

Effect of liquid inorganic and organic fertilizers on the growth and yield of rice

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Abstract

Two field experiments were conducted with Co-51 variety at Annamalai University in randomised block design comprising ten treatments to determine the effect of foliar application of liquid inorganic and organic fertilizers alone and in combination with 75 % recommended NPK on growth and yield of rice. The results revealed that application of 75 % NPK with alternate spraying of liquid fertilizers - SPIC NPK and Isabion on 10, 20, 30, 40, and 50 DAT increased the plant height (2.3,8.1 cm), LAI (1.3,1.9), number of tillers /hill (8.3) and grain yield (530 Kg/ha) compared to 75 % recommended NPK application alone. The same treatment increased the grain yield up to 141 Kg/ha over 100 % recommended NPK.

Keywords: Polyfeed, amino acid, plant height, tillers, LAI, Grain yield

Introduction

Agriculture plays a vital role in the Indian economy and out of the total population 54.6 per cent people are engaged in agriculture and allied activities. Among the Asian countries, China ranks first in production followed by India. Among the South Asian countries, India stands first position in Area (44.16 M ha), Production (116.48 Million metric tonnes), and productivity (3.96 t/ha) (USDA, 2019) which is low compared to world average of 4.58 t/ha. In India, rice is grown in 44.16 million hectares and the production level is 116.48 million tonnes, while productivity is 3.96 t/ha. In Tamil Nadu, rice occupied an area of 1.78 M ha with production and productivity of 6 mt and 3.37 t/ha, respectively (Annual report, 2017-18). The applied fertilizers supplying NPK undergo physical, chemical, and biological transformation processes in the soil. The NPK use efficiency is 30-50, 15-20 and 70-80 %, respectively. Several thousand crores of rupees are wasted due to losses of nutrients. Further, leaching and volatilization loss of N pollutes the environment. The N recovery in basal, mid tillering, panicle initiation and flowering stages are in the range

of 15-30, 30-50, 45-75 and 35-60 % respectively. Foliar fertilization is one of the plant-based interventions to increase nutrient use efficiency. Water-soluble NPK (19:19:19) fertilizers are designed to provide complete plant nutrition throughout the season by fertigation and through foliar application for field crops, vegetables, fruit trees and flower crops grown in all environments. It is safe to use, free of chloride, sodium, other detrimental elements, with high-quality ingredients, instant uptake and enriched with a high concentration of micronutrients. Foliar application improves the nutrient uptake of plants, nutrient use efficiency and minimizes the losses by leaching. Foliar application of polyfeed @ 1 % along with recommended NPK increased the growth and yield components of ADT-R 47 rice (Kunjammal et al., 2016). Isabion is a product of biological activator, composed of free amino acids. Amino acids are important for plant and pollen fertility, necessary to start cell division, regulation of water balance, stimulation of hormone metabolism, readymade building blocks for proteins, stress-resistant and precursor of auxin. It stimulates the basic functions of crops, promotes vegetative



growth, root growth and vigorous development of buds, induces greater flowering, promotes pollination, fruit set, and improves the quantity and quality of the produce. In rice, it helps in overcoming threats due to sudden or extreme heat and cold in young rice plants. Yield components and yield of rice was increased due to isabion application along with recommended NPK (Venkatesh Prasath et al., 2017). With a view to enhance the yield of rice, this study was conducted to know the effect of foliar application of Polyfeed, SPIC NPK and Isabion applied individually as well as in combination with 75 per cent of recommended NPK, on growth and yield of rice.

Materials and Materials

Two field experiments were conducted in the experimental farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, during December 2019 and February 2019 with rice variety Co-51. The rice crops were raised during the Navarai and late Navarai seasons. The experimental farm is situated at 11°24' North Latitude and 79°44' East Longitude with an altitude of +5.79 m above mean sea level.

The soil of experimental fields was clayey loam in texture with low in available Nitrogen (240, 220 Kg/ha), medium in available Phosphorus (17.8, 18 Kg/ha), and high in available Potassium (335, 315 Kg/ha). The experiments were conducted in Randomized Block Design, consisting of ten treatments with three replications. The treatments were T₁ - 100 % Recommended NPK, T₂ - 75 % Recommended NPK, T₃ - T₂ + Polyfeed spray 5 times @ 5 g/l at 10, 20, 30, 40, and 50 DAT, T₄ - T₂ + SPIC NPK spray 5 times @ 5 g/l at 10, 20, 30, 40, and 50 DAT, T₅ - T₂ + Isabion spray 5 times @ 5 ml/l at 10, 20, 30, 40, and 50 DAT, T₆ - T₂ + Polyfeed spray 3 times @ 5 g/l and Isabion spray 2 times @ 5 ml/l at 10, 20, 30, 40, and 50 DAT, T₇ - T₂ + SPIC NPK spray 3 times @ 5 g/l and Isabion spray 2 times @ 5 ml/l at 10, 20, 30, 40, and 50 DAT, T₈ - T₂ + Alternate spray of Polyfeed @ 5 g/l and Isabion @ 5 ml/l at 10, 20, 30, 40, and 50 DAT, T₉ - T₂ + Alternate spray of

SPIC NPK @ 5 g/l and Isabion @ 5 ml/l at 10, 20, 30, 40, and 50 DAT and T₁₀ - T₂ + Urea spray 3 times @ 10g/l and KCl spray 2 times @ 10g/l at 10, 20, 30, 40, and 50 DAT. The spray applications were carried out with the help of water @ 500 l/ha using knapsack sprayer during evening hours. For the experiments 29 and 21 days old seedlings were transplanted @ 2 /hill with a spacing of 15x10 cm respectively. A recommended fertilizer schedule of 120:40:40 was adopted for 100 per cent and from which 75 per cent NPK was calculated and applied to the respective plots as per treatment schedule. The half of N, entire P and half of K were applied basally. The remaining quantities of N and K were top dressed in two equal splits at maximum tillering and flowering stages. Various growth and yield parameters were recorded from five tagged plants in each plot periodically. The grain yield was recorded plot-wise and computed.

Results and Discussion

Data on growth parameters revealed that, among the treatments, T₉ (T₂ + Alternate spraying of SPIC NPK and Isabion 5 times spray at 10, 20, 30, 40 and 50 DAT) resulted in the tallest plants and the heights recorded were 16.9 and 50.8 cm on 25 and 50 DAT, respectively (**Table 1**). Among the individual foliar sprays along with 75% recommended NPK, T₅ (T₂ + Isabion foliar spray 5 times on 10, 20, 30, 40 and 50 DAT) was the best on par with continuous foliar application of Polyfeed / SPIC NPK, 3 times followed by 2 times Isabion spray. Application of 25 % less than recommended NPK resulted in reduced plant height to the tune of 1.4 and 5.1 cm compared to 100 % NPK application, respectively at both the stages.

The treatment, T₉ (T₂ + Alternate spraying of SPIC NPK and Isabion 5 times spray on 10, 20, 30, 40, and 50 DAT) was significantly superior to remaining treatments in showing the highest number of tillers/hill (23.6). This might be due to the presence of macronutrients in the soil from initial stages of the crop growth and supplemental feeding of water-soluble NPK and amino acid resulting in enhanced metabolic activity of the plants leading to more

number of tillers. The next best treatment was T8 (T2 + Alternate spraying of Polyfeed and Isabion 5 times spray on 10, 20, 30, 40 and 50 DAT). A comparable effect was observed among the individual foliar sprays along with 75 % recommended NPK. Continuous application of Polyfeed/SPIC NPK 3 times along with Isabion 2 times on 10, 20, 30, 40 and 50 DAT showed similar effect. Application of 25 % less than recommended NPK reduced the number of tillers/hill to the tune of 4.9 compared to 100% recommended NPK.

The treatment, T9 also resulted in the highest leaf area index of 2.98 and 4.89 on 25 and 50 DAT, respectively. Increased leaf area is a base for better photosynthesis. Increased LAI recorded in this treatment might be due

to the availability and absorption of macronutrients from initial stages of the crop growth from the soil or through foliar feeding favouring the crop growth, plant height, tiller number, leaf length and width. This result is in conforms to the finding of Kunjammal et al., (2016). T8 (- T2 + Alternate spraying of Polyfeed and Isabion 5 times spray on 10, 20, 30, 40, and 50 DAT) was the next best treatment, while among the individual foliar applications, T5 (T2 + Isabion foliar spray 5 times on 10, 20, 30, 40, and 50 DAT) resulted in LAI of 2.23 and 3.72 on 25 and 50 DAT higher than T2 treatment (- 75% recommended NPK). Continuous foliar application of SPIC NPK 3 times along with 2 times spray of Isabion was superior to polyfeed and isabion application at both the stages of observation.

Table-1 Effect of inorganic and organic liquid fertilizers on growth and yield of Rice (Pooled data)

Treatments	Plant height (cm) DAT		Number of tillers/hill 50 DAT	LAI DAT		Grain yield Kg/ha
	25	50		25	50	
T1 – 100 % Recommended NPK	16.0	47.8	20.2	2.57	4.41	4486
T2 – 75% Recommended NPK	14.6	42.7	15.3	1.68	2.98	4097
T3 - T2 + Polyfeed NPK spray 5 times on 10, 20, 30, 40 and 50 DAT	15.1	44.1	17.0	1.97	3.34	4206
T4 - T2 + SPIC NPK foliar spray 5 times on 10, 20, 30, 40 and 50 DAT	15.4	44.6	17.1	2.09	3.54	4237
T5 - T2 + Isabion foliar spray 5 times on 10, 20, 30, 40 and 50 DAT	15.5	45.2	18.2	2.23	3.72	4265
T6 -T2 +Polyfeed 3 times foliar spray +Isabion 2 times foliar spray on 10, 20, 30, 40 and 50 DAT	15.6	45.9	18.5	2.36	3.87	4381
T7 - T2 + SPIC NPK 3 times spray + 2 times Isabion spray on 10, 20, 30, 40 and 50 DAT	15.8	46.7	19.4	2.45	4.09	4439
T8 - T2 + Alternate spraying of Polyfeed and Isabion (totally 5 times spray) on 10, 20, 30, 40 and 50 DAT	16.1	49.4	21.4	2.71	4.64	4588
T9 - T2 + Alternate spraying of SPIC NPK and Isabion (totally 5 times spray) on 10, 20, 30, 40 and 50 DAT	16.9	50.8	23.6	2.98	4.89	4627
T10 - T2 + Urea spray 3 times and KCl spray 2 times on 10, 20, 30, 40 and 50 DAT	14.6	43.25	16.4	1.79	3.16	4147
S. Ed	0.168	0.631	0.984	0.041	0.053	88.6
C.D (P = 0.05)	0.3524	1.323	2.0625	0.0859	0.01112	185.87



Application of 25 % less than recommended NPK reduced LAI compared to 100 % NPK with values of 1.68, 2.98 on 25 and 50 DAT, respectively.

Among all the the treatments T9 (-T2 + Alternate spraying of SPIC NPK and Isabion totally 5 times spray on 10, 20, 30, 40, and 50 DAT) resulted in the highest grain yield of 4627 kg/ha which was 12.94% and 3.14% higher than T2 (75% recommended NPK) and T1 (100% recommended NPK), respectively and on par with T8 (- T2 + Alternate spraying of Polyfeed and Isabion 5 times spray on 10, 20, 30, 40, and 50 DAT).

The grain yield increase was due to increased uptake of nutrients from the soil, increased N assimilation and vigour inducing character of growth-promoting organic amino acid fractions. All these influenced the physiological and morphological characters of the plant in terms of tallest plants, higher tillers, LAI and finally the grain yield. Similar result was obtained by Sorour et al, (2015). Individual foliar application five times on 10, 20, 30, 40, and 50 DAT increased the grain yield by 109 to 168 kg/ha compared to T2 (75% recommended NPK). Among the continuous foliar application of Polyfeed/SPIC NPK 3 times followed by Isabion 2 times spray, T7 (T2 + SPIC NPK 3 times foliar spray followed by Isabion 2 times foliar spray on 10, 20, 30, 40, and 50 DAT) had an edge over T6 (- T2 + Polyfeed 3 times foliar spray +Isabion 2 times foliar spray on 10, 20, 30, 40, and 50 DAT). Application of 25 % less than recommended NPK resulted in reduced yield to the tune of 389 Kg/ha

compared to T1 (100 % recommended NPK). Foliar application of urea 3 times followed by KCl 2 times increased the grain yield up to 50 kg/ha over T2 (75% recommended NPK).

Overall, application of 75 % recommended NPK + alternate spraying of SPIC NPK and Isabion on 10, 20, 30, 40, and 50 DAT was the best treatment and is recommended to get higher grain yields.

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