EFFECT OF VARIOUS NUTRIENT MANAGEMENT OPTIONS ON GROWTH, YIELD ATTRIBUTING CHARACTERS AND YIELD OF SHORT GRAIN AROMATIC RICE VARITIES (*ORYZA SATIVA* L.)

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Abstract: The experiment was carried out at Raipur during season of 2012. The experiment revealed that the performance of *Dubraj* was comparatively better than that of *badshahbhog*, *vishnubhog* and *bisni* in terms of grain yield along with highest plant height, dry matter accumulation, leaf area, leaf area index with good yield attributing characters. Among the different nutrient management practices, application of 80:50:40 kg N:P_2O_5:K_2O ha^{-1}(50% Inorganic+50% Organic) gave better performance in all the above characters. It is revealed that the variety *Dubraj* fertilized with 80:50:40 kg N:P_2O_5:K_2O ha^{-1}(50% Inorganic+50% Organic) gave the highest grain yield along with good growth characters.

Keywords: Effect, Nutrient, Growth, Management, Rice

INTRODUCTION

Rice is the most important and staple food crop for feeding of more than two third population in the world. Rice is only cereal that is eaten as whole grain and human selection down the ages has given preference to quality to cater to the needs of diverse rice based preparations. Rice is intimately involved in the culture as well as the food ways and economy of many societies. In world the total production of rice is 463.3 million tonnes (milled basis) in 2011–12 (Anonymous, 2012a). India is second largest producer after china and has an area of over 42.2 million hectares and production of 104.32 million tonnes with productivity of 2372 kg ha^{-1}. Rice production in India has shown a steady upward trend during the period 2005–06 to 2008–09 reaching a record level of 99.18 million tonnes in 2008–09. Production declined to 89.09 million tonnes in 2009–10 due to a severe drought gripping in most parts of the country but rebounded to 96 million tonnes in 2010–11 and further with a record production of 103.4 million tonnes in 2011–12 (Anonymous, 2012b). Consumer demands for the fine rice varieties are higher due to its good nutritional quality, palatability, taste, cooking quality and fragrance (Kaul *et al*., 1982). Over the past 50 years, agriculture production has increased dramatically, in part through the use of chemical fertilizers and pesticides that increased human and environment health risks (Pradhan, 1992). Nutrient supply either from organic or inorganic fertilizer is a must but continuous use of inorganic fertilizer to soil had a deleterious effect on soil productivity and steadily declining trend in rice productivity associated mainly with loss of inherent soil fertility (Nambiar *et al.,* 1998). Farmers' observations at present day are that fine aromatic rice gradually loses their aroma and other qualities such as yield and taste due to lack of organic matter content in soil, proper cultural management and changes of environment (Singh and Singh, 1997). The yield of fine rice is lower than that of coarse and medium rice. The reasons for low yield are mainly associated with lack of improved varieties and judicious use of synthetic fertilizers.

Extensive research works are necessary to find out appropriate variety and optimum rate of Organic and inorganic fertilizers to obtain satisfactory yield and quality of fine rice. Therefore, the present study was undertaken to evaluate the to study the response of integrated nutrient management on short grain aromatic rice varieties for optimization of yield and quality. For reducing environmental pollution and increasing the use of organic fertilizer in soil.

MATERIAL AND METHOD

A field experiment entitled "Effect of integrated nutrient management on growth, yield and quality of short grain aromatic rice varieties (*Oryza sativa* L.) for Chhattisgarh plains.*"*was carried out at the Instructional Farm I.G.K.V., Raipur (C.G.) during *kharif* season of 2012. The experiment was performed on '*Inceptisols*' (sandy loam) which is locally known as '*Matasi*'. The soil was neutral in reaction and medium in fertility having low N, medium P and high K. The experiment was laid out in split plot design with four varieties namely Dubraj, Badshah Bhog, Vishnu Bhog and Bisni in main plot and six nutrient management treatments *i.e.* (N_1) 60:40:30 Kg N: P_2O_5: K_2O ha^{-1} (Inorganic), (N_2) 80:50:40 Kg N: P_2O_5: K_2O ha^{-1} (Inorganic), (N_3) 60:40:30 Kg N: P_2O_5: K_2O ha^{-1} (50%Inorganic+50% Organic), (N_4) 80:50:40 Kg N: P_2O_5: K_2O ha^{-1} (50%Inorganic+50% Organic), (N_5) 60:40:30 Kg N: P_2O_5: K_2O ha^{-1} (Organic – FYM) and (N_6) 80:50:40 Kg N: P_2O_5: K_2O ha^{-1} (Organic – FYM) in sub- plot and the treatments were replicated thrice.

Quantity of the nutrient was applied as per the treatments. The one third dose of inorganic nitrogen and whole amount of organic nitrogen, phosphorus and potassium was applied as basal dressing. Where as remaining dose of inorganic nitrogen was applied in two equal splits at 25-30 and 55-60 DAT of the

crop. The source of organic nutrient was FYM and remaining nitrogen through urea, phosphorus through single super phosphate, and potassium through murate of potash the potash present were applied, in case of organic nutrient management treatment, amount of FYM was calculated as per the level of nitrogen only, However , the amount of phosphorus and potash present in the calculated FYM had decided the levels of P_2O_5 ad K_2O ha^{-1} in the treatments. Rice varieties are translated in rows with spacing of 20 cm whereas; the plant to plant spacing was 10 cm, using seed rate of 40 kg ha^{-1} for Dubraj, Vishnu Bhog, Bisni and 35 kg ha^{-1} for Badshah Bhog. Crop was transpanted on July 27, 2012 and harvested on December 2, 2012.

The plants of outer row and the extreme ends of the middle rows were excluded to avoid border effect. Five hills were randomly selected from each unit plot prior to harvest for recording data on plant height, total tillers/hill, bearing tillers/hill, non-baring tillers/hill, panicle length, grains/panicle, sterile spikelets/panicle, and 1000-grain weight. Grain yield, straw yield, and harvest index were recorded at harvest. The straws were sun dried and the yield of grain and straw/plot were converted to t/ha. Collected data were analyzed statistically following ANOVA technique and the mean differences were adjudged by Duncan's multiple Range lest (Gomez and Gomez, 1984).

RESULT AND DISCUSSION

Plant height (cm)

It is obvious from the data (Table 1.1) of plant height progressively increased with advancement of the age of crop. When organic sources of nutrients were applied and supplemented with inorganic sources of nutrients enhanced the nutrient availability and helped in increasing the plant height. Plant height varied significantly due to their genetic behavior and different growth habits of four varieties. Among the four varieties, *Badshah Bhog* had taller plants. Data on plant height of rice (Table 4.1) revealed that plant height increased progressively with increase in the age of the crop. The application of 80:50:40 kg $N:P_2O_5:K_2O$ ha^{-1} (50% Inorganic + 50% Organic) was gave maximum height which was found to be at par with 80:50:40 kg $N:P_2O_5:K_2O$ ha^{-1} (Inorganic). This result is in accordance with of Mahaptra *et al.* (2004), this indicated that supply of nutrients under these treatments were sufficient to meet the demand of the crop and thereby maintained the similar plant height. The positive role of nitrogen, phosphorus and potassium for cell division and enlargement has been already established. Increase in height also may be due to the greater availability and steady supply of essential plant nutrients during the entire period of crop growth.

Number of tillers (hill^{-1})

Data related to number of tillers hill^{-1} (Table 1.1) are presented in table 4.2. In general, tillers hill^{-1} increased with crop age upto 90 DAT but, the number of tillers at maturity were slightly reduced. *Badshah Bhog* recorded significantly higher number of tillers hill^{-1}, which were at par with *Dubraj*. Under INM, application of 80:50:40 kg $N:P_2O_5:K_2O$ ha^{-1} (50% Inorganic + 50% Organic) recorded higher number of tillers hill^{-1} which were comparable with application of 80:50:40 kg $N:P_2O_5:K_2O$ ha^{-1} (Inorganic). The results are also in consonance with the findings of Sarawgi and Sarawgi (2004[a]). it might be due to the fact that application of organic sources of nutrients and their combination with inorganic sources of a nutrient leads to greater availability of nutrients to the plants at all the stages of crop growth. Increased plant height also help in better photosynthesis in plant, which in turn helped in formation of new tillers. Similar results were also obtained by Jha *et al.* (2006).

Dry matter accumulation (g hill^{-1})

The higher value of dry matter accumulation might be due to higher availability and translocation of nutrients during growth and development stages. The dry matter accumulation depends upon the photosynthesis and respiration rate, which finally increase the plant growth with respect to increased plant height, tillers etc by Mandal *et al*., (2004). Application of different sources of nutrients influenced the dry matter accumulation of the crop significantly at all the stages of crop growth. The application of 80:50:40 kg $N:P_2O_5:K_2O$ ha^{-1} (50% Inorganic + 50% Organic) recorded the highest dry matter accumulation as compared to other treatments (Table 1.1). The application of inorganic sources in combination with organic sources of nutrients helped to mitigate crop requirement and thus this treatment assisted in increasing dry matter accumulation. These treatments provided sufficient nutrients for proper growth. The highest dry matter accumulation is also may be due to higher length and weight of panicle and filled grains. . Dry matter accumulation increased with the advancement of crop age as given in table 4.3. *Badshah Bhog* and *Vishnu Bhog* recorded the higher dry matter accumulation. The results have also been confirmed by Murali and Setty (2001).

Leaf area and Leaf area index

The variety *Badshah Bhog* recorded maximum leaf area which was found to be at par with *Dubraj* presented in Table 1.1. Among the nutrient management options application of 80:50:40 kg $N:P_2O_5:K_2O$ ha^{-1} (50%Inorganic+50%Organic) showed maximum leaf area. The results are in

agreement with the findings of Sarawgi and Sarawgi (2004[b]). The leaf area and leaf area index were higher in these treatments due to steady supply of essential nutrients for better growth. Same trend was recorded in the case of leaf area index (Fig 1). The present findings are in conformity with results of Behra (1998).

Crop growth rate (CGR)

The data on crop growth rate (Fig 2) is presented in figure 4.2 and it shows that crop growth rate was significantly influenced due to varieties. Among the varieties *Badshah Bhog* and *Vishnu Bhog* produced significantly higher crop growth rate, at 0-30 DAT. whereas at 30- 60 DAT, 60-90 DAT and 90 DAT- at harvest stage the crop growth rate showed non significant variation for the varieties. However the pace of crop growth was highest during 60-90 DAT and after wards it was very slow.

In case of integrated nutrient management at 0-30 DAT the maximum CGR was recorded under the treatment 80:50:40 kg $N:P_2O_5:K_2O$ ha^{-1} (Inorganic) which was closely followed with the treatments 60:40:30 kg $N:P_2O_5:K_2O$ ha^{-1} (Inorganic) and 80:50:40 kg $N:P_2O_5:K_2O$ ha^{-1} (50% Inorganic + 50% Organic). While at 30-60 DAT and 60-90 DAT the highest CGR was recorded under 80:50:40 kg $N:P_2O_5:K_2O$ ha^{-1} (50% Inorganic + 50% Organic) which was closely followed by the 80:50:40 kg $N:P_2O_5:K_2O$ ha^{-1} (Inorganic) and 60:40:30 kg $N:P_2O_5:K_2O$ ha^{-1} (50% Inorganic + 50% Organic). However at 90 DAT- at harvest stage the crop growth rate shows non significant variations due to different nutrient management options.

Effect of varieties and nutrient management practices on Yield Attributing characters

Number of grains panicle^{-1}, number of filled grains panicle^{-1}, and sterility percentage

The number of filled grains panicle^{-1} is another important yield attributing characters, which directly affecting the grain yield of crop. The result revealed that number of grains panicle^{-1} and number of filled grains panicle^{-1} were not significantly influenced due to varieties, (Table 1.2). However, the sterility percentage was influenced significantly due to varieties. The highest sterility was recorded in *Dubraj*, which was at par with *Vishnu Bhog* and *Bisni*. The present findings are in conformity with results of Murali And Settee (2001). In case of nutrient management options 80:50:40 kg $N:P_2O_5:K_2O$ ha^{-1} (50% Inorganic +50% Organic) produced significantly higher number of grains panicle^{-1} and number of filled grains panicle^{-1} which was significantly superior to all the treatments. Whereas the highest sterility was recorded under purely organic treatments with lower nutrient level *i.e.* 60:30:60 kg $N:P_2O_5:K_2O$ ha^{-1}(Organic-FYM).(Table 4.6). The results are in accordance with Paraye *et al.* (2006).

Number of effective tillers m^{-2}, panicle length and test weight

Panicle bearing tillers are termed as effective tillers. The number of effective tillers per m^{-2} is an important yield attributing character, which ultimately determines the yield of rice crop. Data pertaining to number of effective tillers m^{-2} , length and weight of panicle are presented in Table 1.2 revealed that number of effective tillers m^{-2}, panicle length and test weight were significantly influenced due to varieties and nutrient management treatments. Among the varieties, *Badshah Bhog* produced significantly higher number of effective tillers and panicle length. On other hand the highest test weight was recorded in the variety *Dubraj*. These results are in accordance with Mhaskar *et al.,* (2005). Panicle length is one of the important yields attributing character, which influenced the yield directly. In case of integrated nutrient management treatment 80:50:40 kg $N:P_2O_5:K_2O$ ha^{-1}(50% Inorganic + 50 % Organic) produced significantly higher number of effective tillers, panicle length and test weight. Regarding effective tillers significantly similar number of effective tillers were observed under the treatment 80:50:40 kg $N:P_2O_5:K_2O$ ha^{-1}(Inorganic). Whereas, in panicle length and test weight application of 80:50:40 kg $N:P_2O_5:K_2O$ ha^{-1} (Inorganic) was superior to all other treatments. The lowest number of effective tillers m^{-2}, panicle length and test weight was recorded under 60:40:60 kg $N:P_2O_5:K_2O$ ha^{-1} (Organic-FYM). Pandey and Nandeha (2004) recorded similar results.

Increase in plant height, number of tillers in successive growth stages helped in increasing the effective tillers by Dahiphale *et al.* (2004).This was mainly due to higher photosynthetic efficiency and net assimilation, which helped in increasing the overall growth of the plant. Similar result is observed by Sharma (2008). The treatment which recorded the higher number of effective tillers might be due to higher and balanced availability of nutrient to the plants. Mhaskar *et al*., (2005) observed that variation for length of panicle in case of varieties might be due to genetic characters. Treatments where organic sources of nutrients in combination with inorganic sources of nutrients were applied, resulted the highest panicle length. This indicated that the supply of nutrients under this treatment were sufficient to meet the demand of the crop. Similar results were found by Netam and Sarawgi (2008).

Grain yield, straw yield and harvest index

The grain and straw yield as well as harvest index were significantly influenced due to nutrient management options and varieties (Table 1.3). Among the varieties *Dubraj* produced relatively higher grain yield. However highest straw yield was produced by the variety *Badshah Bhog*. While the highest harvest index was produced by the variety

Vishnu Bhog. The application of 80:50:40 Kg $N:P_2O_5:K_2O$ ha^{-1}(50%Inorganic+50% Organic) produced the significantly highest grain yield, which was at par with 80:50:40 Kg $N:P_2O_5:K_2O$ ha^{-1} (Inorganic). The 80:50:40 kg $N:P_2O_5:K_2O$ ha^{-1} (Inorganic) produced the highest straw yield, which was comparable to that of 80:50:40 Kg $N:P_2O_5:K_2O$ ha^{-1} (50%Inorganic +50%Organic).

The increase in yield attributes significantly increased the grain yield. The higher grain yield was achieved under integrated nutrient management system especially with 80:50:40 kg $N:P_2O_5:K_2O$ ha^{-1}(50% Inorganic+50% Organic) might be due to higher availability of essential nutrients and application of organic source(FYM) also helped in improving the physical condition of the soil for better root proliferation leading to higher absorption of water and nutrients and ultimately resulting in higher yield by Gaikwad (2004). It is well known fact that FYM helps in continuous supply of the nutrients, various enzymes and hormones reduced nutrient losses and enhanced the nutrient use efficiency and yield. The harvest index was observed more in 80:40:80 kg $N:P_2O_5:K_2O$ ha^{-1} (Organic-FYM) due to more economic yield and less straw yield. The sterility percentage was more in 60:30:60 kg $N:P_2O_5:K_2O$ ha^{-1} (Organic-FYM) it may be due to minimum yield. Similar results have also been reported by, Mahapatra *et al.* (2004).

CONCLUSION

The result of the experiment revealed that the performance of *Dubraj* was better than that of *badshahbhog*, *vishnubhog* and *bisni* in terms of grain yield and other chracters. Among the different nutrient management the practices, application of 80:50:40 kg $N:P_2O_5:K_2O$ ha^{-1}(50% Inorganic+50% Organic) gave better performance. Although the application of only organic nutrients (FYM) is not profitable. It can be concluded that variety *Dubraj* along with application of 80:50:40 kg $N:P_2O_5:K_2O$ ha^{-1}(50% Inorganic+50% Organic) gave the highest grain yield along with beter growth characters, which could be a profitable nutrient management technique.

Table 1.1: Effect of various nutrient management options on growth of short grain aromatic rice varieties

Treatment	**Growth characters**				
	Plant height (cm)	**Number of tillers $hill^{-1}$**	**Dry matter accumulation (g $hill^{-1}$)**	**Leaf area (cm^{-2})**	**leaf area index**
Varieties					
V_1 –Dubraj	131.38	6.87	36.55	803.24	4.02
V_2 –Badshah Bhog	136.26	7.01	36.29	826.51	4.13
V_3 –Vishnu Bhog	131.05	6.63	35.11	782.96	3.91
V_4 –Bisni	132.54	6.60	35.44	637.68	3.19
SEm+	**0.93**	**0.10**	**1.43**	**8.89**	**0.04**
CD (P=0.05)	**3.22**	**0.34**	**NS**	**30.76**	**0.15**
Nutrient management					
N_1- 60:40:30 Kg N: P_2O_5: K_2O ha^{-1} (Inorganic)	133.75	6.72	34.80	747.38	3.74
N_2- 80:50:40 Kg N: P_2O_5: K_2O ha^{-1} (Inorganic)	142.13	7.33	43.20	808.09	4.04
N_3 - 60:40:30 Kg N: P_2O_5: K_2O ha^{-1} (50%Inorganic+50% Organic)	132.54	6.92	37.57	779.50	3.90
N_4 - 80:50:40 Kg N: P_2O_5: K_2O ha^{-1} (50%Inorganic+50% Organic)	138.49	7.70	47.28	851.71	4.26
N_5 - 60:30:60 Kg N: P_2O_5: K_2O ha^{-1}(Organic – FYM)	122.57	5.82	22.67	672.78	3.36
N_6 - 80:40:80 Kg N: P_2O_5: K_2O ha^{-1}(Organic – FYM)	127.35	6.18	29.57	716.11	3.58
SEm+	**1.91**	**0.09**	**0.46**	**9.83**	**0.05**
CD (P=0.05)	**5.48**	**0.27**	**1.37**	**28.10**	**0.14**

Table 1.2: Effect of various nutrient management options on yield attributing characters of short grain aromatic rice varieties

	Yield attributing characters					
Treatment	**No. of grains panicle^{-1}**	**No. of filled grains panicle^{-1}**	**Sterility (%)**	**No. of effective tillers (m^{-2})**	**Panicle length (cm)**	**Test weight (g)**
Varieties						
V_1 –Dubraj	231.91	208.13	10.4	193.3	22.5	17.64
V_2 –Badshah Bhog	238.34	215.87	9.5	215.5	28.00	12.31
V_3 –Vishnu Bhog	228.61	205.13	10.3	207.6	24.30	15.13
V_4 –Bisni	226.54	204.09	10.0	211.7	27.80	15.23
SEm+	**5.96**	**5.75**	**0.18**	**2.95**	**5.32**	**0.08**
CD (P=0.05)	**NS**	**NS**	**0.62**	**10.21**	**1.84**	**0.29**
Nutrient management						
N_1- 60:40:30 Kg N: P_2O_5: K_2O ha^{-1} (Inorganic)	224.82	201.77	10.3	209.9	24.90	14.91
N_2- 80:50:40 Kg N: P_2O_5: K_2O ha^{-1} (Inorganic)	250.32	226.37	9.6	224.2	26.6	15.24
N_3 - 60:40:30 Kg N: P_2O_5: K_2O ha^{-1} (50%Inorganic+50% Organic)	233.59	210.65	9.8	217.7	26.00	15.36
N_4 - 80:50:40 Kg N: P_2O_5: K_2O ha^{-1} (50%Inorganic+50% Organic)	269.05	244.57	9.2	229.2	27.80	15.62
N_5 - 60:30:60 Kg N: P_2O_5: K_2O ha^{-1} (Organic – FYM)	201.65	179.17	11.2	175.3	23.60	14.56
N_6 - 80:40:80 Kg N: P_2O_5: K_2O ha^{-1}(Organic – FYM)	208.68	187.32	10.3	185.9	24.90	14.77
SEm+	**2.81**	**2.52**	**0.29**	**3.38**	**0.20**	**0.05**
CD (P=0.05)	**8.04**	**7.21**	**0.83**	**9.66**	**0.57**	**0.15**

Table 1.3 *:* Effect of various nutrient management options on grain yield (q ha^{-1}), straw yild (q ha^{-1}) and harvest index (%) of short grain aromatic rice varieties

Treatment	**Grain Yield (q ha^{-1})**	**Straw Yield (q ha^{-1})**	**Harvest Index (%)**
Varieties			
V_1 –Dubraj	29.22	55.1	35.6
V_2 –Badshah Bhog	26.78	59.59	30.9
V_3 –Vishnu Bhog	23.68	52.31	30.4
V_4 –Bisni	24.17	52.05	32.00
SEm+	**0.71**	**1.67**	**0.6**
CD (P=0.05)	**2.47**	**6.79**	**2.1**
Nutrient management			
N_1- 60:40:30 Kg N: P_2O_5: K_2O ha^{-1} (Inorganic)	26.2	59.46	30.4
N_2- 80:50:40 Kg N: P_2O_5: K_2O ha^{-1} (Inorganic)	29.3	66	30.8
N_3 - 60:40:30 Kg N: P_2O_5: K_2O ha^{-1} (50%Inorganic+50% Organic)	27.49	62.44	30.2
N_4 - 80:50:40 Kg N: P_2O_5: K_2O ha^{-1} (50%Inorganic+50% Organic)	30.62	64.08	31.5
N_5 - 60:30:60 Kg N: P_2O_5: K_2O ha^{-1}(Organic – FYM)	20.04	37.8	34.6
N_6 - 80:40:80 Kg N: P_2O_5: K_2O ha^{-1}(Organic – FYM)	21.22	38.76	35.7
SEm+	**0.6**	**1.23**	**0.57**
CD (P=0.05)	**1.71**	**3.51**	**1.63**

Fig. 1: Effect of Nutrient Management on leaf area index at different stages of Short Grain Aromatic Rice varieties

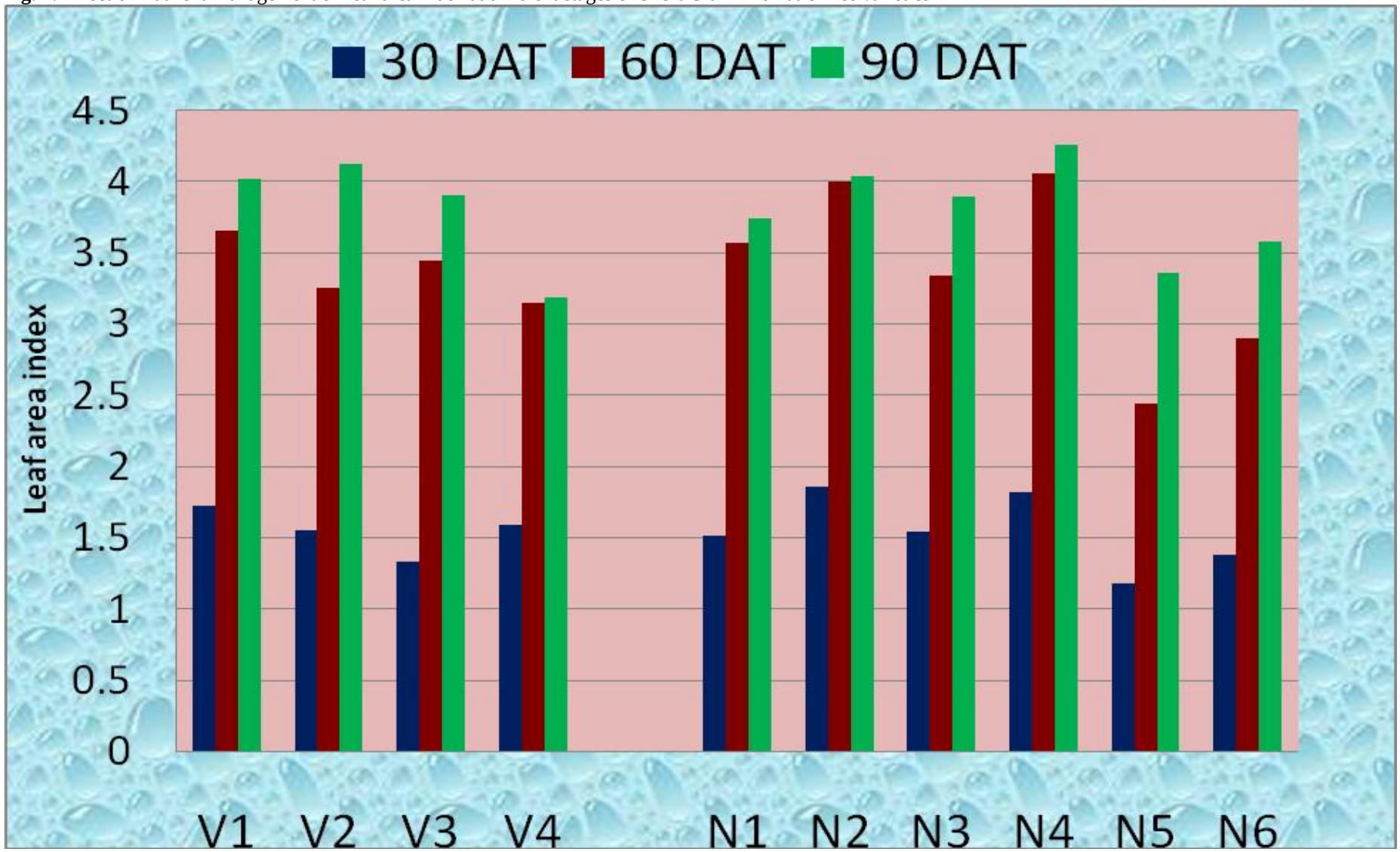
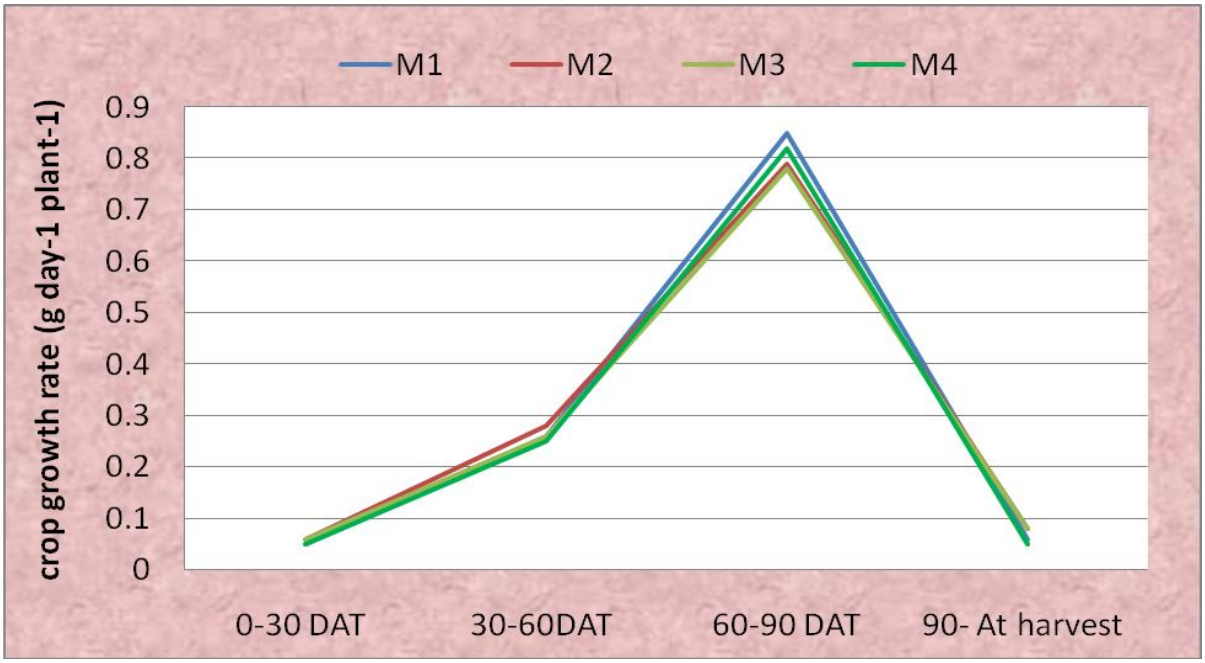
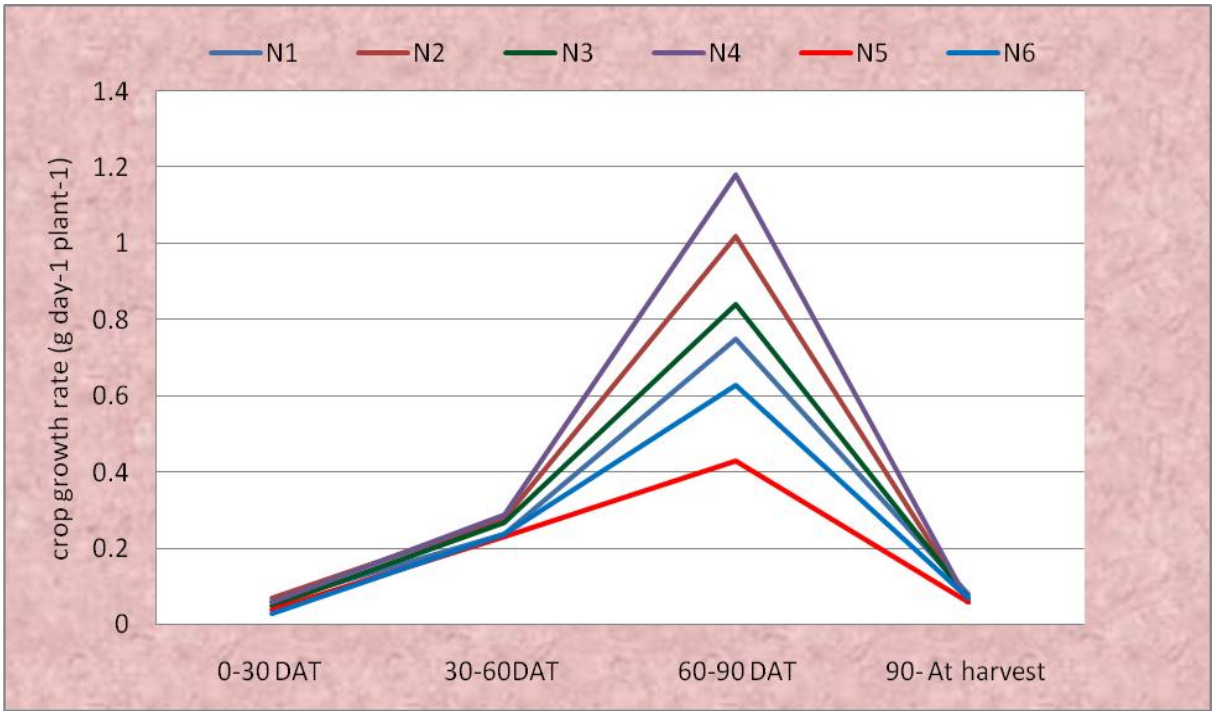


Fig.: 2. Effect of Nutrient Management on crop growth rate at different stages of Short Grain Aromatic Rice varieties





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