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Growth Yield and Nutrient Status of Rice Soil in Response to Genotypes and Levels of Nitrogen Under Different Cultivation Techniques

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Abstract
A field experiment was conducted during rainy seasons of 2013 and 2014 at Agricultural college farm, Raichur, India to study the influence of varieties and nitrogen levels on growth, yield and nutrient status of rice soil under transplanted rice (TPR) and direct seeded rice (DSR) cultivation. The treatments included three rice genotypes [‘BPT 5204’, ‘Gangavathi sona’ and ‘JKPH 3333’) and three nitrogen levels, [75%, 100% and 125% RDN per ha. (100% RDN is 150 kg/ha)] the experiment was laid out in a split plot design. Transplanting method recorded higher growth components and grain yield than direct seeding. The yield increased with the increase in nitrogen level and reached maximum with 125 per cent RDN. Plant height, leaf area index and dry matter production were the highest with JKPH 3333 + 125 % RDN at all the stages during both the years of study. Nitrogen uptake by grain and straw were also significantly higher in the JKPH 3333 + 125 % RDN. Increasing levels of nitrogen progressively enhanced nitrogen uptake by grain and straw. Genotypes and nitrogen levels interaction was non significant and the highest grain yield and economics were recorded with ‘JKPH 3333’ at 125 % RDN/ha and it was found to be optimum combination.
Keywords: Direct seeded rice, Transplanted rice, Nitrogen levels, Genotypes

INTRODUCTION:

Rice *(Oryza sativa* L.) is the principal food for Indian people, being grown in an area of 43.95 m ha with an annual production of about 106.54 million tons and the productivity is about 2.37 tonnes per ha (Anon., 2015). In Karnataka, rice is cultivated in command areas of Cauvery, Tungabhadra and Upper Krishna, where conventional puddling and transplanting are the major system of cultivation. In Western Ghats and high rainfall areas, the rice is cultivated as drill sown. The total area under rice in Karnataka is 1.42 m ha with an annual production of 3.5 million tonnes and the productivity is 2.63 tons per ha (Anon., 2015). Scarcity of freshwater resources in the world’s leading rice-producing countries, such as, China and India is limiting the production of the flooded rice crop. Since more rice needs to be produced with less and less water to feed the ever-growing population, it needs judicious water management practices and suitable water-saving technologies in rice cultivation (Belder *et al*., 2005). Several such technologies like saturated soil culture, alternate wetting and drying, system of rice intensification, direct seeding and aerobic rice have been developed in recent years. These approaches are receiving increasing attention because they increase the water-use efficiency, mainly by reducing unproductive seepage and percolation losses and evaporation (Belder *et al*., 2005 and Bouman *et al*., 2005). Specific cultivars were bred in china for aerobic rice. The results of trials on such cultivars showed that the yields were double that of traditionally grown upland rice, but were 20-30 per cent lower than that of lowland rice cultivars under flooded conditions. University of Agricultural Sciences (UAS), Bangalore has developed six cultivars of aerobic rice by cross-breeding a local variety and IR 64, which require almost half the water needed to grow conventional varieties. The yield is about 5.5 tonnes/ha, on par with the traditional varieties. Research is under way to develop special aerobic and nutrient-responsive varieties across the rice growing countries. In flooded rice with saturated anaerobic soils, ammonium is the dominant form of available N. In aerobic systems, on the other hand, the dominant form of N is nitrate. The application of irrigation water will create soil moisture conditions close to saturation immediately following irrigation and below field capacity a few days later. These alternate moist-dry soil conditions may stimulate nitrification- denitrification process, resulting in a loss of nitrogen through N_2 and N_2O (Prasad, 2005). The differences in soil N dynamics and pathway of N losses between flooded and aerobic systems may result in different fertilizer-N recoveries. With even high nitrogen applications in aerobic rice, grain filling may be limited by a low contribution of post-anthesis assimilates (Zhang *et al*., 2009). Of late, many studies indicated the response of high-yielding rice varieties to nitrogen above the recommended dose under flooded condition as well (Rao *et al*., 2011). Keeping this in view, an attempt was made to evaluate the response of rice genotypes to different levels of nitrogen under different cultivation techniques.

MATERIAL AND METHODS:

The experiment on performance of rice genotypes under transplanted and direct seeded conditions at different nitrogen levels was undertaken during *kharif* 2013 and 2014. The field experiments were conducted at Agricultural college farm, Raichur. It is situated on the latitude of 160 15' North, longitude of 770 21' East and at an elevation of 389 meters above mean sea level and is located in North Eastern Dry Zone of Karnataka. During the crop period 566.7 mm rainfall was received in the first year as against the decennial average of 752 mm. In the second year 661.3 mm rainfall was received. Soil was medium black and clay loam in texture, organic carbon (0.69 %) and available nitrogen (247.32 kg/ha), available phosphorous (27.91 kg/ha) and available potassium (345.68 kg/ha). Treatments consisting of 2 establishment methods (transplanting and direct seeded) in main plots and the combinations of 3 varieties ['BPT 5204', 'Gangavathi sona' and 'JKPH 3333'] and 3 nitrogen levels [75%, 100% and 125% RDN per ha. (100% RDN is 150 kg/ha)] in subplots were tested in a split-plot design and replicated thrice. Spacing of 25X10 cm was followed in both the methods. In direct seeded rice nitrogen was applied in four equal splits (25 % each at sowing, 25, 50 and 75 DAS), and full dose of P and K (75 kg ha^{-1}) was applied at sowing. A blanket application of zinc sulphate @ 25 kg ha^{-1} basally was adopted. In transplanted rice, as per the treatments nitrogen was applied in 3 splits (50 % at transplanting, 25 % each at 30 and 60 DAT) and full dose of P, K and ZnSO4 was applied at one week after transplanting. The experimental area was ploughed twice with tractor drawn cultivator and levelled with leveling blade to obtain the desired tilth for direct seeding of rice seeds. The seed of rice was directly sown in rows in the non puddled and non flooded soil on 14 July, 2013 and 4th July, 2014 during first and second year respectively, in case of transplanted rice, seedlings were selected from the nursery bed sown on same day of sowing direct seeded plots and seedlings were transplanted (30 days old) with a spacing of 25 cm x 10 cm. Two seedlings were placed per hill during transplanting (13-8-2013 and 3-8-2014). Thinning and gap filling were done at 10 DAS to maintain the uniform plant stand in all the plots. Weeds in the experimental plots were controlled by application of Pendimethalin 30 EC @ 1.0 kg a.i. ha^{-1} at 3 days after sowing as pre-emergent and Bispyribac sodium 10 % SL @ 25 g a.i. ha^{-1} was sprayed at 20 days after sowing as early post-emergent, hand weeding was done thrice at 25, 50 and 75 DAS for control of weeds. Irrigations were given to the crop as and when the crop did not receive rainfall for a continuous period of 7-10 days. Stem borer and bacterial leaf blight were observed during *kharif*, 2013 and 2014, they were controlled by spraying Monocrotophos (1000 ml ha^{-1}) and Copper oxychloride (3 g/litre) + Streptomycine sulphate (0.5 g/litre). In transplanted rice to control leaf folder and stem borer, Monocrotophos @ 1000 ml ha^{-1} was sprayed at 25 and 50 days after transplanting and one spray of Streptomycin sulphate @ 60 g ha^{-1} was taken up to control the bacterial leaf blight. Similarly to control brown plant hopper, one spray of Buprofezin and DDVP @ 625 ml and 625 g ha^{-1} were taken up during both the years of study. The crop was harvested on 6th December 2013 during first year and on 2nd December 2014 during the second year. The data recorded on various growth and yield parameters of rice crop were analysed following standard statistical analysis of variance procedure as suggested by Gomez (1972).

RESULTS AND DISCUSSION

Growth attributes

Plant height and leaf area index (LAI) tended to increase with advance in the age of crop up to flowering (Table 1). Significant difference was noticed in plant height with planting methods. Among different planting methods, significantly higher plant height was recorded in transplanted rice (18.9, 39.9, 63.1 and 64.9 cm) compared to direct seeded rice (13.5, 24.5, 29.7 and 31.8 cm) at 60, 90, 120 DAS and at harvest, respectively. These results are in conformity with the findings of Hanson *et al*. (1990). They reported that rice is a semi-aquatic plant that is commonly grown under flooded conditions and responds well to adequate water supply and is better under puddled soil. The tallest plants were observed in JKPH 3333 with 125 % RDN (58.4 cm) at harvest. These results are in conformity with the findings of Om *et al.* (2000). The increasing N doses from 150 to 200 kg ha^{-1} could not register significant increase. Reddy *et al*. (2007) reported that increased rates of N application significantly improved the plant height as compared to control.

Significant differences in leaf area index (Table 2) with different planting methods. Higher LAI was observed in transplanted rice (6.16) compared to that of direct seeded rice (4.16) at 120 DAS. Similar trend was observed in earlier growth stages.The highest LAI (6.31) at 90 DAS was recorded in JKPH 3333 with 125 % RDN when compared to other combinations of genotypes and nitrogen levels at 90 DAS and at all the growth stages. Which might be perhaps due to more number of green leaves per hill.

Dry matter production, particularly in reproductive parts is an important yield contributing character and the basic vegetative phase is essential for the development of reproductive organs. Although, the dry matter production in general is the indicative of the efficiency of the genotypes, the pattern in which it is distributed in different plant parts would give a better understanding of the genotype. Total dry matter production g hill^{-1}

(Table 3) was significantly higher in case of transplanted rice (68.37 g hill^{-1}) as compared to that of direct seeded rice (52.47 g hill^{-1}) at harvest. Similar trend was also observed during early growth stages. This was mainly due to the increased photosynthetic area and adaptability of plants to anaerobic condition.

Higher dry matter production was noticed in JKPH 3333 with 125 % RDN (76.31 g hill^{-1}) as compared to other combinations of genotypes and nitrogen levels at harvest. Similar trend was also observed in earlier growth stages. This was due to better nitrogen use efficiency by the plant which responded to N application compared to other varieties with varied N levels. These results are in conformity with the findings of Srilaxmi *et al.* (2005) who studied the varietal response and reported maximum dry matter production (1116 g m^{-2}) in Krishnaveni than all other varieties. This was due to the increased N application, these results are in conformity with the findings of Tabar (2012).

Rice grain yield

The data presented in the Table 4 revealed that the grain yield of rice was affected significantly by planting methods. Transplanted rice was found to be significantly superior in getting maximum grain and straw yield (5644 and 6882 kg ha^{-1}, respectively) as compared to direct seeded rice (4571 and 5565 kg ha^{-1}, respectively). Between TPR and DSR, grain and straw yield in DSR was 23 and 24 per cent lower compared to TPR. Research findings elsewhere reported slightly (up to 20 %) lower grain yields under DSR compared to TPR (Singh *et al.*, 2007) due to imbalances in nutrient availability, higher weed infestation and pest and disease incidences. In the present study, leaf and sheath blight disease incidence was noticed under DSR besides, higher weed infestation might have resulted in slightly lower yields under DSR compared to TPR.

Among the genotypes with different levels of nitrogen influenced the grain yield significantly in pooled data. JKPH 3333 + 125 % RDN recorded significantly higher grain yield (5952 kg ha^{-1}) and it was statistically at par with JKPH 3333 + 100 % RDN (5718 kg ha^{-1}). This may be due to the varietal response to nitrogen and higher total biomass production at all the growth stages and N is one of the most important nutrient in increasing yield component of rice, including 1000 grain weight these results are akin to the findings of Fageria *et al.* (2011).

Uptake of nitrogen

In both TPR and DSR sites, N uptake in grain (Table 4) increased with increase in the level of N applied and was more than straw at all the levels of N applied differed significantly among N levels. Higher uptake of N in grain at 125 % RDN in all the genotypes could be ascribed to the reason that the absorbed nitrogen used for rice straw and leaf growth at the tillering stage is transported to the panicles later during grain filling stage (Liu *et al.*, 2007). Therefore, the total amount of N in the straw decreases, while both the panicles and plants increase with progressive development.

Significantly higher nitrogen uptake by the grain, straw and total uptake was recorded by transplanted rice (76.7, 38.6 and 115.4 kg ha^{-1}, respectively) over direct seeded rice (60.9, 30.1 and 90.9 kg ha^{-1}, respectively). Relatively low uptake of nitrogen under DSR conditions compared to TPR conditions, which was reflected by the relatively lower fertilizer-N recovery under aerobic conditions (Belder *et al.,* 2005).

Nitrogen uptake by the rice crop showed significant variations under different genotypes with nitrogen levels. Pooled mean revealed that significantly higher nitrogen uptake by grain, straw and total (85.2, 40.8 and 126.1 kg ha^{-1}, respectively) was observed with application of 125 % RDN to the genotype JKPH 3333. The higher uptake of N with 125 % RDN might be due to application of more amount of N in more number of splits leading to increased uptake. Similar results of significantly increased N uptake with increasing levels of N were reported by Marlar *et al.* (2007). This was also true for grain, straw and total N uptake. With each successive increase in the level of N, P uptake increased significantly up to 100 kg ha^{-1}. Significantly lowest total nitrogen uptake (82.6, 87.6 and 85.1 kg ha^{-1} respectively) was recorded by BPT-5204 + 75 % RDN.

CONCLUSION:

It was concluded that the performance of rice cultivar 'JKPH 3333' was better under transplanting and direct seeding, while 'JKPH 3333' gave higher yield under transplanting method, under limited water conditions, direct seeded rice can be adopted for enhancing water productivity. It appears that a 125 per cent RDN per ha needs to be applied for rice cultivation in North Eastern Dry Zone of Karnataka, especially where native soil N status is low.

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Table 1. Plant height at different growth stages of rice as influenced by planting methods and genotypes with nitrogen levels

Treatment	Plant height (cm)											
	60 DAS			90 DAS			120 DAS			At harvest		
	2013	2014	Pooled	2013	2014	Pooled	2013	2014	Pooled	2013	2014	Pooled
Main plots (M)												
M_1- Transplanted rice	18.5	19.2	18.9	38.6	37.2	37.9	66.9	59.4	63.1	68.0	61.8	64.9
M_2- Direct seeded rice	13.8	13.2	13.5	25.4	23.6	24.5	26.7	32.6	29.7	30.3	33.3	31.8
S.Em.±	**0.3**	**0.7**	**0.5**	**0.8**	**1.3**	**1.0**	**0.8**	**1.5**	**1.6**	**2.0**	**1.4**	**1.4**
C.D. at 5 %	**1.4**	**2.8**	**2.1**	**3.2**	**5.5**	**4.2**	**3.5**	**6.3**	**6.9**	**8.4**	**6.1**	**5.9**
Sub plots (S)												
S_1 - BPT-5204+75 % RDN	13.0	12.0	12.5	24.4	22.2	23.3	36.5	35.5	36.0	38.0	37.0	37.5
S_2 - BPT-5204+100 % RDN	13.5	13.0	13.2	27.2	23.9	25.6	38.5	39.5	39.0	40.4	41.0	40.7
S_3 - BPT-5204+125 % RDN	14.3	14.2	14.2	29.0	28.0	28.5	40.3	42.5	41.4	42.6	43.9	43.3
S_4 - Gangavathi sona+75 % RDN	16.5	15.3	15.9	30.2	29.6	29.9	44.5	45.6	45.0	46.8	46.9	46.9
S_5 - Gangavathi sona+100 % RDN	16.9	16.9	16.9	30.4	30.9	30.7	46.3	46.5	46.4	49.4	48.0	48.7
S_6 - Gangavathi sona+125 % RDN	17.6	17.6	17.6	34.3	33.0	33.6	47.2	49.2	48.2	51.7	50.7	51.2
S_7 - JKPH 3333+75 % RDN	17.5	18.0	17.8	36.5	34.5	35.5	52.8	49.8	51.3	54.7	51.7	53.2
S_8 - JKPH 3333+100 % RDN	18.0	19.0	18.5	37.3	34.5	35.9	55.6	51.8	53.7	57.4	53.2	55.3
S_9 - JKPH 3333+125 % RDN	18.4	19.7	19.1	38.5	36.8	37.7	59.5	53.9	56.7	61.4	55.4	58.4
S.Em.±	**0.4**	**0.4**	**0.3**	**0.9**	**1.0**	**0.6**	**1.4**	**1.2**	**1.0**	**1.5**	**1.2**	**0.9**
C.D. at 5 %	**1.1**	**1.0**	**0.9**	**2.7**	**2.9**	**1.8**	**3.9**	**3.6**	**2.8**	**4.3**	**3.6**	**2.7**
Interaction (M X S)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

100 % RDN: Recommended dose of nitrogen (150 kg ha^{-1}), NS: Non significant

Table 2. Leaf area index at different growth stages of rice as influenced by planting methods and genotypes with nitrogen levels

Treatment	Leaf Area Index (LAI)											
	60 DAS			90 DAS			120 DAS			At harvest		
	2013	2014	Pooled	2013	2014	Pooled	2013	2014	Pooled	2013	2014	Pooled
Main plots (M)												
M_1- Transplanted rice	3.39	3.36	3.38	5.67	5.39	5.53	6.10	6.23	6.16	3.37	3.39	3.38
M_2- Direct seeded rice	3.09	2.94	3.02	4.52	4.80	4.66	4.10	4.22	4.16	2.61	2.64	2.62
S.Em.±	**0.07**	**0.04**	**0.04**	**0.06**	**0.11**	**0.07**	**0.13**	**0.11**	**0.09**	**0.15**	**0.13**	**0.14**
C.D. at 5 %	**0.29**	**0.17**	**0.19**	**0.27**	**0.48**	**0.29**	**0.58**	**0.48**	**0.40**	**0.63**	**0.54**	**0.58**
Sub plots (S)												
S_1 - BPT-5204+75 % RDN	2.49	2.49	2.49	3.84	3.89	3.87	5.21	5.34	5.27	3.03	3.10	3.07
S_2 - BPT-5204+100 % RDN	2.58	2.57	2.57	4.37	4.42	4.39	5.33	5.46	5.39	3.21	3.24	3.23
S_3 - BPT-5204+125 % RDN	2.92	2.87	2.90	5.04	5.20	5.12	5.56	5.69	5.62	3.67	3.69	3.68
S_4 - Gangavathi sona+75 % RDN	2.99	2.92	2.95	4.37	4.43	4.40	4.20	4.34	4.27	2.86	2.88	2.87
S_5 - Gangavathi sona+100 % RDN	3.25	3.10	3.18	5.08	5.25	5.16	4.91	5.05	4.98	2.95	2.97	2.96
S_6 - Gangavathi sona+125 % RDN	3.40	3.31	3.36	5.69	5.76	5.73	5.24	5.38	5.31	3.05	3.05	3.05
S_7 - JKPH 3333+75 % RDN	3.56	3.41	3.49	4.96	5.01	4.98	4.88	5.07	4.97	2.54	2.56	2.55
S_8 - JKPH 3333+100 % RDN	3.84	3.71	3.77	5.99	5.77	5.88	5.25	5.33	5.29	2.72	2.73	2.72
S_9 - JKPH 3333+125 % RDN	4.18	3.97	4.08	6.52	6.10	6.31	5.30	5.37	5.33	2.88	2.93	2.90
S.Em.±	**0.15**	**0.16**	**0.13**	**0.14**	**0.24**	**0.16**	**0.20**	**0.19**	**0.13**	**0.16**	**0.17**	**0.16**
C.D. at 5 %	**0.44**	**0.47**	**0.36**	**0.40**	**0.69**	**0.47**	**0.57**	**0.53**	**0.38**	**0.48**	**0.48**	**0.48**
Interaction (M X S)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

100 % RDN: Recommended dose of nitrogen (150 kg ha^{-1}), NS: Non significant

Table 3. Total dry matter production at different growth stages of rice as influenced by planting methods and genotypes with nitrogen levels

Treatment	Total dry matter production (g hill^{-1})											
	60 DAS			90 DAS			120 DAS			At harvest		
	2013	2014	Pooled	2013	2014	Pooled	2013	2014	Pooled	2013	2014	Pooled
Main plots (M)												
M_1- Transplanted rice	4.17	5.03	4.60	20.38	22.63	21.50	58.84	63.52	61.18	66.27	70.47	68.37
M_2- Direct seeded rice	4.38	5.18	4.78	17.06	19.54	18.30	45.17	48.05	46.61	51.00	53.95	52.47
S.Em.±	**0.04**	**0.15**	**0.09**	**0.37**	**0.38**	**0.24**	**1.09**	**0.76**	**0.29**	**1.11**	**0.49**	**0.71**
C.D. at 5 %	**0.18**	**NS**	**NS**	**1.60**	**1.64**	**1.04**	**4.67**	**3.26**	**1.26**	**4.79**	**2.11**	**3.07**
Sub plots (S)												
S_1 - BPT-5204+75 % RDN	3.35	3.93	3.64	13.75	15.39	14.57	35.22	39.64	37.43	43.37	46.23	44.80
S_2 - BPT-5204+100 % RDN	3.71	4.52	4.11	13.97	15.78	14.87	38.65	42.04	40.34	48.88	51.74	50.31
S_3 - BPT-5204+125 % RDN	3.94	4.76	4.35	14.55	16.83	15.69	41.34	44.50	42.92	52.03	54.89	53.46
S_4 - Gangavathi sona+75 % RDN	3.82	4.59	4.21	16.56	19.56	18.06	48.36	51.31	49.84	55.21	58.54	56.88
S_5 - Gangavathi sona+100 % RDN	4.27	5.28	4.77	18.63	21.39	20.01	51.50	56.34	53.92	59.38	62.95	61.17
S_6 - Gangavathi sona+125 % RDN	4.64	5.75	5.19	19.09	23.26	21.17	55.14	59.00	57.07	66.09	70.00	68.04
S_7 - JKPH 3333+75 % RDN	4.65	5.62	5.13	21.25	23.34	22.29	61.86	65.22	63.54	61.80	65.47	63.64
S_8 - JKPH 3333+100 % RDN	4.90	5.55	5.22	24.59	25.52	25.06	65.63	69.75	67.69	67.22	71.16	69.19
S_9 - JKPH 3333+125 % RDN	5.19	5.95	5.57	26.09	28.71	27.40	70.36	74.27	72.31	73.75	78.88	76.31
S.Em.±	**0.15**	**0.13**	**0.09**	**0.56**	**0.60**	**0.41**	**1.25**	**1.64**	**1.25**	**1.17**	**1.60**	**1.32**
C.D. at 5 %	**0.42**	**0.36**	**0.26**	**1.61**	**1.72**	**1.17**	**3.61**	**4.73**	**3.61**	**3.36**	**4.61**	**3.81**
Interaction (M X S)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

100 % RDN: Recommended dose of nitrogen (150 kg ha^{-1}), NS: Non significant

Table 4. Grain yield and nitrogen uptake by grain, straw and total of rice as influenced by planting methods and genotypes with nitrogen levels

Treatment	Grain yield (kg ha^{-1})			Grain (kg N ha^{-1})			Straw (kg N ha^{-1})			Total (kg N ha^{-1})		
	2013	2014	Pooled	2013	2014	Pooled	2013	2014	Pooled	2013	2014	Pooled
Main plots (M)												
M_1- Transplanted rice	5519	5768	5644	74.0	79.5	76.7	36.5	40.8	38.6	110.5	120.2	115.4
M_2- Direct seeded rice	4532	4610	4571	59.7	62.1	60.9	28.2	31.9	30.1	88.0	93.9	90.9
S.Em.±	**157**	**204**	**158**	**2.5**	**3.8**	**3.0**	**1.1**	**1.0**	**1.0**	**1.4**	**3.1**	**2.1**
C.D. at 5 %	**674**	**878**	**680**	**10.8**	**16.3**	**12.8**	**4.8**	**4.3**	**4.5**	**6.1**	**13.5**	**9.0**
Sub plots (S)												
S_1 - BPT-5204+75 % RDN	4325	4424	4374	55.3	57.4	56.3	27.3	30.2	28.7	82.6	87.6	85.1
S_2 - BPT-5204+100 % RDN	4573	4785	4679	60.3	64.4	62.3	29.2	33.7	31.5	89.5	98.1	93.8
S_3 - BPT-5204+125 % RDN	4730	5053	4892	65.1	71.3	68.2	33.1	37.6	35.4	98.2	108.9	103.5
S_4 - Gangavathi sona+75 % RDN	4547	4735	4641	56.2	60.5	58.4	26.6	32.0	29.3	82.8	92.6	87.7
S_5 - Gangavathi sona+100 % RDN	4983	5145	5064	63.7	67.9	65.8	30.4	34.5	32.4	94.1	102.4	98.2
S_6 - Gangavathi sona+125 % RDN	5344	5464	5404	73.3	77.1	75.2	35.1	38.1	36.6	108.4	115.3	111.8
S_7 - JKPH 3333+75 % RDN	5215	5269	5242	67.3	70.1	68.7	33.3	38.1	35.7	100.6	108.2	104.4
S_8 - JKPH 3333+100 % RDN	5675	5761	5718	77.9	80.5	79.2	37.0	40.3	38.6	114.8	120.8	117.8
S_9 - JKPH 3333+125 % RDN	5835	6069	5952	82.7	87.7	85.2	39.4	42.3	40.8	122.1	130.0	126.1
S.Em.±	**166**	**154**	**107**	**2.5**	**2.4**	**1.9**	**1.9**	**2.2**	**1.7**	**3.7**	**3.8**	**3.0**
C.D. at 5 %	**478**	**444**	**309**	**7.3**	**6.9**	**5.4**	**5.5**	**6.4**	**5.0**	**10.6**	**10.8**	**8.7**
Interaction (M X S)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

100 % RDN: Recommended dose of nitrogen (150 kg ha^{-1}), NS: Non significant

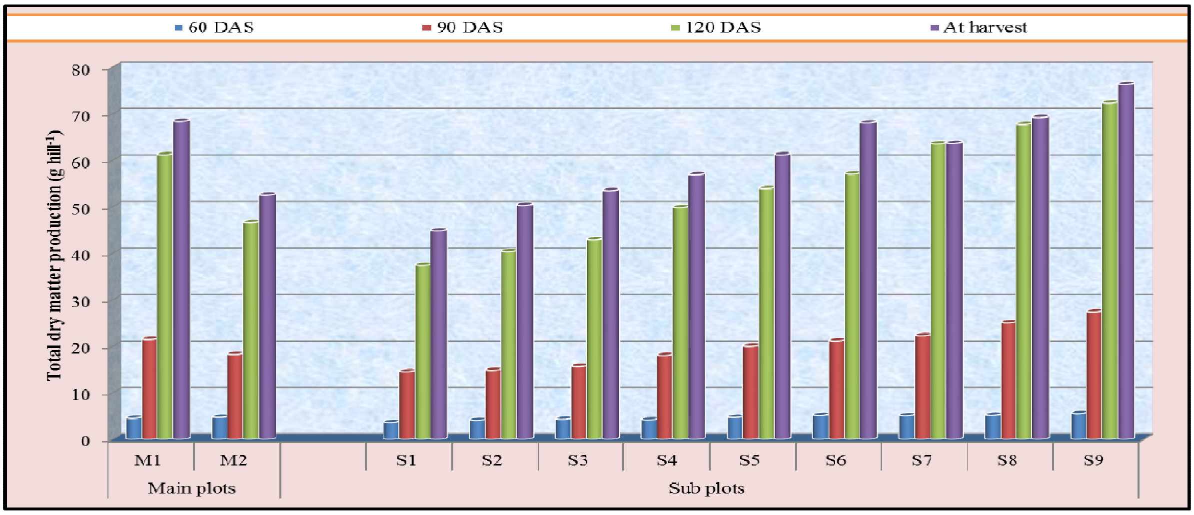

Fig. Total dry matter production at different growth stages of rice as influenced by planting methods and genotypes with nitrogen levels

M_1 (Transplanted Rice) M_2 (Direct seeded Rice) 100 % RDN: Recommended dose of nitrogen (150 kg ha^{-1})

S_1 = BPT-5204+75 % RDN S_4 = Gangavathi sona+75 % RDN S_7 = JKPH 3333+75 % RDN

S_2 = BPT-5204+100 % RDN S_5 = Gangavathi sona+100 % RDN S_8 = JKPH 3333+100 % RDN

S_3 = BPT-5204+125 % RDN S_6 = Gangavathi sona+125 % RDN S_9 = JKPH 3333+125 % RDN

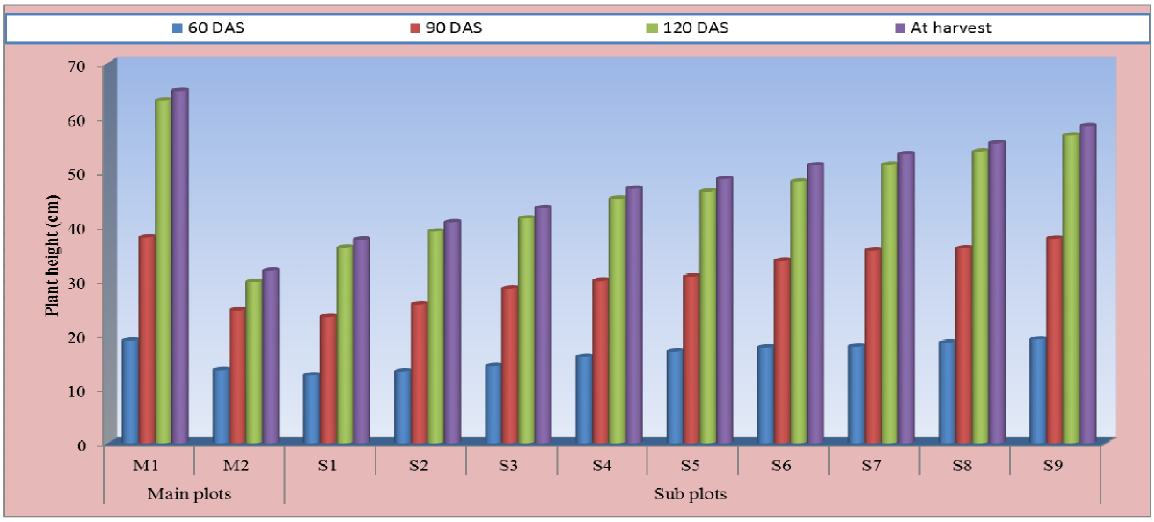

Fig. Plant height at different growth stages of rice as influenced by planting methods and genotypes with nitrogen levels

M_1 (Transplanted Rice) M_2 (Direct seeded Rice) 100 % RDN: Recommended dose of nitrogen (150 kg ha^{-1})

S_1 = BPT-5204+75 % RDN S_4 = Gangavathi sona+75 % RDN S_7 = JKPH 3333+75 % RDN

S_2 = BPT-5204+100 % RDN S_5 = Gangavathi sona+100 % RDN S_8 = JKPH 3333+100 % RDN

S_3 = BPT-5204+125 % RDN S_6 = Gangavathi sona+125 % RDN S_9 = JKPH 3333+125 % RDN