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Manjunath S Shatoji
Department of Plant Physiology, College of Agriculture, Odisha University of Agriculture and Technology, Bhubaneswar, Odisha, India

Chittaranjan Sahoo
Department of Plant Physiology, College of Agriculture, Odisha University of Agriculture and Technology, Bhubaneswar, Odisha, India

Surekha Shetty
Department of Plant Physiology, College of Agriculture, Odisha University of Agriculture and Technology, Bhubaneswar, Odisha, India

Kishore Chandra Sahoo
Regional Research and Technology Transfer Station, Odisha University of Agriculture and Technology, Keonjhar, Odisha, India

Sukumar Tudu
Regional Research and Technology Transfer Station, Odisha University of Agriculture and Technology, Keonjhar, Odisha, India

Corresponding Author:
Manjunath S Shatoji
Department of Plant Physiology, College of Agriculture, Odisha University of Agriculture and Technology, Bhubaneswar, Odisha, India

Influence of foliar applied water-soluble nutrients (NPK) on growth and yield attributing characters of rice (*Oryza sativa* L.)

Manjunath S Shatoji, Chittaranjan Sahoo, Surekha Shetty, Kishore Chandra Sahoo and Sukumar Tudu

Abstract
Rice is the world's second most important cereal crop next to corn because more than 80% of the world population depends on it. But there is decline in the production that may be due to the methodology followed for crop management. Here a field was laid out in Randomized Block Design with 10 treatments and 3 replications with paddy variety Lalat. Among the treatments, T_8 (75% (N&P) +100% K STD + 2% urea phosphate spray) has shown better result in the light of growth parameters and yield attributing characters. A high value for the total nutrient uptake of N, P and K were 58.5, 19.68 and 111.62 kg per ha respectively was found in T_8 treatment. Also, the grain and straw yield of 40.03 q and 53 q per ha respectively with B: C ratio of 1.15 was observed in treatment T_8.

Keywords: Rice, nutrient uptake, growth, water-soluble nutrients, yield

1. Introduction
Rice (*Oryza sativa* L.) is the most important crop worldwide and is the staple nourishment for the vast majority of the nations including India, China, Thailand, Philippines. Rice is grown in more than 100 countries over approximately 158 million hectares, with production of more than 700 million tons annually (Lar *et al*., 2021) [10]. It is the world's third most significant oat crop following just wheat and maize which is generally disseminated on account of its exceptional capacity to develop on a wide range of soils and water systems, joined with its variation to a wide assortment of environments and horticultural conditions. It is the lone cereal harvest which has probability to fill in standing water. 57% of rice is developed on flooded land, 25% on downpour took care of marsh, 10% on the uplands, and 6% in profound water and 2% in flowing wetlands of the world. The growth and development of plant or crop depends on the proportionate absorption of the nutrients given. To have a phased increase in the production of rice it is important to have adequate crop management practices to increase its efficient use of inputs to improve productivity. Soil amended nutrients have less efficacy towards the plant absorption, Foliar application is credited with the advantage of quick and efficient utilization of nutrients, elimination of losses through leaching and fixation as well as regulating the uptake of nutrients by plant (Manonmani and Srimathi, 2009) [11]. Besides adverse soil conditions like acidity, alkalinity, water logging, and lack of adequate moisture would also result in non-availability of nutrients. In order to abandon or minimize severity of such condition, foliar feeding of nutrients is the easiest way to boost up the crop growth because the nutrients provided through foliar feeding are available to plants at initial stages and critical stages. The better utilization of the organic nutrients can be done through the nutrient management practices *i.e*., either it may be through improving the formulations of the cheaply available organic sources or time of application of nutrients or fertilizers so that the nutrient uptake by plants is maximized Pandey (1999) [15]. Foliar fertilization provides more rapid utilization of nutrients and allows rectifying the observed deficiencies symptoms in less time than would be required by soil application. Foliar fertilization will work as a visible economic way to supplement the plant nutrients for more efficient fertilization (Girma *et al*., 2007) [6].

2. Material and Methods
Experiment was conducted during *Kharif* 2018-19 in Central farm, Regional Research and Technology Transfer Station (RRTTS), OUAT, Bhubaneswar between latitude 20.2961° N

and longitude 85.8245° E and an average altitude of 45 m (148 ft) above sea level which lies in the East & South Eastern coastal Plain Zone of agro climatic zone of Odisha The experimental filed was loamy sand in textural class with available average NPK content of 162, 11.2 and 62 kg ha^{-1} respectively. The field was laid out in Randomized Block Design with 10 treatments and 3 replications with paddy variety Lalat *viz*., Treatments were T_1 (absolute control), T_2 (50%(N&P) +100% K STD), T_3 (75%(N&P) +100% K STD), T_4 (100% STD), T_5 (50%(N&P) +100% K STD + 2% urea phosphate spray), T_6 (50%(N&P) +100% K STD + 2% DAP spray), T_7 (50%(N&P) +100% K STD + 2% NPK spray), T_8 (75%(N&P) +100% K STD + 2% urea phosphate spray), T_9 (75%(N&P) +100% K STD + 2% DAP spray) and T_{10} (75%(N&P) +100% K STD + 2% NPK spray). Observations on growth and yield attributes (Plant height, No of Leaves, No of tiller number, Number of Panicles per hill, Length of Panicle, Number of fertile and sterile grains per panicle, Sterility percentage, 1000 grain weight, Grain and straw yield and LAI, CGR, NAR, and,) were recorded.

3. Result and Discussion

3.1 Yield Attributing Characters

3.1.1 Plant height

The investigation on the impact of basal and foliar application of nutrients was studied for the plant height and the results obtained have been presented in table 1. It was observed that treatment T_8 (75% STD + 2% urea phosphate spray) has shown the highest plant height of 87.23cm at harvest, among all the treatments which is 51.24% higher than the control. The next highest was observed by treatment T_9 and T_{10} having the value of 83.09cm and 80.99cm respectively. As in case of basal application treatment T_4 (100% STD) recorded the highest height of 80.13 cm (8.9% lower than T_8). The height of plant was more in T_8 treatment due to the application of additional nitrogen through foliar spray along with the basal dose. Nitrogen is the major compound which helps in the increasing the meristematic activity and intermodal length of plant which ultimately helps in resulting higher plant height. Similar findings were also reported by Saha *et al*. (2017) [17] and Jan *et al*. (2018) [8] in rice.

3.1.2 Number of leaves per hill

The investigation on the impact of basal and foliar application of nutrients was made for number of active leaves per hill and the observations have been depicted in table-2. The rate of increase in the leaf number was higher between 30-60 DAS and then gradually decreased. The result showed that the highest mean number of leaves were recorded at 60 DAS in the treatment T_8 (75% STD + 2% urea phosphate spray) of 32.76 numbers per hill, which is 38.4% higher over control and followed by T_9 of 29.0 numbers per hill. Among soil applied treatments T_4 (100% STD) showed the highest number of leaves at 60 DAS i.e.28.40 numbers per hill and T_{10} (28.29) found to be at par with the T_4. The lowest number leaves in all the stages was showed by T_1 (control) at 30, 60, 90 and at harvest was 11.62, 23.67, 19.30 and 15.0 per hill respectively. The nitrogen content absorbed by the plants will help in the growth and development of plant it may be vegetative growth in producing more number of leaves, like wise Phosphorus effects root growth, seed formation, and plant maturity. Potassium is important in disease resistance, fruit formation, and effects plant enzymes. The leaf growth in the plant increases up to a certain period and later on gradually decreases due to the process of senescence in the plant in which older leaves starts shedding.

Table 1: Effect of basal and foliar application of nutrients on plant height (cm per hill)

Treatment	30 DAS		60 DAS		90 DAS		At Harvest	
		% C		% C		% C		% C
T_1 (Control)	25.94		36.34		55.43		57.68	
T_2 (50%STD (N&P)+100% K)	29.45	13.55	40.79	12.24	62.29	12.38	66.65	15.55
T_3 (75%STD (N&P)+100% K)	32.91	26.89	44.87	23.46	65.21	17.64	67.16	16.45
T_4 (100%STD)	34.89	34.49	53.83	48.12	76.54	38.10	80.13	38.93
T_5 (T_2+2%UP)	34.39	32.58	48.55	33.60	67.97	22.63	74.04	28.37
T_6 (T_2+2%DAP)	34.19	31.79	48.80	34.27	68.32	23.25	70.36	22.00
T_7 (T_2+2%N-P-K)	32.00	23.36	40.80	12.27	63.07	13.79	64.97	12.64
T_8 (T_3+2%UP)	36.84	42.03	54.39	49.65	80.50	45.23	87.23	51.24
T_9(T_3+2%DAP)	35.57	37.14	53.91	48.34	78.69	41.97	83.09	44.07
T_{10} (T_3+2%N-P-K)	34.96	34.78	54.66	50.40	76.70	38.37	80.99	40.42
S.Em(±)	1.404		3.976		5.176		4.802	
C.D.(0.05)	4.172		11.814		15.380		14.267	
C.V.	7.34		14.44		12.91		11.36	

% C- Percent increase (+) or Decrease (-) over control

Table 2: Effect of basal and foliar application of nutrients on number of leaves per hill

Treatment	30 DAS		60 DAS		90 DAS		At Harvest	
		% C		% C		% C		% C
(T_1 Control)	11.62		23.67		19.30		15.00	
T_2 (50%STD (N&P)+100% K)	14.23	22.5	26.25	10.9	19.99	3.6	17.31	15.4
T_3 (75%STD (N&P)+100% K)	14.61	25.7	26.00	9.9	21.96	13.8	18.13	20.9
T_4 (100%STD)	15.53	33.7	28.40	20.0	23.53	21.9	20.28	35.2
T_5 (T_2+2%UP)	15.01	29.2	26.65	12.6	22.14	14.7	19.17	27.8
T_6 (T_2+2%DAP)	14.80	27.4	26.31	11.2	21.10	9.3	18.64	24.3
T_7 (T_2+2%N-P-K)	14.38	23.8	26.58	12.3	21.52	11.5	17.46	16.4
T_8 (T_3+2%UP)	16.60	42.9	32.76	38.4	27.11	40.4	22.25	48.4
T_9 (T_3+2%DAP)	15.67	34.9	29.00	22.5	24.48	26.9	20.78	38.5

T_{10} (T_3+2%N-P-K)	14.94	28.6	28.29	19.5	23.74	23.0	20.48	36.6
S.Em(±)	0.542		0.853		1.345		1.002	
C.D.(0.05)	1.611		2.535		3.997		2.978	
C.V.	6.37		5.40		10.36		9.16	

% C- Percent increase (+) or Decrease (-) over control

3.1.3 Number of tillers per hill

The investigation on the impact of basal and foliar application of nutrients on the number of tillers per hill was recorded at 30, 60, 90 DAS and at harvesting and the data being presented in the table-3. The mean number tillers at 90 DAS have shown highest values compared to 30 and 60 DAS. At 90 DAS the highest number of tillers were shown by T_8 (75% STD + 2% urea phosphate spray) of 11.4 per hill which showed 44.2% high over the control (7.9 per hill) followed by T_9 and T_{10} of 10.2 and 10 per hill respectively. But in case of basal application T_4 (100% STD) it was found 9.5 per hill as compared to T_2 and T_3 (8.7 and 8.8 respectively). The treatment T_8 showed the 26.0% increase over the T_4. In case of rice it requires more amount of nitrogen at the active tillering stage and panicle initiation stage. Since supplemental application of urea phosphate as a foliar spray increased the number of tiller up to certain stage (90 DAS). However, the application of N fertilizer significantly increases the number of tillers in rice.

3.1.4 Number of panicles per hill

Study on the impact of basal and foliar application of nutrients on number of panicles was taken up and the results have been presented in table-4. It was found that all the treatments produced significantly higher number of panicles per hill as compared to control. The treatment T_8 (75% STD + 2% urea phosphate spray) has given higher number of tillers per hill i.e. 7.4 numbers of tillers per hill and which is 40.45% increase over the control followed by T9. But in case of basal application the treatment T_4 (100% STD) showed the highest number of panicles per hill of 6.6 as compared to treatment T_2 and T_3 (6.0 and 6.1 respectively). The application of nitrogen in excess helps in production of more number of panicles and also in increasing the yield. The similar results were observed by Jan *et al*. (2018) [8]. Potassium nutrition improves germination of pollen in the floret which leads to high spikelet fertility in rice (Uexkull, 1978) [21]. This explains the reason for more no. of filled grains panicle-1. Similar findings have been reported by Ojha and Baroova (1997) [15], Kumar *et al*. (2005) [10], Das *et al*. (2009) [5] and Shekara *et al*. (2010) [19].

Table 3: Effect of basal and foliar application of nutrients on number of tillers per hill

Treatment	30 DAS		60 DAS		90 DAS		At Harvest	
		% C		% C		% C		% C
T_1 (Control)	2.8		5.8		7.9		5.3	
T_2 (50%STD (N&P)+100% K)	2.8	1.2	6.1	5.7	8.7	9.6	6.9	29.4
T_3 (75%STD (N&P)+100% K)	3.2	15.6	6.3	9.4	8.8	11.3	7.2	35.6
T_4 (100%STD)	3.5	26.8	6.8	18.0	9.5	20.3	8.3	56.3
T_5 (T_2+2%UP)	3.2	15.6	6.4	11.3	9.3	17.6	7.5	40.5
T_6 (T_2+2%DAP)	3.3	18.6	6.4	11.3	9.0	13.8	7.3	37.7
T_7 (T_2+2%N-P-K)	3.0	9.8	6.5	13.0	8.8	11.3	7.2	34.4
T_8 (T_3+2%UP)	3.6	31.7	8.0	38.4	11.4	44.2	10.5	96.9
T_9(T_3+2%DAP)	3.4	22.8	7.2	25.2	10.2	29.0	8.9	66.3
T_{10} (T_3+2%N-P-K)	3.4	22.8	7.0	21.7	10.0	26.4	8.5	59.5
S.Em(±)	0.17		0.38		0.39		0.69	
C.D.(0.05)	0.505		1.123		1.165		2.064	
C.V.	9.13		9.86		7.26		15.49	

% C- Percent increase (+) or Decrease (-) over control

3.1.5 Length of panicles per hill

The impact of basal and foliar application of nutrients on panicle length was studied and the observations have been presented table-4. It was revealed that the length of panicle in treatment T_8 (75% STD + 2% urea phosphate spray) was higher (27.33 cm) which showed 22.1% more over the control, the treatment T_9 (75% STD +2%DAP) showed the nearest values to the T8. The treatment T4 (100% STD) with basal application showed the highest length of panicles (26.08 cm) but 4.8% lower to T_8. The panicle length is lined with the grain yield, as nitrogen application in excess helps in increases the internodal length. Saha *et al*. (2017) [17] noticed that longest panicle was observed in the treatment where 90 kg N was applied which shows increase in the nitrogen level also increase the panicle length.

3.1.6 Number of filled grains per panicle

The investigation on the impact of basal and foliar application of nutrients on the number of filled grains per panicle was studied and the results have been given in the table-4. The highest value of 144.3 numbers of filled grains was found in treatment T_8 (75% STD + 2% urea phosphate spray) which is 110.6% more over the control (68.5) followed by treatments T_9 and T_{10} having 112.9 and 111.0 grains per panicle respectively. The treatments T_4 (100% STD) with basal application showed the highest filled grains per panicle (111.8), but 29% lesser than T_8.

3.1.7 Number of unfilled grains per panicle

The investigation on the impact of basal and foliar application of nutrients on the number of unfilled grains per panicle was studied and results were presented in the table-4. The highest numbers of unfilled grains was observed in control (28.7 grains per panicles). The lowest all among the treatment was recorded in the treatment T_8 (75% STD + 2% urea phosphate spray) with unfilled grain number of 8.3 grains per panicle which is 71.0% less over control. The treatments T_4 (100% STD) with basal application showed the less Number sterile

grains (12.1) as compared to T_2 and T_3 (16.4 and 14.3 respectively), but treatment T_8 showed the 31.1% less sterile grains over T_4.

3.1.8 Spikelet Sterility

The effect of basal and foliar application of nutrients on spikelet sterility was studied and the observations have been presented in the table-4. A lowest value of 5.52% was observed in the treatment T_8 (75% STD + 2% urea phosphate spray) which are 81.3% less over the control. The treatment T_4 (100% STD) showed the lesser value of 9.79% as compared to T_2 and T_3 (15.72 and 13.79 respectively).

3.1.8 1000-grain weight

The studies were made on the impact of basal and foliar application of nutrients on 1000-grain weight and results presented in table-4. It was revealed that the treatment T_8 (75% STD + 2% urea phosphate spray) showed the higher value of 25g which was 22.97% over the control (20.33g) followed by T_9 and T_{10}. The treatment T_4 (100% STD) with basal application showed a value of 22g as compared to T_2 and T_3 (20.57 and 20.82 g respectively). Effective translocation of assimilates to the sink might have resulted in sound filling of grains as revealed by the highest number of filled grains panicle-1 and 1000 grain weight (Bouman *et al*., 2006) [4]. The results of the present experiment confirmed from the findings of Ramamoorthy *et al*. (1997) [16], Sharma and Sharma (2002) [18], Maqsood *et al*. (2005) [12], Zaidi and Tripathy (2007) [23], Das *et al*. (2009) [5], Banerjee *et al*. (2011) [3], Murthy *et al*. (2012) [13]. The high yield associated with higher level of potassium application may be due to its greater uptake and active participation in all structure, carbon assimilation, photosynthesis, starch formation, translocation of protein and sugar, entry of water into roots and development etc.

3.1.9 Grain yield

The effects of basal and foliar application of nutrients on grain yield as influenced by different treatment have been analyzed and presented in table-5. It was revealed that the yield increased significantly in all the treatments over control. In treatment T_8, there was a highest grain yield of 40.03 q ha-1 which gave 32.12% more yield than the control (30.3q ha-1) followed by T_4 (39.67q ha-1) and T_9 (39.53q ha^{-1}). Similar observations also recorded by Uma Maheswari and Karthik (2017) [22].

3.1.10 Straw yield

The experiment was conducted to study the impact of basal and foliar application of nutrients on straw yield as influenced by different treatment have been analyzed and presented in table-5. The results revealed a highest value of 53.67 q per ha was found in treatment T_4 (100%STD) which is 51.89% higher over the control followed by T_8 (75% STD + 2% urea phosphate spray) with 53q per ha and are at par with each other.

Table 4: Effect of basal and foliar application of nutrients on yield and yield attributing characters

Treatment	No of panicles		Panicle length (cm)		No of fertile grains		No of sterile grains		Sterility percentage (%)		1000 seed weight (g)	
		% C		% C		% C		% C		% C		% C
T_1 (Control)	5.3		22.38		68.5		28.7		29.51		20.33	
T_2 (50%STD (N&P)+100% K)	6.0	13.88	22.82	1.9	87.9	28.3	16.4	-42.9	15.72	-46.7	20.57	1.18
T_3 (75%STD (N&P)+100% K)	6.1	14.91	24.34	8.7	89.4	30.5	14.3	-50.2	13.79	-53.3	20.82	2.41
T_4 (100%STD)	6.6	25.27	26.08	16.5	111.8	63.2	12.1	-57.8	9.79	-66.8	22	8.21
T_5 (T_2+2%UP)	6.4	21.47	25.98	16.1	93.0	35.8	11.8	-58.9	11.26	-61.8	21.48	5.66
T_6 (T_2+2%DAP)	6.2	17.68	25.23	12.7	92.7	35.3	13.3	-53.7	12.55	-57.5	21.24	4.48
T_7 (T_2+2%N-P-K)	6.0	13.88	23.56	5.3	88.2	28.8	16.6	-42.2	15.84	-46.3	20.63	1.48
T_8 (T_3+2%UP)	7.4	40.45	27.33	22.1	144.3	110.6	8.3	-71.0	5.52	-81.3	25	22.97
T_9(T_3+2%DAP)	7.2	36.66	27.06	20.9	112.9	64.8	9.1	-68.3	7.46	-74.7	24.19	18.99
T_{10} (T_3+2%N-P-K)	6.8	29.06	26.80	19.7	111.0	62.0	11.2	-61.0	9.17	-68.9	23.2	14.12
S.Em(±)	0.22		0.798		4.86		0.68		0.289		0.342	
C.D.(0.05)	0.660		2.370		14.441		2.024		0.860		1.017	
C.V.	6.02		5.49		8.42		8.32		3.84		2.70	

% C- Percent increase (+) or Decrease (-) over control

Table 5: Effect of basal and foliar application of nutrients on grain and straw yield (q ha^{-1}) and harvest index (%)

Treatment	Grain yield (q ha^{-1})		Straw yield (q ha^{-1})		Harvest Index (%)	
		% C		% C		% C
T_1 (Control)	30.30		35.33		46.17	
T_2 (50%STD (N&P)+100% K)	32.50	7.26	44.00	24.53	42.38	-8.21
T_3 (75%STD (N&P)+100% K)	36.27	19.69	46.33	31.13	43.98	-4.74
T_4 (100%STD)	39.67	30.91	53.67	51.89	42.55	-7.84
T_5 (T_2+2%UP)	37.65	24.26	46.67	32.08	44.75	-3.08
T_6 (T_2+2%DAP)	35.23	16.28	42.67	20.76	45.15	-2.21
T_7 (T_2+2%N-P-K)	33.55	10.73	41.17	16.51	44.88	-2.79
T_8 (T_3+2%UP)	40.03	32.12	53.00	50.00	43.03	-6.81
T_9(T_3+2%DAP)	39.53	30.47	49.17	39.15	44.60	-3.40
T_{10} (T_3+2%N-P-K)	37.77	24.64	48.67	37.74	43.93	-4.86
S.Em(±)	0.348		0.498		1.637	
C.D.(0.05)	1.03		1.48		NS	
C.V.	8.32		9.37		6.42	

% C- Percent increase (+) or Decrease (-) over control

3.2 Growth Parameters

3.2.1 Leaf Area Index

The investigation on the impact of basal and foliar application of nutrients on the analysis for observation on LAI determined at different growth stages commencing from 30 DAS up to harvest have been presented in table-6. It was observed that the LAI continued to increase till 60 DAS and then gradually decreased till harvest. Highest mean value of LAI at 60 DAS is shown by treatment T_8 (75% STD + 2% urea phosphate spray) of 3.12 which is 111.64% over control. The lowest leaf area index (LAI) was showed by the control having value of 1.48. The treatmentT_9 and T_{10} are at par with each other with LAI of 2.59 and 2.53 respectively. The research showed that applying nitrogen and phosphorus in enhanced doses at phases of tillering, heading and physiological maturity helps to increase the LAI. This corroborates with the results of Amanullah *et al*. (2016) [1]. Siddiqui MH (2008) [20] also found that application of nitrogen and phosphorus increases the LAI.

3.2.2 Crop Growth Rate

The investigation on the impact of basal and foliar application of nutrients on CGR was studied and the set out in the table-7. The results revealed that the crop growth rate till harvest was shown a decreasing path. It is observed that the highest value of CGR was found at 30-60 DAS interval in the treatment T_8 (75% STD + 2% urea phosphate spray) of 29.78 gram per sq. m per day followed by T_9 and T_{10} of 22.31 and 20.75 g per sq.m per day. As the crop reaches the 60 days maturity from the day of sowing the growth rate gradually decreased till the harvest. The lowest crop growth rate was shown in T_1 (control) of 13.69 g per sq. m per day. As known, the crop growth rate is related to the dry matter accumulation and increase in the rate of photosynthetic ability of crop.

3.2.3 Net Assimilation Rate

The investigation on the impact of basal and foliar application of nutrients on NAR was studied and the observation on NAR was worked out based on the leaf area and the crop growth rate and the results were depicted in the table-8. The result revealed that the high NAR was seen at 30-60 DAS and then the rate decreased at 60-90 DAS. The highest mean value for the NAR at 30-60 DAS is shown by the treatment T_8 (75% STD + 2% urea phosphate spray) of 0.256 gram per hill per day and the lowest shown by the control (0.197 gram per hill per day). Among soil applied treatments T_4 and T_5 are at par with each other having net assimilation rate of 0.225 and 0.224 gram per hill per day respectively. The nitrogen is the prime component of chlorophyll formation in the plants which ultimately helps in increasing the photosynthetic rate due to more supplement of urea phosphate through foliar application has made changes among the net assimilation rate in different growth stages.

3.2.4 Harvest Index

The harvest index for all the treatments was calculated and presented in the table5. The result showed that no significant difference was noticed in harvest index among treatments including control. In fact the highest value of 46.17% was observed in control (of 46.17%) and lowest was observed in T_2 (50%STD (N&P) +100% K) i.e. 42.38%. Hence, it was evident that the economic yield (grain yield) was proportionate to the total biomass production irrespective of the treatment imposed. In the rhizosphere, nutrient content has been increased by basal application and with split foliar application increases the absorption of nutrients by the rice plant to create more chlorophyll and other assimilates. Those were translocated and used for higher production of grain. Foliar application of both nitrogen and phosphorus enhances absorption and translocation as it was easily reached through stomata to the plant tissue. With the help of more nitrogen, more protein and carbohydrates were formed for grain and straw production. Less translocation in the reproductive phase assimilates leads to more straw production, which also affects the harvest index. Due to the increase in straw production, the highest harvest index was observed with control than the grain yield that definitely affects the harvest index. In accordance with the above discussion Jagathjothi *et al*. (2012) [7] and Azarpour *et al*. (2014) [2] also observed the same effect.

Table 6: Effect of basal and foliar application of nutrients on leaf area index (cm^{-2})

Treatment	30 DAS		60 DAS		90 DAS		AT HARVEST	
		% C		% C		% C		% C
T_1 (Control)	0.46		1.48		1.30		0.83	
T_2 (50% STD (N & P) + 100% K)	0.64	37.94	1.96	32.95	1.35	3.60	1.00	20.59
T_3 (75% STD (N & P) + 100% K)	0.68	46.86	2.19	48.58	2.18	67.45	1.08	30.17
T_4 (100% STD)	0.80	72.25	2.48	67.80	1.90	46.12	1.25	49.89
T_5 (T_2+2% UP)	0.72	56.52	2.27	53.85	1.70	30.28	1.15	38.13
T_6 (T_2+2% DAP)	0.69	50.33	2.23	50.91	1.55	18.91	1.09	31.74
T_7 (T_2+2% N-P-K)	0.66	43.84	2.03	37.68	1.60	22.50	1.02	22.41
T_8 (T_3+2% UP)	0.94	102.99	3.12	111.64	2.51	92.82	1.58	89.64
T_9 (T_3+2% DAP)	0.82	77.00	2.59	75.33	2.10	61.46	1.40	68.03
T_{10} (T_3+2% N-P-K)	0.77	66.82	2.53	71.39	2.03	56.23	1.32	59.12
S.Em(±)	0.033		0.116		0.172		0.122	
C.D. (0.05)	0.099		0.346		0.512		0.362	
C.V.	8.01		8.80		16.38		18.01	

% C- Percent increase (+) or Decrease (-) over control

Table 7: Effect of basal and foliar application of nutrients on crop growth rate (g m^{-2} day^{-1})

Treatment Details	30-60 DAS	60-90 DAS	90- Harvest
T_1 (Control)	13.69	9.05	6.57
T_2 (50%STD (N&P)+100% K)	15.58	9.83	8.50
T_3 (75%STD (N&P)+100% K)	16.85	10.80	10.10
T_4 (100%STD)	19.31	13.05	10.58
T_5 (T_2+2%UP)	18.47	11.93	10.36
T_6 (T_2+2%DAP)	18.31	11.89	10.34
T_7 (T_2+2%N-P-K)	16.34	10.24	8.91
T_8 (T_3+2%UP)	29.78	16.73	13.24
T_9(T_3+2%DAP)	22.31	13.33	11.90
T_{10} (T_3+2%N-P-K)	20.75	13.27	10.81
S.Em(±)	0.021	0.030	0.049
C.D.(0.05)	0.062	0.090	NS
C.V.	6.30	14.49	27.98

Table 8: Effect of basal and foliar application of nutrients on net assimilation rate (g $hill^{-1}$ day^{-1})

Treatment Details	30-60 DAS	60-90 DAS
T_1 (Control)	0.197	0.099
T_2 (50%STD (N&P)+100% K)	0.197	0.110
T_3 (75%STD (N&P)+100% K)	0.209	0.116
T_4 (100%STD)	0.225	0.127
T_5 (T_2+2%UP)	0.224	0.124
T_6 (T_2+2%DAP)	0.212	0.117
T_7 (T_2+2%N-P-K)	0.202	0.116
T_8 (T_3+2%UP)	0.256	0.136
T_9(T_3+2%DAP)	0.245	0.135
T_{10} (T_3+2%N-P-K)	0.230	0.134
S.Em (±)	0.011	0.009
C.D. (0.05)	0.033	NS
C.V.	8.81	12.84

4. Conclusion

The present study indicated that foliar application of 75% STD + 2% urea phosphate resulted in higher Plant height, no. of Leaves, no. of tiller number, Number of Panicles per hill, Length of Panicle, Number of fertile and sterile grains per panicle, Sterility percentage, 1000 grain weight, Grain and straw yield, which was followed by the treatments T_9 (75% N & P) +100% K STD + 2% DAP spray) and T_{10} (75% N & P) + 100% K STD + 2% NPK spray). The growth parameters were also found to be higher when 75% STD + 2% urea phosphate is given as spray at 30-60 DAS and gradually shown a decrease in LAI, CGR and NAR and in case of HI there was no significant difference was noticed in harvest index among treatments including control. Hence it is evident from the above study that application of both basal dose of fertilizers based on STD and Foliar application of water-soluble nutrients enhance the nutrient absorption and supports in plant growth and development.

5. References

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