27	46.50
S.Em±	0.05	0.05	0.40	0.58	0.76
CD@5%	1.69	1.27	0.64	0.51	0.46

T_1:	Absolute Control	T_6:	N Omission with Recommended Dose of P and K as per STL method*
T_2:	SSNM approach targeted yield of 70 q ha^{-1}	T_7:	P Omission with Recommended Dose of N and K as per STL method*
T_3:	Recommended Dose of Fertilizer (Urea, DAP and MoP)	T_8:	K Omission with Recommended Dose of N and P as per STL method*
T_4:	Recommended Dose of Fertilizer (Urea: SSP: MoP)	T_9:	STCR method approach targeted yield of 70 q ha^{-1}
T_5	Soil Test Ratings method (STL) (Urea: SSP: MoP)	T_{10}	Farmer's Practice
Note: * Fertilizers were applied using Urea: SSP: MoP			

Crop growth is the dynamic process which is affected by the complex interactions occurring between the environment and the physiological processes and the soil fertility factors. Plant growth parameters *viz.*, plant height and number of tillers per meter square was significantly influenced by the variable fertilization at all the crop growth stages except at 30 DAS. However, it is pertinent to mention herewith that the imposition of treatments was made at basal and that might be the probable reason for observing no significant influence of treatments on rice growth parameters at the early crop growth stages. On the other hand, the treatments that received higher N application have responded positively with higher plant height and higher number of tillers per meter square. Similar observations of increase in the plant height of rice due to increased nitrogen applications were also reported by Ramesh and Chandrasekaran (2007) [5]. This can be attributed to the beneficial effect of nitrogen on the growth of plant as revealed by the several researchers. Nitrogen is associated with the increase in protoplasm, cell division and cell enlargement (Tisdale *et al*., 1985) [6]; might also enhance vegetative growth resulting from cell size and meristematic activity (Haefele, 2008) [2]. Adequate nitrogen supply increases the amount of cell plasma and chlorophyll which is the factor for the growth of the plants (Kou and Chen, 1980) [3].

The number of tillers per meter square was found significant at all the crop growth stages except at 30 DAS. Successive increase in tillers at all the crop growth stages might be due to continuous availability of the nitrogen owing to split application. Kumar *et al.* (2007) [4] have reported that split application of nitrogen in paddy will take care of the continuous supply of nitrogen to paddy crop.

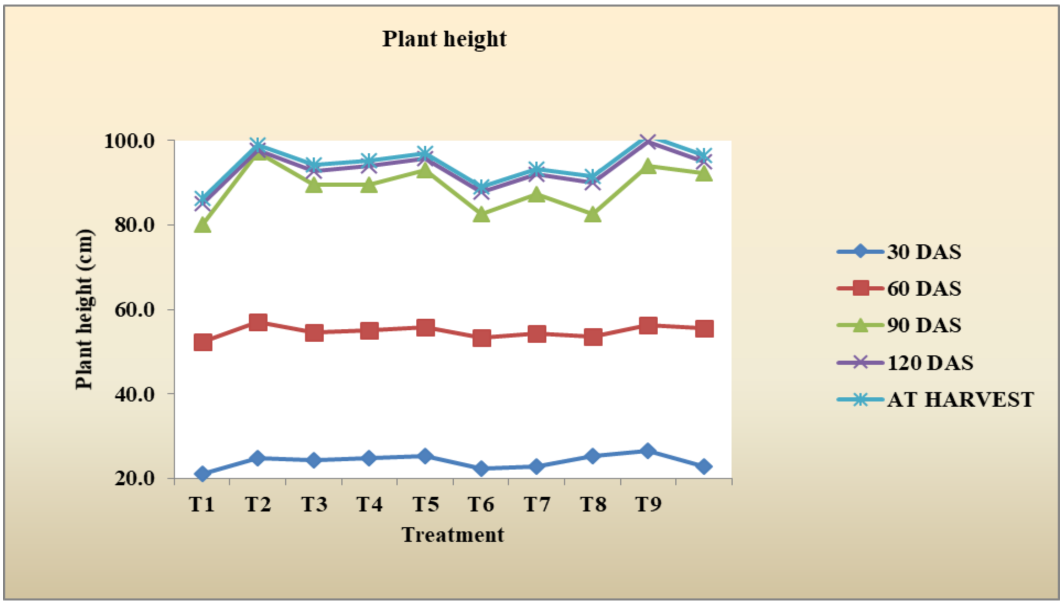

Fig 1: Plant height as influenced by major nutrients at different growth stages of dry-DSR

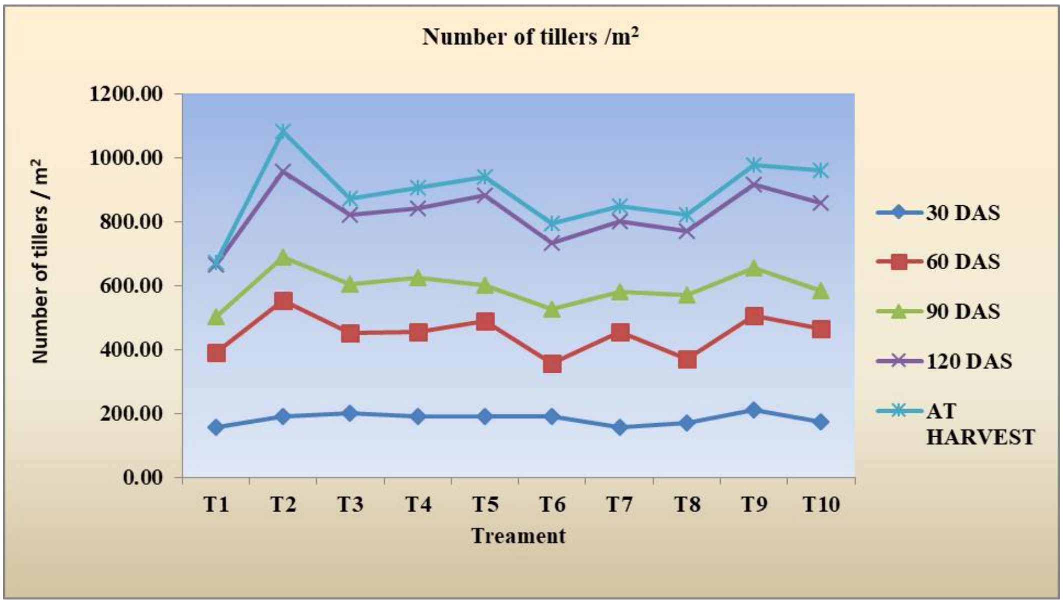

Fig 2: Number of tillers per m^{-2} as influenced by major nutrients at different growth stages of dry-DSR

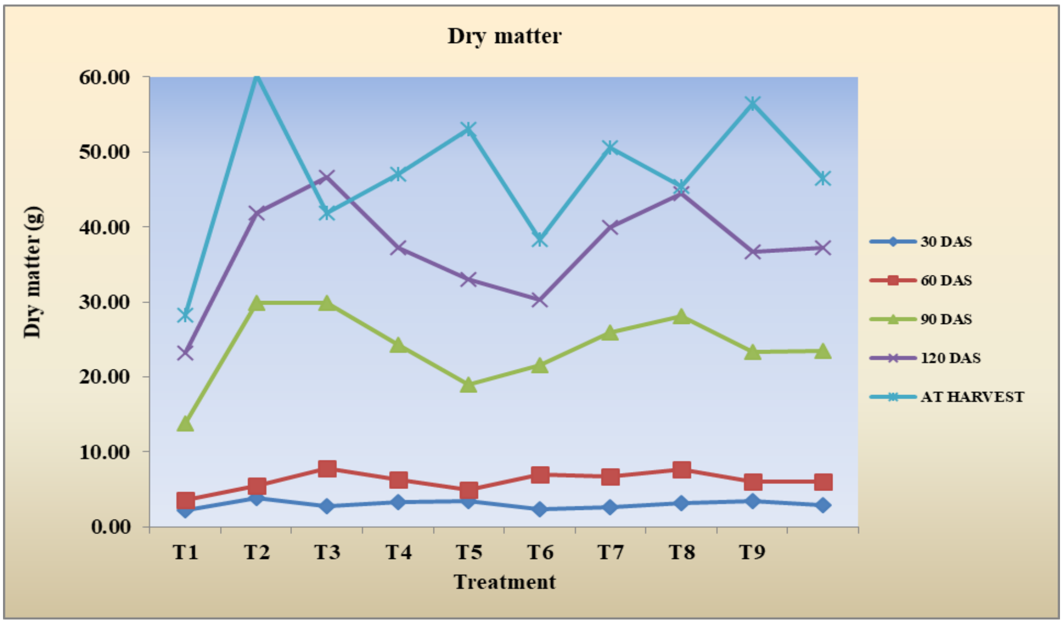

Fig 3: Total dry matter production (g $plant^{-1}$) as influenced by major nutrients at different growth stages of dry-DSR

Conclusions
The application of nutrients through SSNM approach produced significantly more in plant height, number of tillers per m^{-2} and total dry matter production as compared to absolute control, RDF and STL. However, it was on par with STCR approach.

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