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Enhancing rice (*Oryza sativa* L.) productivity through plant growth regulators

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Abstract

An experiment was conducted at AC& RI, Killikulam to study the foliar application of plant growth regulator and nutrients in *rabi* Rice during 2011-2012. The experiment was laid out in Randomized Block Design with 16 treatments and replicated thrice. The result revealed that foliar spray of Triacantanol 2 ppm + Cytokinin 10 ppm + Polyfeed 1% + KCl 1% given at 35 and 65 DAT along with application of recommended dose of fertilizer increased all yield attributes *viz.*, dry matter production (13.96 t ha⁻¹), number of productive tillers (548 m⁻²), panicle length (23.8 cm) and decreased sterility level (12.5%). Further, the treatment recorded higher grain yield of 6.2 t ha⁻¹ and straw yield of 6.95 t ha⁻¹. It has been learned through this study, to maximize rice production in *rabi* season, by foliar application of Triacantanol 2 ppm + Cytokinin 10 ppm + Polyfeed 1% + KCl 1% applied at 35 and 65 DAT along with recommended dose of fertilizer as a viable nutrient management package to enhance grain yield in ADT 47 rice variety during *rabi* season.

Keywords: Cytokinin, foliar spray, KCl, poly feed

Introduction

Rice (*Oryza sativa* L.) is a staple food for millions of people in the world, particularly in developing countries. About 90 per cent of rice grown in the world is produced and consumed in Asian countries. India rank first in respect of area (44.50 million ha), second in production (102.75 million tonnes), with the productivity of rice (2.20 t ha⁻¹). Rice productivity level could not be maintained because of significant control exercised by seasons. When compared to rice grown under summer season (4.79 t ha⁻¹), the yield of *rabi* season rice is much lower (3.94 t ha⁻¹) and this could be attributed to lower level of solar radiation and decreased temperature pertaining during *rabi* season (GOTN, 2015). Under low light conditions, the crop suffered due to higher sterility, which accounted for low yields during *rabi* season. Physiological efficiency including photosynthetic ability of plants and offer a significant role in realizing higher crop yields. Though, the PGR have great potential, its application and accrual assessments etc., have to be judiciously planned in terms of optimal concentration, stage of application and seasons. Nutrients also have important role in plant metabolism, growth and developmental processes and helps in increasing the biomass production and yield. In this content, a field experiment was conducted to maximize the production of *rabi* season rice through foliar nutrition of plant growth regulators and nutrients with the objective of evolving best PGR and nutrient foliar spray combination for *rabi* rice on their growth and productivity.

Materials and Methods

The field experiment was conducted at Agricultural College and Research Institute, Killikulam during *rabi* 2011-12. The experimental site is geographically located in the southern part of Tamil Nadu at 8°46' N latitude and 77° 42' E longitudes at an altitude of 40 meters above MSL. The soil of the experiment site was sandy clay loam in texture with low available nitrogen (246 kg ha⁻¹) (Kjeldahl method) and high in phosphorus (18.75 kg ha⁻¹) (Olsen's method) and high in potassium (236.00 kg ha⁻¹) (Flame photometric method) content, Organic carbon (0.56 %) and neutral in reaction with 7.0 pH (Potentiometric method). The experiment was laid out in Randomized Block Design and replicated thrice.

Rice variety ADT (R) 47 with a duration of 120 days was chosen. The field experiments consisting of 12 treatments comprised of combination of plant growth regulators and nutrients *viz.*, T1: Triacantanol 2 ppm + Cytokinin 10 ppm + Polyfeed 1% + KCl 1%, T2: T1

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(except KCl), T3: T1 (except polyeed), T4: T1 (except cytokinin), T5: T1 (except cytokinin and KCl), T6: T1 (except poly feed and KCl), T7: T1 (except cytokinin and poly feed), T8: T1 (except Triacantanol), T9: T1 (except Triacantanol and KCl), T10: T1 (except Triacantanol and poly feed), T11: T1 (except Triacantanol and cytokinin), T12: Triacantanol 2 ppm, T13: Cytokinin 10 ppm, T14: Polyfeed 1%, T15: KCl 1%, T16: control *i.e.*, no foliar spray. Foliar spray of plant growth regulator and nutrient was done at 35 DAT and 65

DAT as per the treatment schedule. Blanket recommendation of 150:50:50 kg NPK ha⁻¹ were applied common to all the treatments. The various biometric observations, analytical data of plant sample and the computed data were subjected to statistical tool as per the procedure given by Gomez and Gomez (1984) [3]. The treatment differences were worked out at five per cent probability level.

Results and Discussion

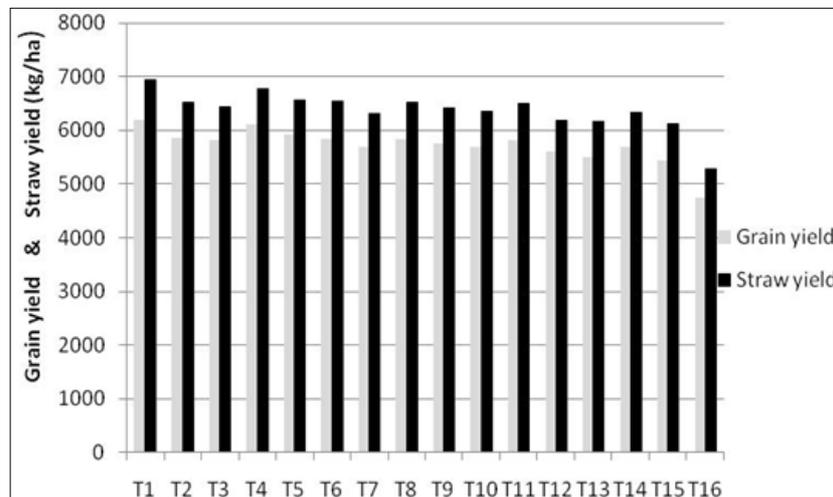


Fig 1: Effect of foliar spray of plant growth regulators and nutrients on yield of *rabi* rice

Foliar application of plant growth regulators and nutrients combination significantly influenced the yield and yield parameter (Figure 1, Table 1). Triacantanol 2 ppm + Cytokinin 10 ppm + Polyfeed 1% + KCl 1% spray at different stages increased the productive tillers (548 / m²) and lowered the sterility percentage (12.5%) of rice. This may be due to effect of Triacantanol reducing panicle senescence in rice by maintaining succinic dehydrogenase, thereby increasing the

number of panicles plant⁻¹, panicle weight and grain yield (Sharma *et al.* 2006) [9], Cytokinin increased the N content in flag leaf (Panday *et al.*, 2001) [7], The polyfeed fertilizer provides nutrients (NPK) to the plant (Kharub *et al.*, 2002) [5]. & KCl spray increasing enzyme activity, improving synthesis of protein, carbohydrates and fats, translocation of photosynthates (Mengel and Kirkby, 1997) [10].

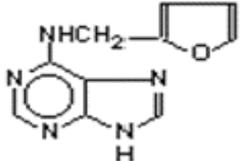
Table 1: Effect of foliar spray of plant growth regulators and nutrients on yield parameters and yield of *rabi* rice

Treatments	Yield parameters				
	No. of productive tillers m ⁻²	Panicle Length (cm)	Sterility percentage	Grain yield (kg ha ⁻¹)	Straw yield (kg ha ⁻¹)
T1- Triacantanol + Cytokinin + Polyfeed + KCl	548	23.8	12.5	6200	6950
T2- Triacantanol + Cytokinin+ Polyfeed	489	21.2	15.6	5865	6535
T3- Triacantanol + Cytokinin + KCl	453	19.7	17.2	5816	6440
T4- Triacantanol + Polyfeed + KCl	540	22.8	13.4	6100	6770
T5- Triacantanol + Polyfeed	507	21.9	14.8	5916	6575
T6- Triacantanol + Cytokinin	479	20.5	17.1	5840	6555
T7- Triacantanol + KCl	433	19	18.7	5685	6325
T8- Cytokinin + Polyfeed + KCl	472	19.8	17.2	5846	6525
T9 - Cytokinin + Polyfeed	442	19.2	18.1	5758	6420
T10- Cytokinin + KCl	432	18.5	19.5	5685	6350
T11- Polyfeed + KCl	470	19.8	18.2	5825	6510
T12- Triacantanol	416	18.1	21.9	5605	6195
T13- Cytokinin	411	17.8	23.7	5500	6160
T14- Polyfeed	426	19.1	17.5	5700	6340
T15- KCl	396	17.6	24.5	5440	6120
T16- Control	331	16	27.4	4750	5275
SEd	22	0.8	1.5	196	218
CD (p=0.05)	45	1.6	3	400	445

Plant growth regulator: Triacantanol (2 ppm) & Cytokinin (10 ppm)

Nutrients: Polyfeed (1 %) and Potassium chloride (1 %)

Table 2: The chemical formula and structure of foliar spraying nutrient and growth regulators illustrated

Trade Name	Chemical Name/ Molecular formula	Structure
Triacantanol	C ₃₀ H ₆₂ O	
Cytokinin	N-(2-Furanylmethyl)- 1H-purin-6-amine	
Polyfeed	NPK (19:19:19) + Mn, Fe, Cu, Zn, B and Mo	
Potassium Chloride (Muriate of potash)	KCl	

The enhancement of yield components through input management should pave the way for maximization of rice grain yield. Foliar application of Triacantanol 2 ppm + Cytokinin 10 ppm + Polyfeed 1% + KCl 1% recorded higher grain yield (6.2 t ha⁻¹) as well as straw yield (6.95 t ha⁻¹).

Conclusion

Plant growth regulators of triacantanol and cytokinin application in plants shows higher photosynthetic efficiency and enhanced source to sink relationship of the plant, increased uptake of nutrients and water, enhanced translocation and accumulation of sugar and other metabolites. This might be the reason for increase in the grain and straw yield of Rice. Foliar spaying of PGR and nutrients effectively absorbed by the plant and translocated more efficiently to the developing panicles, aiding in proper filling of the grain. It can be concluded that application of recommended dose of fertilizers @ 150:50:50 kg NPK ha⁻¹ and foliar spray of Triacantanol 2 ppm + Polyfeed 1% + KCl 1% given at 35 and 65 DAT is the viable nutrient management package to *rabi* rice for getting higher income through higher yield.

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