

Original Research Article

<https://doi.org/10.20546/ijcmas.2026.1505.003>

Influence of Plant Bio Regulators on Growth of Khamti Lahi Rice (*Oryza sativa* L.)

Devi Taku*, Kasinam Doruk and Lipi Rina

Himalayan University Jollang, Itanagar Arunachal Pradesh, India - 791111

*Corresponding author

ABSTRACT

A field experiment was carried out during the kharif season of 2025 at the Agriculture Research Farm at Himalayan University, Jollang, Itanagar, to examine the Influence of Plant Bio – Regulators on the Growth of Khamti Lahi Rice (*Oryza Sativa* L.). The experiment was laid out in a Randomized Block Design (RBD) with three replications and nine treatments, viz., T₁-Control, T₂- Seaweed extract-0.5 ml, T₃- Seaweed extract-0.5 ml + 1.5% Urea, T₄-Jeevamrut-100 ml, T₅- Jeevamrut-100 ml + 1.5% Urea, T₆- Thiourea-500 ppm, T₇- Thiourea-1000 ppm, T₈- Gibberellic acid-100 ppm, T₉- Gibberellic acid-100 ppm + 1.5% Urea. The observation recorded at 30, 60, and 90 days after transplanting (DAT) showed significant differences among treatments in term of plant height, leaf length, number of tillers, leaf width, dry matter accumulation, and yield attributes. The results revealed that treatments T₈ (Gibberellic acid-100 ppm) was found to be the most effective in enhancing growth and yield parameters, followed by its combined application with urea T₉ (Gibberellic acid -100 ppm +1.5% Urea). In contrast, the control treatment T₁ consistently recorded the lowest value, which did not receive any growth regulators, or nutrient supplementation. The findings of the study indicate that the application of plant bio-regulators, particularly gibberellic acid, either alone or in combination with urea significantly improves growth, yield and nutrient uptake of khamti lahi rice under the agro-climatic conditions of Arunachal Pradesh.

Keywords

Plant bio regulators on growth of khamti lahi rice.

Article Info

Received:

15 March 2026

Accepted:

28 April 2026

Available Online:

10 May 2026

Introduction

Rice (*Oryza sativa* L.) is one of the most popular and important cereal crops. It is the staple food of more than three billion people. Bhattacharjee *et al.*, (2002) reported in 39 countries that comprises of nearly half of the world's population. Rice can provide food for almost half of the world's population, accounting for over 21% of human caloric requirement and upto 76% of calorific intake of southeast-asian inhabitant. Zhao *et al.*, (2020).

Over 2 billion people in Asia alone derive 80% of their energy needs from rice, which contains 80% carbohydrates, 7-8% protein, 3% fat and 3% fiber (Chaudhari *et al.*, 2018).

India and china are the top countries to produce total rice production in the world (Wallach 2022). Rice is one of the major contributions to the food grain production contributing approximately 43% of the total grain production in India (Upendra *et al.*, 2013). India is the

second-largest rice production country in the world and the crop contributed over 42% to the annual food grain production of the country. In India, it is cultivated over an area of 43.86 million hectares with 117.47 million tons of production (DAC&FW, 2019-2020).

Rice has white, red, purple, and black colours based on its pigment. Pigmented rice contains anthocyanins, which have the potential to be used as a source of antioxidants apart from being a source of starch.

In India, rice holds profound socio-cultural and economic value. The northeastern region of India, including states such as Assam and Arunachal Pradesh, harbors an exceptional diversity of rice land races and local cultivars that reflect unique agro-ecological adaptations and indigenous preferences (Das *et al.*, 2013). These landraces are often characterized by distinct grain types, aroma, culinary qualities, and resilience to local climatic conditions. Among them, khamti Lahi stands out as a traditional rice cultivar of great importance to tribal farmers in eastern Arunachal Pradesh. This rice variety is not only integral to local subsistence cropping system but also linked to cultural identity and dietary habits of the Khamti tribe (Barua *et al.*, 2025).

Most of the farmers of Arunachal Pradesh, particularly in the districts of Namsai, Changlang and Lohit cultivate Khamti Lahi Rice, locally known as Khaw Tai, is a traditional short-grained, glutinous rice cultivated by the Tai Khamti community of Arunachal Pradesh. The name derives from “Khaw” meaning rice and “Tai” referring to the Tai ethnic group, reflecting its cultural association with the community. Recent developments in geographical indication (GI) protection have recognized Khamti Rice under the GI Registry of India, granting it a protected geographic identity as “Arunachal Pradesh Khaw Tai (Khamti Rice)”.

This official designation confirms both its regional uniqueness and its importance to local agro-cultural system. GI registration not only provides legal protection against misuse of the variety’s name outside its native region but also facilitates market regional and national markets (Geographical Indications Registry, 2023).

Nutritional studies on indigenous rice varieties of Assam and Arunachal Pradesh revealed that Khamti Lahi contains a high carbohydrate content, making it a valuable source of dietary energy. Although it does not rank highest in protein or antioxidant properties

compared to other local varieties, its cultural value, sensory qualities, and heritage significance establish it as an irreplaceable crop (Longvah *et al.*, 2020).

GA₃ application was very effective in increasing seed set rate and grain yield through elongation of plant height, promoting panicle and spikelet exertion, enhancing stigma exertion and longevity and receptivity in rice and also key to win higher grain yield in rice production (Gavino *et al.*, 2008).

Gibberellic acid influences that hormonal balance within the plant, promoting the transition from vegetative to reproductive stages. This can lead to earlier panicle initiation and flowering, critical steps toward early crop maturity (Haifaa and Moses, 2022).

Seaweeds are rich in growth regulators like cytokinins, auxins, gibberellins and essential nutrients and they have been shown to improve nutrient uptake, stress tolerance and yield (Sasi *et al.*, 2021).

Materials and Methods

The experiment was carried out at agriculture field, Jollang, college of Agricultural, Himalayan University, Itanagar, Arunachal Pradesh during the period of kharif season of 26 June 2025. The experimental farm is situated at 27.074684 ° N latitude and 93.652878 ° E longitude with an average elevation of 320 meters. It was undertaken with the objective to analyze the different rice varieties and to assess their performance in kharif season.

The treatments include T₁-Control, T₂- Seaweed extract-0.5ml, T₃- Seaweed extract-0.5ml +1.5% Urea, T₄-Jeevamrui-100ml, T₅- Jeevamrui-100ml + 1.5% Urea, T₆- Thiourea -500 ppm, T₇- Thiourea-1000 ppm, T₈-Gibberellic acid-100 ppm, T₉- Gibberellic acid-100 ppm +1.5% Urea. The experiment was carried out in Randomized Block Design (RBD) in the year 2025-2026.

The climate condition of Itanagar is humid subtropical climate with distinct seasons. The rainy season usually starts from May and it extends up to September and October onwards. The meteorological data of weather parameter, temperature, rainfall, relative humidity, and sunshine hours recorded during the period of the experimentation have been presented in the table. The mean minimum and maximum temperature recorded during the cropping season was 22.9 °C and 25.5 °C, respectively. The average relative humidity 8.0%.

Crop Growth Attributes

Plant height was measured in centimeters from the base to the tip of the plant for 5 randomly selected plants in each plot. These plants were tagged so the same ones could be observed again later, measurements were taken three times at 30, 60 and 90 days after sowing (DAT). The average height of the plants in each treatment was calculated for each observation time. Leaf length was measured from the base to the tip of the leaf on 5 randomly selected plants in each plot. These plants were tagged and measured again later. Observation was taken at 30, 60, and 90 days after sowing (DAT), and the average leaf length for each time point. The dry weight of a plant is the weight remaining after all the water has been eliminated. This is usually achieved by heating the plant material at a temperature until all the moisture has been dried out.

Results and Discussion

The growth and development parameters of Khamti Lahi rice were recorded under a Randomized Block Design (RBD) with three replications. Observation was taken for various traits such as plant height (cm), leaf length, numbers of tillers, and leaf width. The data were statistically analyzed to compute the general mean, standard error (Sed), and critical difference (CD) for each trait.

Plant height

Plant height of Khamti Lahi rice recorded at 30, 60 and 90 DAT was statistically analyzed and presented in table 1.

At 30 DAT, significant variation in plant height was observed among different treatments. The tallest plants were recorded under treatments T8 (Gibberellic acid 100 ppm) with a mean height of 61.53 cm, which was statistically superior over other treatments. This was closely followed by T9 (Gibberellic acid 100 ppm + 1.5% Urea) with 60.50 cm and T4 (Jeevamrut 100 ml) with 59.77 cm. In contrast, the lowest plant height 51.20 cm was observed in T1 control. The differences among treatments exceeded the critical difference indicating statistical significance.

At 60 DAT, a similar trend was observed. Treatment T8 recorded the maximum plant height, followed by T9 and T4. The minimum plant height was again recorded under

the control T1. The differences were found to be statistically significant as they were greater than the CD value.

At 90 DAT, plant height continued to increase across all treatments. The highest plant height was recorded in T8, which remained significantly superior. Treatments T9 and T4 also showed comparatively higher plant height. The lowest value was recorded in T1 control. The variation among treatments was statistically significant.

The increased plant height under gibberellic acid treatments can be attributed to its role in promoting cell elongation and division, leading to greater internodal length. Foliar application of nutrients such as urea, among the bio-inputs like jeevamrut and seaweed extract, likely enhanced nutrient availability and uptake, thereby supporting vegetative growth. Gibberellic acid also stimulates physiological processes such as enzyme activity and photosynthesis, contributing to vigorous growth. In contrast, reduced plant height in the control may be due to limited nutrient availability and the absence of growth-promoting substances. Lower growth in some treatments could also result from suboptimal nutrient levels or lack of synergistic interaction among inputs. These findings are consistent with reports by [Verma *et al.*, \(2026\)](#) and [Taiz and Zeiger \(2025\)](#). Who highlighted the role of growth regulators and nitrogen in enhancing plant height.

Total number of tillers at 30, 60 and 90 DAT

The total number of tillers in Thai Khamti rice was recorded at 30, 60 and 90 days after transplanting (DAT). The observed data were subjected to statistical analysis, and the results are presented in Table 2.

At 30 DAT, significant differences were observed among the treatments with respect to tiller production. The highest number of tillers (16.54) was recorded in T8 (Gibberellic acid- 100 ppm), which was statistically superior to the other treatments. This was followed by T9 (Gibberellic acid-100ppm + 1.5% Urea) with (15.70) tillers and T4 (Jeevamrut-100ml) with (14.90) tillers. The lowest number of tillers (10.60) was observed in the control treatment T1, indicating reduced vegetative growth under no-input conditions.

At 60 DAT, a similar trend was noted, with T8 recording the maximum number of tillers (22.90). Followed by T9 (21.50) and T4 (20.37). The control T1 exhibited the

minimum tiller count (13.27). The differences among treatments were found to be statistically significant, highlighting the effectiveness of growth regulators and organic inputs in enhancing tillering.

At 90 DAT, the superiority of T8 (Gibberellic acid-100 ppm) was again evident, producing the highest number of tillers (24.30), followed by T9 (Gibberellic acid-100 ppm + 1.5% Urea) with (23.30) and T4 (Jeevamrut- 100 ml) with (22.77) tillers. The controls treatment T1 recorded the lowest value (16.87), confirming the consistent positive impact of applied treatments over the untreated control.

Overall, the results clearly demonstrate that the application of gibberellic acid, either alone or in combination with urea, significantly improved the tillering ability of Tai Khamti rice compared to other treatments.

The enhanced tiller production in T8 may be attributed to the role of gibberellic acid in stimulating cell division and elongation, as well as promoting the growth of axillary buds, which ultimately leads to increased tiller formation. Additionally, improved nutrient assimilation and physiological activity contribute to better vegetative growth. Similar findings have been reported by (Yoshida, S. 1981), who observed that enhanced availability of nutrients and growth regulators significantly increased tiller number through improved photosynthetic efficiency, carbohydrate metabolism, and enzymatic activity.

Dry weight at 30, 60 and 90 DAT

The dry weight of Tai Khamti Rice was recorded at 30, 60 and 90 days after transplanting (DAT). The recorded observation was statistically analyzed and the results are presented in Table 3.

At 30 DAT, significant differences in dry matter accumulation were observed among the treatments. The highest dry weight (1.96g) was recorded under T8 (Gibberellic acid-100 ppm + 1.5% Urea) with 1.77g and T4 (Jeevamrut-100ml) with 1.67g. The lowest dry weight (0.96g) was recorded in the control treatment T1, indicating reduced biomass accumulation in the absence of external inputs.

At 60 DAT, the increasing trend in dry matter production continued across all treatments. Treatment T8 again

recorded the maximum dry weight (3.63g), followed by T9 (3.47g) and T4 (3.27g). The control T1 showed the minimum dry weight (2.75g). The observed differences were statistically significant, suggested that both growth regulators and organic inputs enhanced biomass production.

At 90 DAT, the maximum dry weight (9.23g) was recorded in T8 (Gibberellic acid- 100 ppm), which remained significantly superior over other treatments. This was followed by T9 (8.70g) and T4 (8.10g). The minimum dry weight (5.73g) was observed in the control treatment T1.

Overall, the results clearly indicate that the application of gibberellic acid, alone or in combination with urea, significantly improved dry matter accumulation in Tai Khamti Rice.

The enhanced dry weight observed in T8 may be attributed to the stimulatory effect of gibberellic acid on plant growth processes such as cell division, elongation and expansion, which ultimately contribute to increased biomass production.

Additionally, improved photosynthetic efficiency and nutrient uptake under the influence of growth regulators lead to greater accumulation of assimilates. These findings are in close agreement with the results reported by (Goutam *et al.*, 2018).

Who observed that enhanced nutrient availability and growth-promoting substances significantly increased dry matter production in rice.

In conclusion, the present investigation clearly indicates that plant bio-regulators significantly influenced the growth performance of Khamti Lahi rice at all stages (30, 60 and 90 DAT). Among the different treatments, the application of gibberellic acid at 100 ppm (T8) consistently produced the best results in terms of plant height, number of tillers, and dry matter accumulation. This was followed by its combination with 1.5% Urea (T9) and jeevamrut (T4). The improvement in plant height under gibberellic acid can be attributed to its role in stimulating cell elongation and division, leading to increased internodal length. Enhancing tillering suggests better activation of axillary buds and improved vegetative growth, while higher dry matter accumulation reflects improved photosynthesis, nutrient uptake, and assimilate movement within the plant.

Table.1 Meterological data of weather parameters and total rainfall during the cropping season (Kharif 2025-2026).

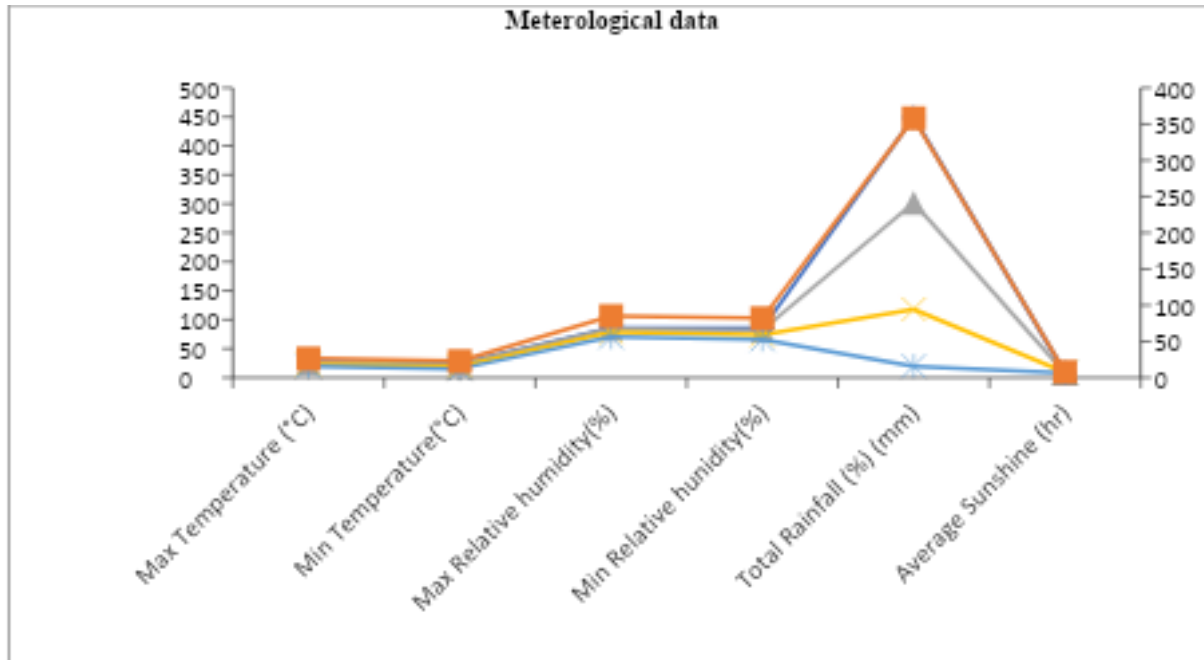


Table.1 Effect of plant bio regulators plant height of Khamti Lahi Rice:

Treatments	Plant Height(cm)		
	30DAS	60DAS	90DAS
T1: control	51.2	85.9	115.97
T2: seaweed extract-0.5ml	54.77	90.27	120.97
T3: seaweed extract-0.5ml+1.5%Urea	56.67	94	123.1
T4: jeevamrut-100ml	59.77	100.63	127.1
T5: jeevamrut-100ml+1.5%Urea	53.57	88.43	119.17
T6: Thiourea 500ppm	52.47	87.47	117.83
T7: Thiourea 1000ppm	58.37	97.57	125.37
T8: Giberalliacid 100ppm	61.53	105.33	131.23
T9: Giberalliacid 100ppm+1.5% Urea	60.5	103.07	129.23
F test	s	s	s
S. Ed ±	0.121208	0.13182	0.176033
CD(P=0.05)	0.256949	0.279446	0.373174

Table.1 Effect of plant bio regulators plant height of Khamti Lahi Rice:

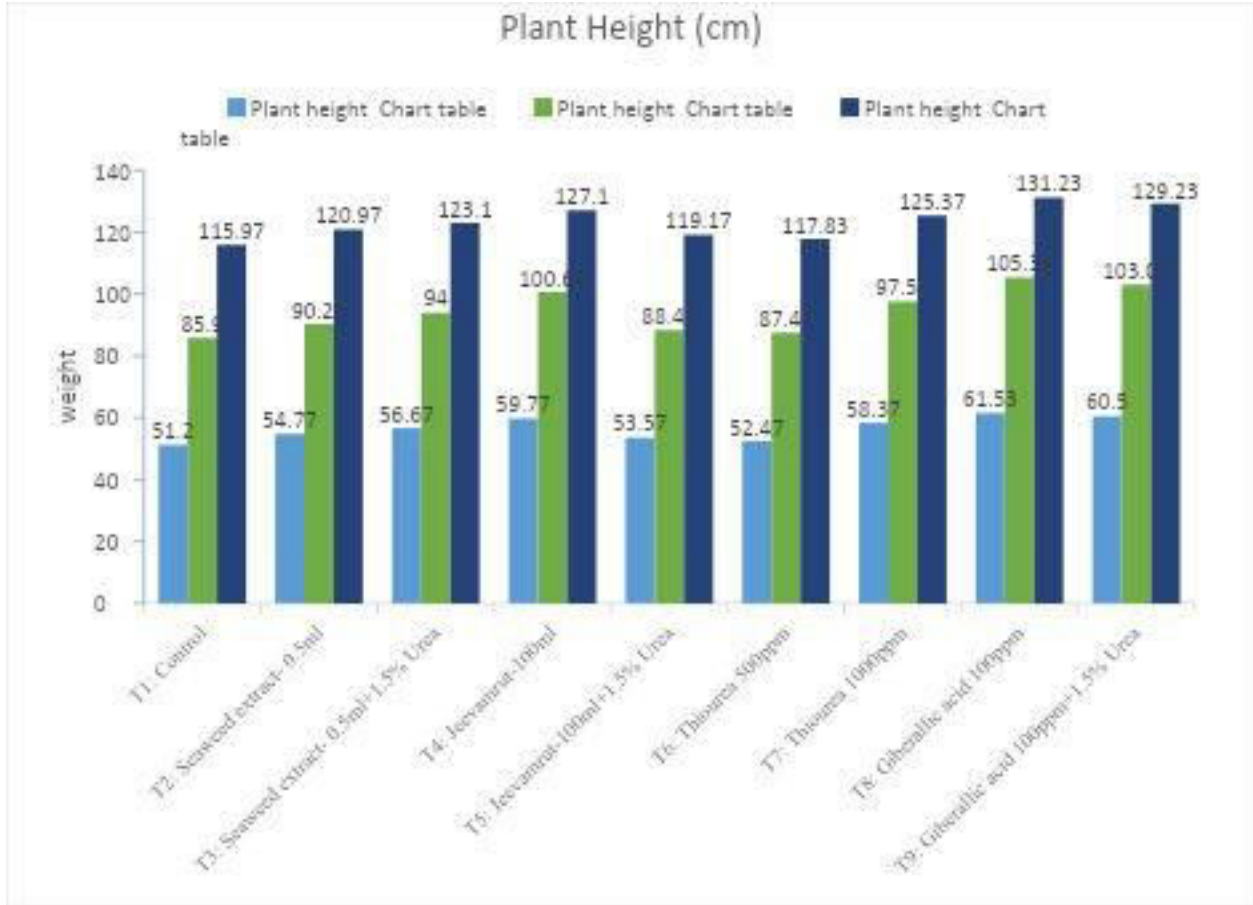


Table.2 Effect of plant bio regulators on tillers of Khamti Lahi Rice.

Treatments	Tillers		
	30DAS	60DAS	90DAS
T1: control	10.6	13.27	16.87
T2: seaweed extract-0.5ml	12.97	18.14	20.2
T3: seaweed extract-0.5ml+1.5%Urea	14.14	19.2	21.57
T4: jeevamrut-100ml	14.9	20.37	22.77
T5: jeevamrut-100ml+1.5%Urea	12.67	17.17	19.4
T6: Thiourea 500ppm	12.2	16.44	18.6
T7: Thiourea 1000ppm	14.5	19.7	22.1
T8: Giberallie acid 100ppm	16.54	22.9	24.3
T9: Giberallie acid 100ppm+1.5% Urea	15.7	21.5	23.3
F test	s	S	S
S. Ed ±	0.068041	0.139665	0.04479
CD(P=0.05)	0.144241	0.296076	0.094961

Table.2 Effect of plant bio regulators on tillers of Khamti Lahi Rice:

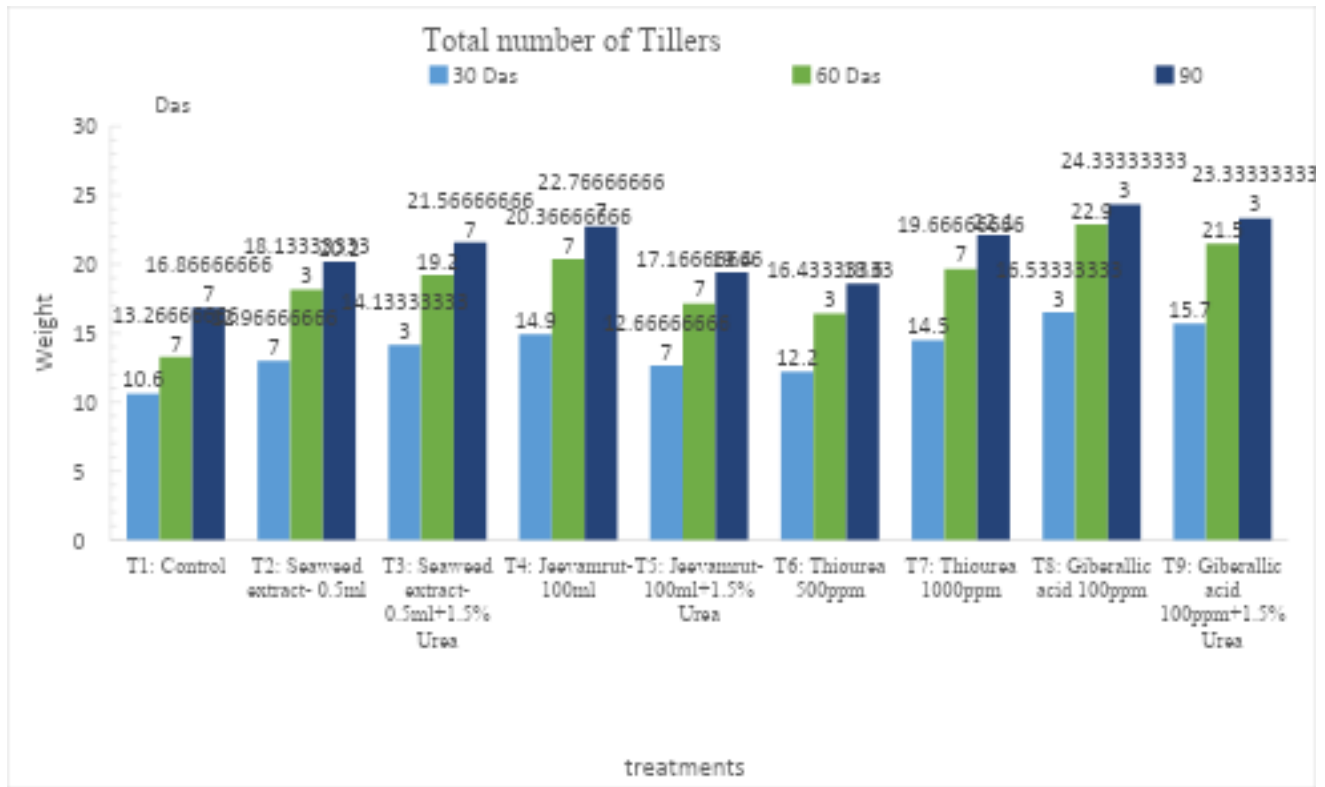
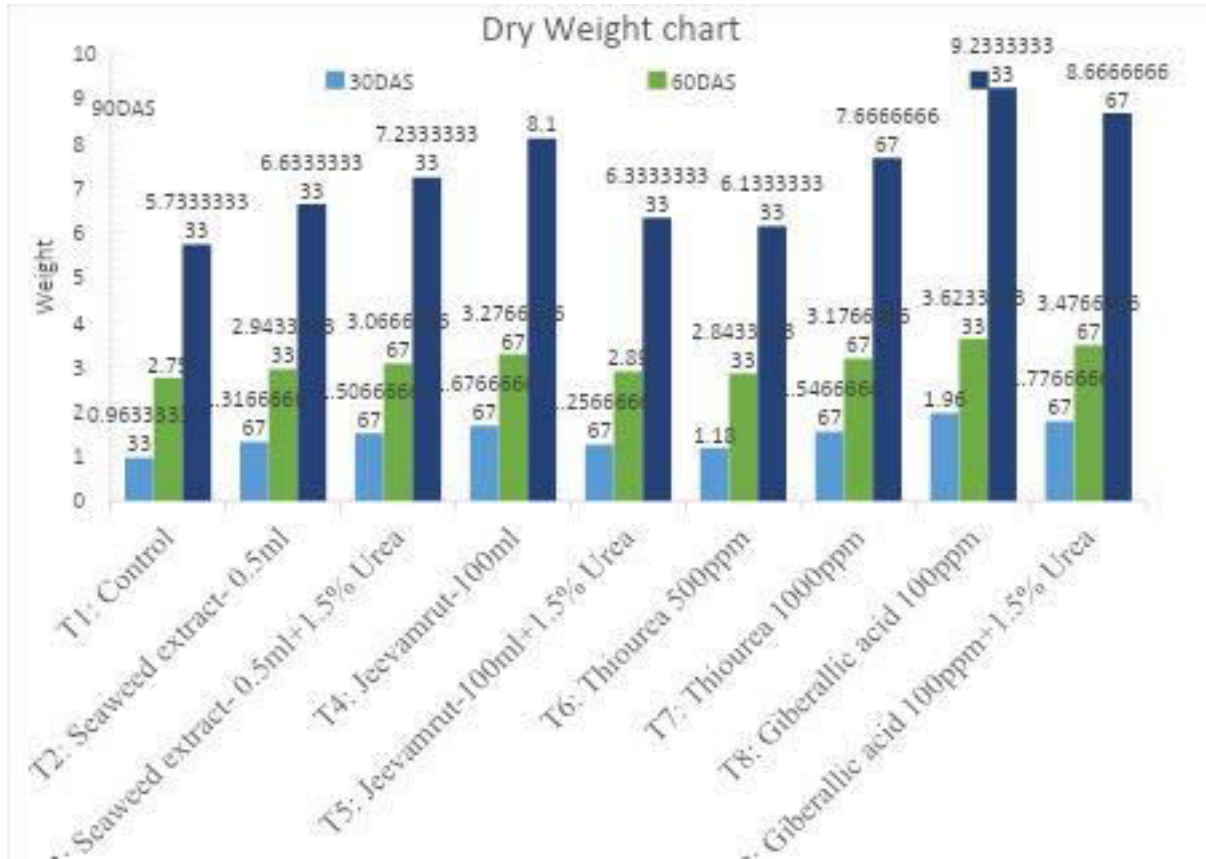


Table.3 Effect of plant bio regulators on dry weight of Khamti Lahi Rice:

Treatments	Dry weight		
	30DAS	60DAS	90DAS
T1: control	0.963	2.75	5.73
T2: seaweed extract-0.5ml	1.317	2.944	6.63
T3: seaweed extract-0.5ml+1.5%Urea	1.507	3.07	7.23
T4: jeevamrut-100ml	1.677	3.277	8.1
T5: jeevamrut-100ml+1.5%Urea	1.257	2.89	6.3
T6: Thiourea 500ppm	1.18	2.843	6.13
T7: Thiourea 1000ppm	1.547	3.177	7.7
T8: Giberalllic acid 100ppm	1.96	3.623	9.23
T9: Giberalllic acid 100ppm+1.5% Urea	1.777	3.477	8.7
F test	S	S	S
S. Ed ±	0.0234652	0.0083703	0.0743283
CD(P=0.05)	0.0497441	0.0177442	0.1575689

Table.3 Effect of plant bio regulators on dry weight of Khamti Lahi Rice:



In contrast, the control treatments showed the lowest performance, highlighting the importance of external inputs for optimal growth. Bio-inputs like jeevamrut and seaweed extract showed moderates benefits, likely due to improved soil biological activity and nutrient availability. Overall, foliar application of gibberellic acid at 100 ppm, alone or combined with urea, proved highly effective in enhancing growth and biomass of Khamti Lahi Rice, making it a practical agronomic strategy under similar conditions.

Disclaimer (Artificial Intelligence)

I Devi Taku, hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text- to – image generators have been during the writing or editing of this manuscript.

Competing Interests

Author(s) here declared that no competing interests exist.

Author Contributions

Devi Taku: Investigation, formal analysis, writing—original draft. Kasinam Doruk: Validation, methodology, writing—reviewing. Lipi Rina:—Formal analysis, writing—review and editing.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

References

- Bhattacharjee, P., Singhal, R, S., and Kulkarni, P, R. (2002). Basmati rice A review. *International Journal of Food Science and Technology*, 37(1); 1-12.
- Barua, U., Bora, M, S., Nithinkumar, K., Munglang, N., Borah, B, K, D., Sahani, S. and Wangchu, L. (2025). Evaluating climateresilient rice varieties in eastern Arunachal Pradesh. *Annals of Agricultural Research New Series*, 46(3); 240-245.
- Chaudhari, P, R., Tamrakar, N., Singh, L., Tandon, A. and Sharma, D. (2018). Rice nutritional and medicinal properties. *Journal of Pharmacognosy and Phytochemistry*, 7 (2); 150-156.
- DAC&FC (2020). Agriculture statistics at a glance 2019-2020. Ministry of Agriculture and farmers welfare, Government of India, New Delhi.
- Das, B., Sengupta, S., Parida, S, K., Roy, B., Ghosh, M., Prasad, M. and Ghose, T, K. (2013). Genetic diversity and population structure of rice landraces from eastern and north eastern states of India. *BMC Genetics*, 14 (1); 71.
- Gavino, B, R., Pi, Y. and Abon, J, R, C, C. (2008). Application of gibberellic acid (GA3) in dosage for three hybrid rice seed production in the phillippines. *Journal of Agricultural Technology*, 4(1); 183-192.
- Geographical Indications Registry (2023). *Arunachal Pradesh Khaw Tai (Khamti Rice)*. Intellectual Property India, Government of India, 720 (177); 134-135.
- Goutam, P, K., Kushwaha, S, P., Chauhan, D., Maurya, N. and Kumar, S. (2018). Foliar application of plant growth regulators on growth, yield and quality of hybrid rice. *Internation Journal of Chemical Studies*, 6(6); 2908-2911.
- Haifaa, M, I. and Moses, C. (2022). Effect of foliar and soil application of gibberellic acid (GA3) at different growth stages on agronomic traits and yield of rice. *Journal of Agriculture Science*, 14(6); 55-67.
- Longvah, T. and Prasad, V, S, S. (2020). Nutritional variability and milling losses of rice landraces from Arunachal Pradesh, Northeast India. *Food Chemistry*, 311; 126385.
- Sasi, M., Awana, M., Samota, M, K., Tyagi, A., Kumar, S., Sathee, L. and Singh, A. (2021). Plant growth regulators induced mitigation of oxidative burst helps in the management of drought stress in rice. *Environment and Experimental Botany*, 185; 104413.
- Taiz, L. and Zeiger, E. (2015). Plant physiology and development sinuauer associates.
- Upendra, R, S., Pratima, K., Amiri, Z, R., Shwetha, L. and Ausim, M. (2013). Screening and molecular characterization of natural fungal isolates producing lovastatin. *Journal of Microbial and Biochemical Technology*, 5(2); 25-30.
- Verma, R., Kumar, R., Gopal, S, K., Panotra, N., Tiwari, A., Kumar, A. and Mishra, S. (2026). Influence of integrated nutrient management on nutrient content and nutrient uptake in rice. *International Journal of Plant and Soil Science*, 38(2); 28-35.
- Wallach, O. (2022). This is how much rice is produced around the world and the countries that grow the most. *World Economic Forum*, 13(48); 2277-7601.
- Yoshida, S. (1981). Fundamentals of rice crop science. *International Rice Research Institute (IRRI)*, Los Banos, Philippines.
- Zhao, Y., Wu, C, X., Zhu, X, D., Jiang, X, H., Zhang, X, X. and Zhai, B, P. (2011). Tracking the source regions of southern rice black streaked dwarf virus occurred in wuyi country. *Ecta Entomological Sinica*, 54(8); 949-959.

How to cite this article:

Devi Taku, Kasinam Doruk and Lipi Rina. 2026. Influence of Plant Bio Regulators on Growth of Khamti Lahi Rice (*Oryza sativa* L.). *Int.J.Curr.Microbiol.App.Sci*. 15(5): 17-25. doi: <https://doi.org/10.20546/ijemas.2026.1505.003>