EFFECT OF BIOSTIMULANTS ON THE GROWTH ATTRIBUTES AND YIELD OF RICE

ABSTRACT

A field investigation was conducted at Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Chidambaram, Tamil Nadu during September - February 2022 to study the effect of biostimulants on the growth attributes and yield of rice. The experiment was laid out in a randomized block design with nine treatments and three replications. The treatments consisted of T_1 - 100% RDF (150:50:50 kg of N, P_2O_5 and K_2O), T_2 - 100% RDF + 3% Panchagavya spray at 30, 45 and 60 DAT, T_3 - 100% RDF + 5% Jeevamirtham spray at 30, 45 and 60 DAT, T_4 - 100% RDF + 3 % Dasagavya spray at 30, 45 and 60 DAT, T_5 - 100% RDF + 2% Humic acid spray at 30, 45 and 60 DAT, T_6 - 100% RDF + 5% Seaweed liquid fertilizer (*Sargassumwightii*) spray at 30, 45 and 60 DAT, T_7 - 100% RDF + 2% Effective microorganism inoculation spray at 30, 45 and 60 DAT, T_8 - 100% RDF + 1% Liquid biofertilizer spray at 30, 45 and 60 DAT and T_9 - 100% RDF + 5% Seaweed liquid fertilizer (*Ascophyllumnodosum*) spray at 30, 45 and 60 DAT. Among these treatments, it is observed that the application of a recommended dose of fertilizers along with 2 per cent humic acid spray at 30, 45 and 60 DAT had a remarkable effect on the resulted in enhanced values of growth attributes and yield *viz*., plant height (95.6 cm), number of tillers hill^{-1} (25.01), leaf area index (5.43), dry matter production (12927 kg ha^{-1}), root length (24.63 cm), root volume (34.73 cc), grain yield (5540 kg ha^{-1}) and straw yield (8200 kg ha^{-1}) of rice.

Comment [SL1]: Add statistical result

Keywords:*Growth, yield, rice, biostimulants and humic acid*

1. INTRODUCTION

Agriculture has a critical role in the Indian economy. It serves as its foundation and is acknowledged as the most common employment globally. Rice (*Oryza sativa* L.) is one of the world's most significant staple food grain crops, both in terms of farmed area and consumption levels. Rice is the most common ancient crop, growing in 117 countries and accounting for over 90% of global rice production and consumption in Asia [1]. Rice is cultivated in 114 countries across the world with an area of 165.25 million hectares with a production of 505.4 million tonnes and average productivity is 4.66 t ha^{-1} [2]. In India, rice is grown on approximately 44.6 million hectares, with a production of around 130.5 million tonnes and an average productivity of 2927 kg ha^{-1} [3].

Rice requires a large amount of nutrients to get its maximum production. Continuous and indiscriminate use of inorganic fertilizers in intensive cropping systems causes nutrient imbalances in the soil as well as environmental contamination, which has a negative impact on soil health, ecological dangers, and crop yields [4]. To maintain current food security and fulfill future food demands, innovative management strategies must be devised and tested to boost production. The use of biostimulants in modest doses improves physiological processes in plants, resulting in highquality product [5]. They improve plants metabolic and enzymatic activities, particularly during the early stages of crop development. They also improve nutrient absorption, making plants more resistant to stress and increasing output. As a result, these chemicals play a vital role in plant structural processes that promote growth, tolerance to abiotic and biotic stress, and increased product yield and quality. The use of biostimulants in agriculture is a sustainable approach that boosts output while minimizing environmental impact [6]. As a result, the current study was designed to investigate the influence of biostimulants on rice growth and yield.

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2. MATERIALS AND METHODS

The field experiment was conducted at Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Tamil Nadu during September - February, 2023 to study the effect of biostimulants on the growth and yield of rice. The experimental farm is geographically located at 11^{o} 24' N latitude and 79^{o} 44' E longitude, at an altitude of +5.79 m above MSL. The soil of the experimental field was clay loam in texture. The initial nutrient status of the experimental field soil was low in available nitrogen, medium in available phosphorus and high in available potassium. The field experiment was laid out in a randomized block design with three replications. The treatments consisted of T_1 - 100% RDF (150:50:50 kg of N, P_2O_5 and K_2O), T_2 - 100% RDF + 3% Panchagavya spray at 30, 45 and 60 DAT, T_3 - 100% RDF + 5% Jeevamirtham spray at 30, 45 and 60 DAT, T_4 - 100% RDF + 3 % Dasagavya spray at 30, 45 and 60 DAT, T_5 - 100% RDF + 2% Humic acid spray at 30, 45 and 60 DAT, T_6 - 100% RDF + 5% Seaweed liquid fertilizer (*Sargassumwightii*) spray at 30, 45 and 60 DAT, T_7 - 100% RDF + 2% Effective microorganism inoculation spray at 30, 45 and 60 DAT, T_8 - 100% RDF + 1% Liquid biofertilizer spray at 30, 45 and 60 DAT and T_9 - 100% RDF + 5% Seaweed liquid fertilizer (*Ascophyllumnodosum*) spray at 30, 45 and 60 DAT. BPT-5204 was the variety chosen for the experiment, and 30 kg of seed was sown per hectare at a spacing of 20 × 10 cm in a field that had been levelled and well-puddled. The foliar application of 3% Panchagavya, 5% Jeevamurtha, 3% Dasagavya, 2% Humic acid, 5% Seaweed liquid fertilizer, 2% Effective Microorganism inoculation and 1% Liquid Biofertilizer were sprayed as per the treatment schedule at 30, 45, 60 days after transplanting. Two hand weeding were done on 20 DAT and 45 DAT. The quantitative assessment of growth parameters and yield were recorded at

Comment [SL5]: There is no need to repeat the same sentence in every section of the manuscript respective stages of crop growth. The data collected from the field experiment was statistically analyzed.

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3. RESULT AND DISCUSSION

3.1 Growth attributes

The results of the field experiment involving inorganic fertilizers with biostimulants exhibit an impact on the growth and growth parameters on rice are furnished in Table 1. Among the various treatments, 100 per cent recommended dose of fertilizer and 2 per cent humic acid spray at 30, 45 and 60 DAT (T_5) performed the highest growth attributes *viz.,* plant height (95.6 cm), number of tillers hill^{-1} (25.01), leaf area index (5.43), dry matter production (12927 kg ha^{-1}), root length (24.63 cm), root volume (34.73 cc), grain yield (5540 kg ha^{-1}) and straw yield (8200 kg ha^{-1}) than rest of the treatments. It was followed by the application of a recommended dose of fertilizer along with Seaweed liquid fertilizer (*Sargassumwightii*) 5 per cent spray at 30, 45 and 60 DAT (T_6). The increased plant height could be attributed to an adequate supply of inorganic and humic acid to the plant, which resulted in rapid growth through good root establishment and various metabolic processes, ultimately performing better mobilization of synthesized carbohydrates into amino acids and protein, stimulating rapid cell division and cell elongation. Humic acid's auxin action enhances plant membrane permeability and intensifies enzyme systems, resulting in enhanced plant height and crop dry matter. These results are presented with the findings of [7] and [8].

The number of tillers hill^{-1} and LAI also significantly increased with the combination of 100 per cent RDF along with 2 per cent humic acid at 30, 45 and 60 DAT (T_5). The increased number of tillers might be attributed to the rapid availability of nutrients through inorganics in the latter phases of crop growth, as well as the delayed release of nitrogen and consistent release of other nutrients over a prolonged period of crop growth by organics. Productive tillers naturally stabilize as crop age increases. Humic acid improves nitrogen availability, which is required for vegetative development, leading in an increase in the number of tillers hill^{-1} and maximum LAI. The results are similar to the findings of [9]; [10] and [11].

3.2 Grain and straw yield

All the treatments significantly influenced the grain and straw yield of rice are presented in Table 2. The treatment 100 per cent RDF + 2 per cent humic acid spray at 30, 45 and 60 DAT significantly increased and enhanced the grain and straw yield of rice. This might be attributed to the rapid adsorption and absorption of more nitrogen, phosphorous, potassium, and micronutrients found in inorganic fertilizers and organic compounds. This leads to improved physiological and morphological characteristics, which are then reflected in better yield. Similarly, higher growth metrics such as plant height, the number of tillers per hill, the leaf area index, and dry matter production resulted in the maximum straw output. This results in similar findings of [12] and [13].

4. CONCLUSION

Based on the result of the field experiment, it is observed that the application of a recommended dose of fertilizers along with 2 per cent humic acid spray at 30, 45 and 60 DAT had a remarkable effect on the growth attributes and yield of rice. It is an effective practice for augmenting higher yield and has also been found to be agronomically feasible and economically viable. So, this practice can be recommended to the rice cultivating farmers of Tamil Nadu.

REFERENCES

1. Debbarma VICTOR, Abraham V, Abraham T, Debbarma S, Debbarma H. Influence of different planting methods and organic nutrients on growth and yield of rice (*Oryza sativa* L. sub sp. *Japonica*). The Bioscan. 2015;9:1039-1044.
2. USDA. World Agricultural Production. United States Department of Agriculture, Foreign Agricultural Service. Washington, D.C. 2022.
3. Ministry of Agriculture & Farmers Welfare, Government of India. Second Advance Estimates of Production of Foodgrains for 2023-24. New Delhi, India.
4. Sivanantha J, Sunil JA. The paddy cultivation in the era of corona virus (COVID–19) pandemic crises and its prompts changes in paddy cultivation. In Book: Latest innovation for future education (LIFE-2021), Agriculture and Food, ESN Publications, 2021;99-208.
5. Vasconcelos ACF, Chaves LHG. Biostimulants and their role in improving plant growth under abiotic stresses. In Book: Biostimulants in plant science. 2019;3-16.
6. Rodrigues M, Baptistella JLC, Horz DC, Bortolato LM, Mazzafera P. Organic plant biostimulants and fruit quality-A review. Agron. 2020;10(7):988.
7. Eshwar M, Srilatha M, BhanuRekha K, Harish Kumar Sharma S. Effect of humic substances (humic, fulvic acid) and chemical fertilizers on nutrient uptake, dry matter production of aerobic rice (*Oryza sativa* L.). J. Pharma. Phyochem. 2017;6(5):1063-1066.
8. Rajnesh T, Singh NB, Singh V, Kumar D. Effect of planting methods and integrated nutrient management on growth parameters, yield and economics of rice. J. Pharma. Phytochem. 2018;7(2):520-527.
9. Osman EAM, El-Masry AA, Khatab KA. Effect of nitrogen fertilizer sources and foliar spray of humic and / or fulvic acids on yield and quality of rice plants. Adv. Appl. Sci. Res. 2013;4(4):174-183.
10. Rasool G, Wahla AJ, Nawaz M, Rehman MA. Determination and evaluation of the effect of different dosesofhumic acid on the growth and yield of wheat (Triticumaestivum L.). J. Agri. Veter. Sci. 2015;8(2):5-7.

11. Balamurugan R, Babu R, Swaminathan C, Baskar K, Gopal, NO. Performance of organic nutrition on physiological characters and yield of aerobic rice. Int. J Cur. Micro. Appl. Sci. 2018;6:2936-2947.

12. Priyanka B, Ramesh T, Rathika S, Balasubramaniam P. Foliar application of fish amino acid and egg amino acid to improve the physiological parameters of rice. Int. J. Curr. Microbio. Appl. Sci. 2019;8(2):3005-3009.

Table 1.Effect of biostimulants on the growth attributes of rice crop at harvest

Treatments	Plant height (cm)	Number of tillers hill^{-1} (At maximu	Leaf area index	Dry matter production (kg ha^{-1})	Root length (cm) (At flowering	Root volume (cc) (At flowering
T_1 - 100% RDF	82.1	13.10	3.47	8153	17.47	26.33
T_2 - 100% RDF + 3% Panchagavya spray at 30,45 and 60 DAT	86.3	15.60	4.31	9526	19.70	27.73
T_3 - 100% RDF + 5% Jeevamurtha spray at 30,45 and 60 DAT	86.6	15.50	4.29	9489	18.63	29.23
T_4 - 100% RDF + 3% Dasagavya spray at 30,45 and 60 DAT	88.8	15.33	4.18	9390	20.80	30.87
T_5 - 100% RDF + 2% Humic acid spray at 30,45 and 60 DAT	95.6	25.01	5.43	12927	24..63	34.73
T_6 - 100% RDF + 5% Seaweed liquid fertilizer (*Sargassumwightii*) spray at 30,45 and 60 DAT	90.3	22.90	5.16	11120	24.00	34.47
T_7 - 100% RDF + 2% Effective microorganism inoculation spray at 30,45 and 60 DAT	87.6	19.02	4.73	10788	22.17	33.40
T_8 - 100% RDF + 1% Liquid biofertilizer spray at 30,45 and 60 DAT	88.7	17.02	4.47	9820	21.67	30.47
T_9 -100% RDF + 5% Seaweed liquid fertilizer (*Ascophyllum nodosum*)spray at 30,45 and 60	90.6	22.01	5.13	11160	23.33	33.27
S.Ed	**0.83**	**0.55**	**0.07**	**110.98**	**0.87**	**0.49**
CD (P=0.05)	**1.76**	**1.17**	**0.15**	**235.29**	**1.88**	**1.04**

Table 2.Effect of biostimulants on the grain yield and straw yield of rice crop at harvest

Treatments	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
T_1 - 100% RDF	4150	6990
T_2 - 100% RDF + 3% Panchagavya spray at 30,45 and 60 DAT	4490	7220

T_3 - 100% RDF + 5% Jeevamurtha spray at 30,45 and 60 DAT	4500		
T_4 - 100% RDF + 3% Dasagavya spray at 30,45 and 60 DAT		7210	4450
T_5 - 100% RDF + 2% Humic acid spray at 30,45 and 60 DAT	5540	8200	
T_6 - 100% RDF + 5% Seaweed liquid fertilizer (*Sargassumwightii*) spray at 30,45 and 60 DAT	5240	7820	
T_7 - 100% RDF + 2% Effective microorganism inoculation spray at 30,45 and 60 DAT	4820	7610	
T_8 - 100% RDF + 1% Liquid biofertilizer spray at 30,45 and 60 DAT	4630	7400	
T_9 -100% RDF + 5% Seaweed liquid fertilizer (*Ascophyllumnodosum*) spray at 30,45 and 60 DAT	5150	7840	
S.Ed	**58.00**	**89.79**	
CD (P=0.05)	**122.95**	**190.36**	