



## Influence of Foliar Nutrition on Growth and Yield of Transplanted Rice

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**A field experiment was carried out at the wetland of Tamil Nadu Agricultural University, Coimbatore during Navarai (Dec - Jan) season 2010–11 to investigate the effect of foliar nutrition on growth, yield attributes and yield of rice. The experiment was laid out in a randomized block design with twelve treatments replicated thrice. The results revealed that combined application of organic and inorganic sources with foliar spray had enhanced effect on growth and yield of rice crop over application of chemical fertilizers or organic sources alone. Among the nutrient management treatments, the plant height, dry matter production, number of tillers, yield attributes and yield of grain (5631 kg ha<sup>-1</sup>) and straw (7647 kg ha<sup>-1</sup>) were the highest with recommended integrated nutrient management (INM) practice +2% urea phosphate spray at panicle initiation and 10 days later. However the yield was comparable with recommended INM practice + 2% DAP spray at panicle initiation and 10 days later and recommended INM practice + 1% urea phosphate spray at panicle initiation and 10 days later.**

**Key words:** Foliar spray, rice, urea phosphate, vermicompost, yield.

Rice is India's preeminent crop and staple food of the people of the eastern and southern parts of the country. India is the second leading producer of rice in the entire world, preceded only by China. Demand for rice in India is projected at 128 million tonnes for the year 2012 and will require a production level of 3,000 kg/ha which is greater than the present average yield of 1,930 kg ha<sup>-1</sup> (Tiwari, 2002). This low level of productivity can be increased substantially by growing high yielding varieties or hybrids and by increasing both the area under balanced fertilizer use and application rates. But, over the last decade, average productivity of Tamil Nadu ranged from 3462 kg ha<sup>-1</sup> to 5369 kg ha<sup>-1</sup>. Hence, productivity enhancement is required to meet out the ever increasing demand.

An appropriate crop management strategies to increase the efficient use of inputs is needed to enhance the productivity. Nutrient management technology is oriented towards better utilization of organic sources that may be available cheaply or improving the formulation, timing and placement of chemical fertilizers so that the nutrient uptake by plants is maximized (Pandey, 1999). Generally foliar application of major nutrients was found to be as good as soil application (Subramanian and Palaniappan, 1981) in most of the pulse crop. Research on foliar nutrition with water soluble fertilizer is limited. Hence, the present investigation was undertaken to assess the effect of foliar nutrition on growth, yield attributes and yield of rice.

### Materials and Methods

A field experiment was carried out during Navarai (Dec - Jan) season 2010 – 11 at the wetland of Tamil Nadu Agricultural University, Coimbatore to study the effect of foliar nutrition on growth, yield attributes and yield of rice. The soil of the field was clay loam in texture. The experimental soil was low in available nitrogen (276.0 kg ha<sup>-1</sup>), medium in available phosphorus (21.4 kg ha<sup>-1</sup>) and high in available potash (489.0kg ha<sup>-1</sup>). The experiment was laid out in a randomized block design with twelve treatments replicated thrice. The treatments were, T<sub>1</sub> - 100% recommended dose of fertilizer (RDF) through inorganic, T<sub>2</sub> - 100% RDF through organic on N equivalent basis, T<sub>3</sub> - Recommended INM practice, T<sub>4</sub> - T<sub>1</sub> + 2% DAP spray at panicle initiation (PI) and 10 days later, T<sub>5</sub> - T<sub>1</sub> + 1% Urea phosphate spray at PI and 10 days later, T<sub>6</sub> - T<sub>1</sub> + 2% Urea phosphate spray at PI and 10 days later, T<sub>7</sub> - T<sub>2</sub> + 2% DAP spray at panicle initiation (PI) and 10 days later, T<sub>8</sub> - T<sub>2</sub> + 1% Urea phosphate spray at PI and 10 days later, T<sub>9</sub> - T<sub>2</sub> + 2% Urea phosphate spray at PI and 10 days later, T<sub>10</sub> - T<sub>3</sub> + 2% DAP spray at panicle initiation (PI) and 10 days later, T<sub>11</sub> - T<sub>3</sub> + 1% Urea phosphate spray at PI and 10 days later and T<sub>12</sub> - T<sub>3</sub> + 2% Urea phosphate spray at PI and 10 days later. The recommended dose of fertilizer was 175: 60: 60 kg NPK ha<sup>-1</sup>. Recommended INM followed for rice was 100% RDF + vermicompost 5t ha<sup>-1</sup>. Vermicompost applied on N equivalent basis (1.81%N) under complete organic treatment (T<sub>2</sub>) with the quantity of 9668 kg ha<sup>-1</sup>. A short duration rice hybrid CORH3 with 14 days old seedling was used

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as test hybrid which was cultivated with a spacing of 25 × 25 cm under SRI method.

Recommended dose of 175: 60: 60 kg ha<sup>-1</sup> of nitrogen, phosphorus and potassium were applied in the form of urea (46 per cent N), diammonium phosphate (18 per cent N, 46 per cent P<sub>2</sub>O<sub>5</sub>) and muriate of potash (60 per cent K<sub>2</sub>O). Fifty per cent of nitrogen and potassium and full dose of phosphorus were applied basally before transplanting. The balance fifty per cent of nitrogen and potassium was top dressed twice at active tillering and panicle initiation stages of rice crop for 100% RDF through inorganic (T<sub>1</sub>). As per the treatment schedule, full dose of 9668 kg vermicompost per hectare was applied basally before transplanting as nitrogen (1.81%N) equivalent basis for 100% RDF through organic (T<sub>2</sub>). For INM practice (T<sub>3</sub>), full dose of 5000 kg of recommended vermicompost ha<sup>-1</sup> was applied basally with the application of recommended dose of fertilizers as applied in T<sub>1</sub>.

The spray solution of DAP was prepared by dissolving 20g of DAP (18:46) in 1 litre of water to get 2 per cent concentration. DAP granules were dissolved in water and allowed to settle overnight

and the supernatant solution was taken for spraying after dilution with the remaining quantity of water. Similarly, Urea phosphate (17: 44) solution was prepared by dissolving 10g and 20g of Urea phosphate each in 1 litre to get 1 per cent and 2 per cent concentration. Urea phosphate solution was prepared instantly before spraying since it is a water soluble fertilizer that dissolves immediately in water. As per the treatment schedule, foliar application of Urea phosphate at 1 per cent, 2 per cent and DAP at 2 per cent was done manually with knapsack sprayer at panicle initiation stage of crop and 10 days later.

## Results and Discussion

### Growth parameters

In the present study, the different treatments significantly influenced the rice growth characters. Among the twelve treatments tried, recommended INM practice +2% urea phosphate spray at panicle initiation and 10 days later (T<sub>12</sub>) produced taller plants at harvest (Table 1). This was comparable with recommended INM practice + 2% DAP spray at PI and 10 days later (T<sub>10</sub>), recommended INM practice + 1% urea phosphate spray at PI and 10 days later

**Table 1. Effect of foliar nutrition of urea phosphate on growth and yield parameters of rice at harvest**

Treatments	Plant height (cm)	Dry matter production (kg ha <sup>-1</sup> )	No. of tillers m <sup>-2</sup>	No. of Productive tillers m <sup>-2</sup>	Panicle length (cm)	Total no. of grains panicle <sup>-1</sup>	Total no. of filled grains panicle <sup>-1</sup>	1000 grain weight (g)
T <sub>1</sub> : 100% RDF through inorganic	73.50	8868	244	178	22.0	125	105	19.67
T <sub>2</sub> : 100% RDF through organic	71.67	7537	163	116	20.5	112	97	19.53
T <sub>3</sub> : Recommended INM practice	76.76	10079	312	194	21.7	160	125	19.84
T <sub>4</sub> :T <sub>1</sub> + 2% DAP spray at PI and10 days later	76.41	9127	299	191	21.6	152	116	19.77
T <sub>5</sub> :T <sub>1</sub> + 1% UP spray at PI and10 days later	74.08	9039	277	191	21.1	138	107	19.70
T <sub>6</sub> : T <sub>1</sub> + 2% UP spray at PI and10 days later	76.39	9191	308	193	21.9	160	122	19.81
T <sub>7</sub> : T <sub>2</sub> + 2% DAP spray at PI and10 days later	72.58	8785	202	138	20.8	115	106	19.64
T <sub>8</sub> : T <sub>2</sub> + 1% UP spray at PI and10 days later	72.01	7823	172	123	20.6	106	99	19.57
T <sub>9</sub> : T <sub>2</sub> + 2% UP spray at PI and10 days later	72.43	8113	180	136	20.7	112	102	19.60
T <sub>10</sub> : T <sub>3</sub> + 2% DAP spray at PI and10 days later	78.18	11473	332	198	22.5	188	143	19.91
T <sub>11</sub> : T <sub>3</sub> + 1% UP spray at PI and10 days later	77.37	11169	326	197	22.1	175	136	19.87
T <sub>12</sub> : T <sub>3</sub> + 2% UP spray at PI and10 days later	78.34	11603	345	200	23.0	190	148	19.97
SEd	2.74	411	14	11	0.9	11	9	0.29
CD (P = 0.05)	5.68	832	28	22	1.9	23	18	NS

(RDF= Recommend dose of fertilizer, UP= Urea phosphate, PI= Panicle initiation)

(T<sub>11</sub>) and recommended INM practice (T<sub>3</sub>). The increased nitrogen addition might have increased the plant height favourably due to cell elongation and increased photosynthetic rate (Sharief *et al.*, 2006). The use of vermicompost in conjunction with chemical fertilizers have sparing effect on chemical fertilizers by possibly reducing the loss of the latter due to leaching and volatilization and enhanced rice growth parameters. The results corroborate with the findings of Guerrero *et al.* (2008).

Dry matter production of rice (Table.1) was higher under recommended INM practice +2% urea

phosphate spray at panicle initiation and 10 days later (T<sub>12</sub>) and was comparable with recommended INM practice + 2% DAP spray at PI and 10 days later (T<sub>10</sub>) and recommended INM practice + 1% urea phosphate spray at PI and 10 days later (T<sub>11</sub>). This might be due to application of full dose of nitrogen which resulted in increased enzyme protein and improved the photosynthetic rate and carbohydrate translocation which in turn played a major role in increasing the dry matter production. The addition of organic improved soil physical properties and nutrient uptake thereby the soil health favoured better

growth and dry matter production as reported by Satyanarayana *et al.* (2002).

The total number of tillers  $m^{-2}$  (Table1) was higher under recommended INM practice +2% urea phosphate spray at panicle initiation and 10 days later ( $T_{12}$ ) and was comparable with recommended INM practice + 2% DAP spray at PI and 10 days later ( $T_{10}$ ) and recommended INM practice + 1% urea phosphate spray at PI and 10 days later ( $T_{11}$ ) due to addition of nutrient through soil as well as foliar spray which increased the metabolic activity of plant (Ali *et al.*, 2005).

#### Yield attributes

The number of productive tillers per  $m^{-2}$ , panicle length, total number of grains panicle $^{-1}$ , total number of filled grains panicle $^{-1}$  and thousand grain weight were higher in recommended INM practice +2% urea phosphate spray at panicle initiation and 10 days later (Table 1) and was comparable with recommended INM practice + 2% DAP spray at PI and 10 days later ( $T_{10}$ ) and recommended INM

practice + 1% urea phosphate spray at PI and 10 days later ( $T_{11}$ ). The increased yield attributes in these treatments might be due to enhanced partitioning of assimilates from vegetative tissues to grains. The appropriate combination of organic and inorganic nutrient sources was found to enhance the efficiency of nutrients and ultimately increased yield attributes of rice. This is in line with the findings of Maragatham *et al.* (2010).

#### Grain and straw yield

Among the different treatments, the recommended INM practice + 2% urea phosphate spray at panicle initiation and 10 days later ( $T_{12}$ ) registered higher grain (5631  $kg\ ha^{-1}$ ) and straw (7647  $kg\ ha^{-1}$ ) yields (Table 2). The grain yield increase under this treatment was 28.3 percent over 100% RDF through organic ( $T_2$ ). This could be due to apart from N and P content, urea phosphate also contains minor nutrients ( Mg- 0.11 %, S-0.1 %, B-0.003 %, Fe- 0.04 %, Cu- 0.001 %, Mn- 0.004 %, Zn- 0.001 % and Mo- 0.001%) which have positive effect on yield parameters of rice. Further, foliar spray of

**Table 2. Effect of foliar nutrition of urea phosphate on yield and economics of rice**

Treatments	Grain yield ( $kg\ ha^{-1}$ )	Straw yield ( $kg\ ha^{-1}$ )	Gross return (Rs.)	Net return (Rs.)	B:C ratio
$T_1$ : 100% RDF through inorganic	4419	6483	46254	33054	3.50
$T_2$ : 100% RDF through organic	4036	5075	41396	8996	1.28
$T_3$ : Recommended INM practice	5060	6850	52386	26486	2.02
$T_4$ : $T_1$ + 2% DAP spray at PI and 10 days later	4833	6812	50310	36510	3.65
$T_5$ : $T_1$ + 1% UP spray at PI and 10 days later	4752	6633	49401	35426	3.53
$T_6$ : $T_1$ + 2% UP spray at PI and 10 days later	5048	6702	52131	37781	3.63
$T_7$ : $T_2$ + 2% DAP spray at PI and 10 days later	4333	5550	44551	11551	1.35
$T_8$ : $T_2$ + 1% UP spray at PI and 10 days later	4095	5203	42060	8885	1.27
$T_9$ : $T_2$ + 2% UP spray at PI and 10 days later	4202	5408	43230	9680	1.29
$T_{10}$ : $T_3$ + 2% DAP spray at PI and 10 days later	5439	7302	56253	29753	2.12
$T_{11}$ : $T_3$ + 1% UP spray at PI and 10 days later	5393	7083	55620	28945	2.09
$T_{12}$ : $T_3$ + 2% UP spray at PI and 10 days later	5631	7647	58324	31274	2.16
SEd	159	221	-	-	-
CD (P = 0.05)	329	459	-	-	-

(RDF= Recommend dose of fertilizer, UP= Urea phosphate, PI= Panicle initiation)

nutrients resulted in effective absorption by plants and translocation of assimilates more efficiently for developing grains for proper filling by increased leaf nitrogen content, chlorophyll synthesis and by regulating cellular functions (Ward and Shroedar, 1994). The grain and straw yield under  $T_{12}$  were comparable with recommended INM practice + 2% DAP spray at PI and 10 days later ( $T_{10}$ ) and recommended INM practice + 1% urea phosphate spray at PI and 10 days later ( $T_{11}$ ).

#### Economics

The economic analysis in rice revealed that the highest gross return (Rs. 58324  $ha^{-1}$ ) was obtained with recommended INM practice + 2% urea phosphate spray at panicle initiation and 10 days

later ( $T_{12}$ ). This was followed by recommended INM practice + 2% DAP spray at panicle initiation and 10 days later ( $T_{10}$ ) which recorded a gross return of Rs. 56,253  $ha^{-1}$  as compared to all other treatments due to higher grain and straw yield.

Application of 100% RDF through inorganic + 2% DAP spray at panicle initiation and 10 days later ( $T_4$ ) and 100% RDF through inorganic + 2% urea phosphate spray at panicle initiation and 10 days later ( $T_6$ ) secured the highest net return of Rs.36510 and Rs. 37,781 per hectare with the B:C ratio of 3.65 and 3.63, respectively. This treatment recorded lower cost of production. Chaity Kundu and Sarkar (2009) reported the pronounced effect of foliar application on net return and B:C ratio in rice.

The study revealed that application of recommended INM practice (100% RDF with vermicompost 5t ha<sup>-1</sup>) + 2% urea phosphate spray at panicle initiation and 10 days later holds promise in enhancing the rice productivity. With regard to economics, application of 100% RDF through inorganic + 2% either DAP or UP spray at PI and 10 days later recorded higher net return and B:C ratio compared to all other treatment combinations due to reduced cost of cultivation.

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