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Effect Different Concentrations of Growth Regulator on Morphological Traits of *Zea mays L.* and *Pennisetum glaucum* Seedlings

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ABSTRACT

Objective: *Effect of different concentrations of the growth regulator ATONIK on the morphological characteristics of germinated Zea mays L. (ZM) and Pennisetum glaucum (PG) seeds were studied.* ***Method:*** *In the laboratories of Tikrit University/College of Education for Women/Department of Life Sciences, the study was conducted. The experimental design included four treatments: a control group T1, and three concentrations of growth regulator T2(0.05 ml/kg), T3(0.075 ml/kg) and T4(0.1 ml/kg) of seeds with seedling growth monitored over 15 days.* ***Results:*** *The results show a significant (P≤0.05) advantage of the growth regulator ATONIK in T4 where root length reach (6.16)cm and the stem length (5.01cm) at the end of the experiment. Early superiority was observe in T3 follow by a convergence in growth favoring the highest concentration over time. On vegetative growth stage (ZM) in T3 exhibited a strong early response in stem growth and root length during the first six days while T2 show, a marked physiological acceleration in later stages rivaling in T3 in the final length. In biomass the high concentrations in each T3 and T4 groups resulted in the highest wet and dry weight values for both crops reflecting the regulator efficiency, in directing the food seed stock towards vegetative structural growth. According to the optimal concentration, statistical analysis showed confirmed that 0.1 ml of ATONIK is the for maximizing the growth response in the vegetative growth stage PG. The vegetative growth stage (ZM) exhibited a dynamic response dependent on the interaction between concentration and physiological stage.* ***Novelty:*** *All results indicate that the use of these stimulants is an effective strategy for increasing green fodder productivity and overcoming slow growth constraints in controlled environments.*

INTRODUCTION

Zea mays L. and *Pennisetum glaucum* are considered among the most vital strategic cereal crops contributing to global food security owing to their high nutritional value and their integration into various processing industries [1]. During their early growth stages these crops encounter environmental and physiological challenges that directly impact germination rates and seedling vigor necessitating the exploration of modern techniques to enhance the biological performance of seeds [2]. The significance of plant growth regulators, emerges as effective tools in modulating metabolic processes within the plant, as they function at low concentrations stimulated cell division and tissue elongation [3]. Among these regulators, ATONIK is distinguish a unique bio stimulant composed of nitro phenolic compounds is accelerate protoplasmic streaming and improve nutriention uptake [4]. Indicated in studies treating seeds with ATONIK, increases the activity of enzymes responsible for digesting stored materials in endosperm thereby accelerate the emergence of radicle and plumule [5]. Enhancing root, and SL during early stages 3^{ed} and 15th day serves as a vital indicator of plant future ability to resist a stress, as a robust root system provides a larger surface area for water absorption [6]. Many Research's confirms that varying concentrations of growth regulators, lead to divergent responses depending on the plant species and genetic makeup of the seeds [7]. On the other hand in crops such as millet characterize by drought resistance ATONIK promotes the biological accumulation, of dry matter in tissues thereby reduce water loss [8]. Furthermore measured fresh and dry weights, the shoot and root system both separately and combined represents the most accurate criterion for evaluating photosynthetic efficiency and nutrient conversion [9]. Based on aforementioned the study aims to - determine the optimal concentration of the ATONIK growth regulator (0.05, 0.075, and 0.1 ml/kg) and the effect on enhancing on primary growth of *Zea mays L.* and *Pennisetum glaucum* in control laboratory environment; providing scientific recommendations that contribute to improving agricultural production in the region.

MATERIALS AND METHODS

This study was conducted in laboratories of the department of biology College of Education for Women/ University of Tikrit. during the period from 1/12/2025 to 15/12/2025. Plant growth regulator used in the experiment was ATONIK manufactured by ASAHI CHEMICAL MFG. CO., LTD, Japan. The plant materials utilized for the study included *Zea mays L.* seeds and *Pennisetum glaucum* seeds which were procured from local markets. Prior to the commencement of the experiment plastic planting boxes measuring 45 × 27 cm were sterilized use appropriate disinfectants to prevent contamination by microorganisms such as parasites and fungi. 1 kg of seeds from each crop was put in these boxes under controlled laboratory conditions. The experiment consisted of 4 treatments tabl1 and 2 for each type of seed. The experimental treatments are organized as shown in the following tables:

Table 1. Treatments for *Zea mays L.*

Treatments	Additives
T1	Control No growth regulator added
T2	0.05 ml of growth regulator / 1 kg of seeds
T3	0.075 ml of growth regulator / 1 kg of seeds
T4	0.1 ml of growth regulator / 1 kg of seeds

Table 2. Treatments for *Pennisetum glaucum* Seeds.

Treatments	Additives
T1	Control No growth regulator added
T2	0.05 ml of growth regulator / 1 kg of seeds
T3	0.075 ml of growth regulator / 1 kg of seeds
T4	0.1 ml of growth regulator / 1 kg of seeds

The study involved a measurement of many morphological growth indicators. RL and SL were measured using a graduated ruler in centimeters cm and the total plant weight was recorded in grams g. Measurements were conducted at two time intervals: the first on the 3rd day of the experiment and the second on the 15th day marking the conclusion of the experimental period. To estimate the dry weight plant parts were dried using a thermal oven. The fresh weight of the plant part was measured first followed by drying the samples in the oven until a constant weight was reached. Subsequently, the dry weight of the shoot system leaves and the root system were recorded separately and the total dry weight of the plant was calculated. Data were statistically analyzed using SPSS Version 2020 to test the significance of differences between the various treatments [10].

RESULTS AND DISCUSSION

Figure 1 shows the effect of varying concentrations of plant growth regulator on the average wall length of millet *Pennisetum glaucum* over a period of 18 days, where a general significant response is observed in all treatments over time. The data reveal that the T4 treatment achieved the greatest superiority in stimulating growth, as it recorded a maximum root length exceeding 6.00 cm at the end of the period, followed by the T3 and T2 treatments, which showed a similar pattern of growth during the intermediate stages. In contrast, treatment T1 recorded the lowest levels of elongation throughout the test period, which clearly indicates that the efficiency of root system development increases directly with increasing concentration of the growth regulator used, reaching the optimal concentration represented by treatment four.

All results boil down to the fact that growth regulators exerted a dual physiological and directive effect. While they acted as dynamic stimulants in shoots and millet roots by activating meristematic division and increasing metabolic efficiency, they showed an inhibitory effect in maize roots as a result of exceeding the threshold of tissue hormonal sensitivity, which confirms that the optimal response depends on the precise balance between the concentration of the regulator and the plant type to achieve maximum efficiency in biomass accumulation [11][12].

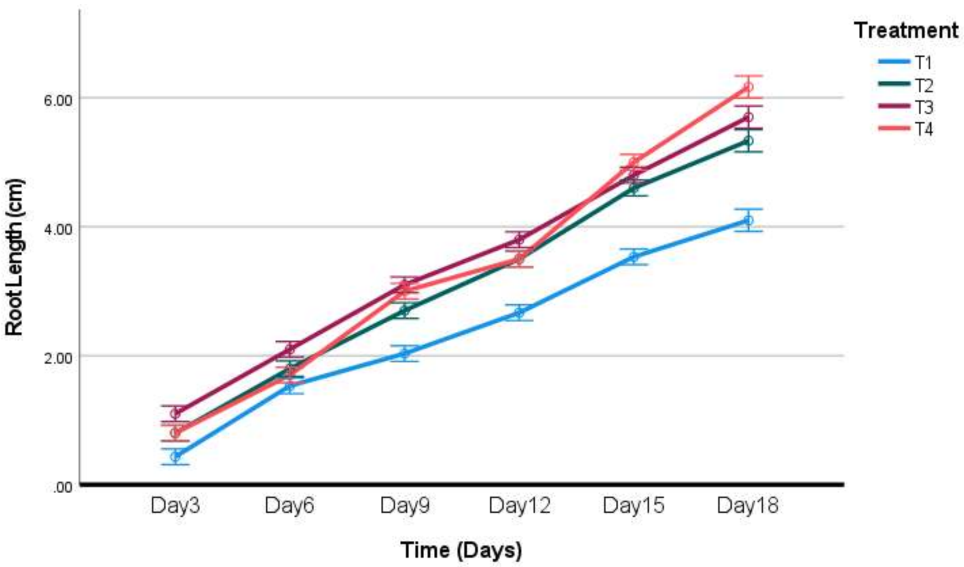

Figure 1. Effect of Different Concentrations of Plant Growth Regulator on Root Length of Germinated *Pennisetum glaucum* Seeds over Time.

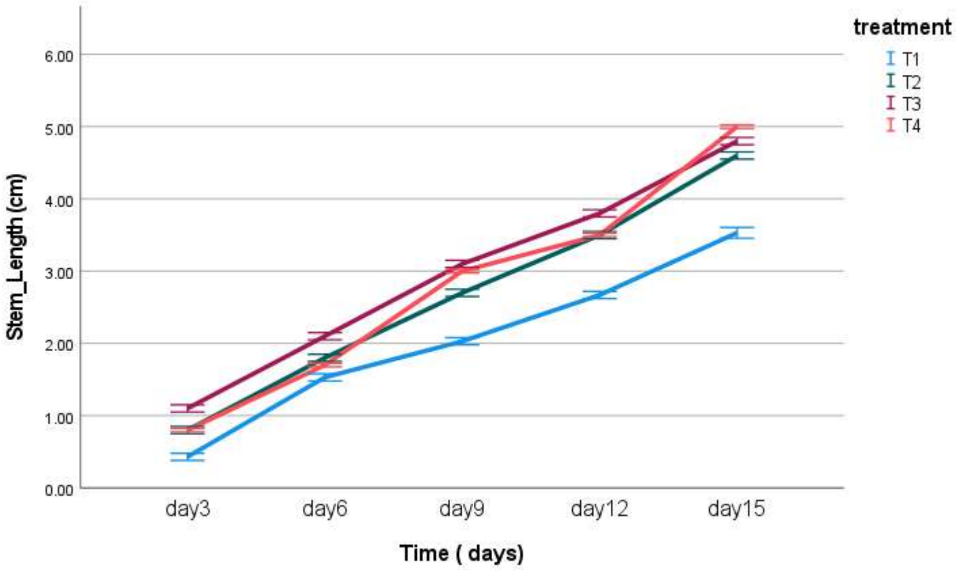

Figure 2. Effect of Different Concentrations of Plant Growth Regulator on Shoot Length of Germinated Pearl Millet Seeds over Time.

Figure 2 shows the effect of different concentrations of plant growth regulator on the shoot length of germinated pearl millet seeds over successive time periods of 15 days. The results show a gradual and continuous increase in shoot growth rates for all treatments, with a clear variation in the response of plant tissues depending on the concentration used. T4 excelled significantly in the end of experiment record on highest value for stem length at the level of approximately (5.00cm) follow by T3 and T2, which show close overlap in growth curves indicating the convergence of their physiological effectiveness. In contrast, treatment T1 showed a relative slowdown in elongation rates compared to the rest of the treatments, as it stabilized at the lowest growth value at the end of the fifteenth day. The essential role of the growth regulator in stimulating cellular division and elongation on these results reflect at the develop shoot apex confirming that the optimal response is associated with the higher concentration applied in this experiment. Data prove that stem elongation in pearl millet follows a proportional pattern with increasing concentration in T4 represented the peak production with a growth of approximately 5.00 cm. This superiority is scientifically explained by the role of growth regulators such as gibberellins or auxins in stimulating cell division at the growing apex of the stem and increasing the flexibility of the cell walls, which allowed for a faster rate of elongation Mourya and Singh, 2022 [13] compared to the low concentration in T1. As for the close overlap between treatments T3 and T2, it indicates the presence of a balanced physiological response zone, as no fundamental differences appeared between these two concentrations, which suggests that the plant has reached a stage of similar metabolic efficiency at these levels [14]. In contrast, the delayed growth of the T1 treatment reflects the insufficiency of the external stimulus to activate the vital processes associated with the longitudinal growth of the stem.

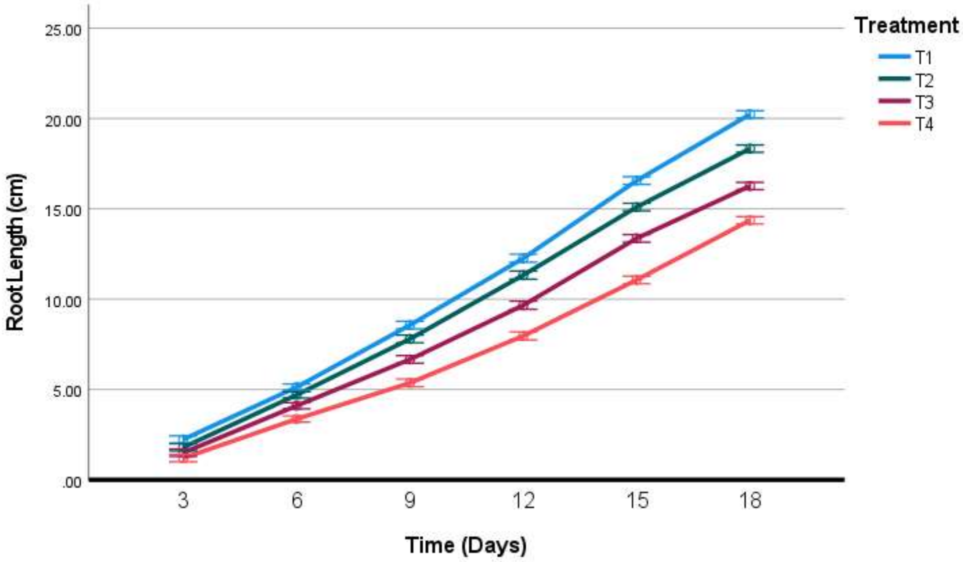

Figure 3. Effect of different plant growth regulator treatments on the root length of maize *Zea mays L.* seedlings during an 18-day germination period.

Figure 3 shows the effect of different plant growth regulator treatments on the root length of maize *Zea mays L.* seedlings during a germination period that lasted 18 days. Result showed in graph indicate, a significant and continuous increase in the root sum length of all treatments as time progresses with a clear differentiation, in efficiency of each concentration. Interestingly T1, significantly outperformed the rest of the treatments, as it record the highest root elongation rate reaching about 20.00 cm on the eighteenth day. In contrast, treatments T2, T3 and T4 showed a gradual decrease in root length compared to T1, where T4 recorded the lowest level of root growth at the end of the experiment at about 14.00 cm. These patterns reflect the opposite response in this plant model, as it appears that the lowest concentration or type of T1 was the most stimulating for root growth, while other concentrations led to a relative inhibition of elongation.

The results in Figure 3 show a clear inhibitory response of maize roots to growth regulator treatments compared to the control group. Despite the normal growth of roots at T1 up to 20.00 cm, the experimental treatments T2, T3 and T4 led to a gradual decline in length with increasing concentration, with treatment T4 recording the lowest level at 14.00 cm. This stabilization was physiologically attributed to the high sensitivity of maize roots to the regulator, as added concentrations inhibited rather than stimulated cell elongation [15], indicating that natural growth without additives was the most efficient in this model.

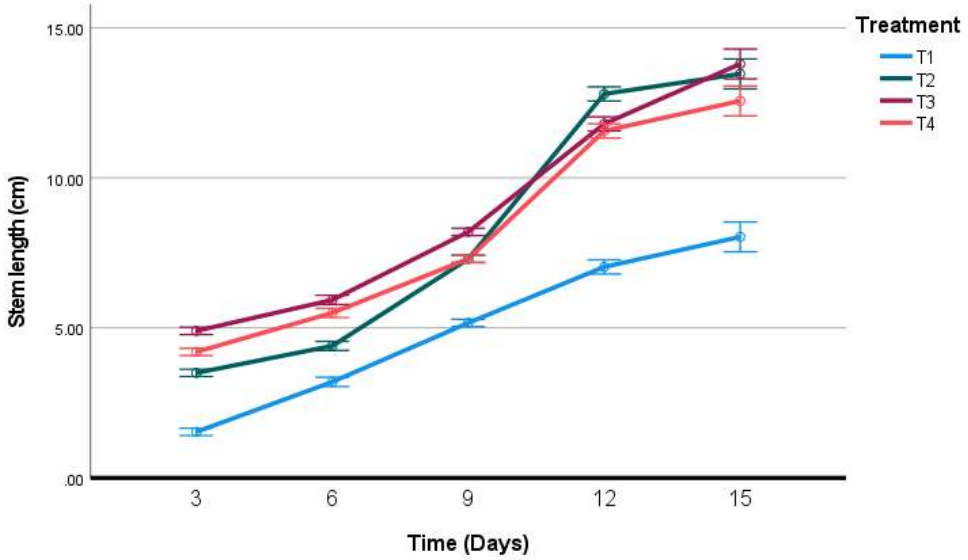

Figure 4. Effect of Plant Growth Regulator on the Stem Length of Sweet Corn *Zea mays L.* Over a 15-Day Period.

Figure 4 illustrates the effect of the plant growth regulator on the stem length of sweet corn *Zea mays L.* over a 15-day period. The recorded data indicate a significant variation in shoot growth rates among the four treatments studied. Treatments T2, T3, and T4 showed a similar and high response in stimulating stem elongation, all stabilizing at values between 12and 14 cm by the end of the fifteenth day. Treatment T3 maintained a relative advantage in the early stages of growth, while treatment T2 showed a strong acceleration after the ninth day. In contrast, treatment T1 recorded the lowest growth rates throughout the experiment, significantly lower than the other treatments, not exceeding 8cm at the end of the measurement. These results reflect the effective role of the growth regulator in promoting biological activity in the sweet corn stem, with a specific concentration threshold starting from T2 ensuring maximum growth efficiency.

The results in Figure 4 reveal a significant stimulatory role for the growth regulator treatments in sweet corn stem elongation compared to the control group T1. While T1 exhibited limited growth not exceeding 8cm, the experimental treatments T2, T3 andT4 produced a clear growth surge, stabilizing between 12and 14cm. This confirms that the concentration threshold required to activate cell division in the growing tip was exceeded. The early superiority of T3 and the subsequent acceleration of T2 are attributed to the dynamic interaction between the regulator concentration and the physiological stages of the seedling [16], demonstrating that the chemical intervention in these treatments doubled the efficiency of the vegetative growth compared to normal growth in the control group.

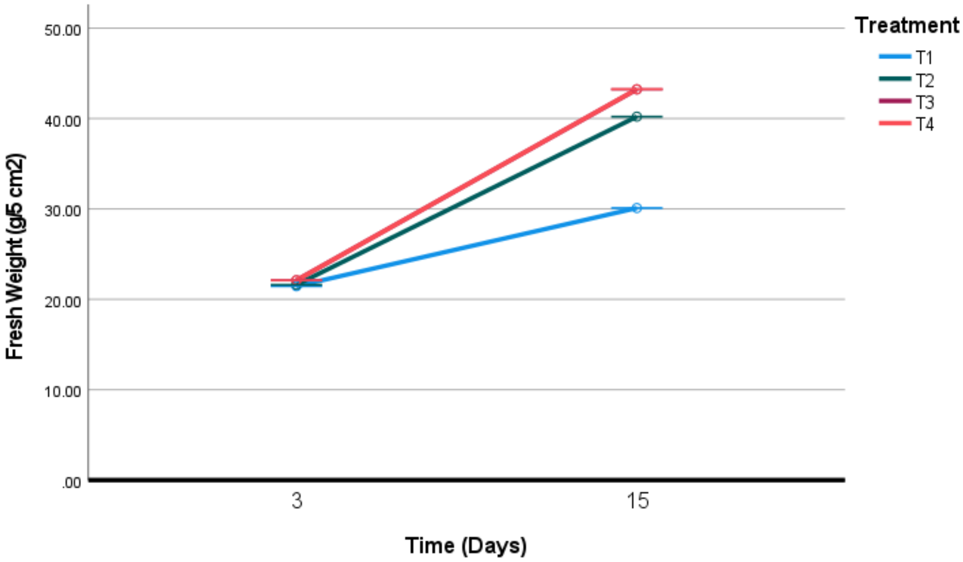

Figure 5. Comparison of Seedling Fresh Weight g/5 cm² for Germinated Maize Seeds at Day 3 and Day 15 under Different Growth Regulator Treatments.

Figure 5 shows a comparison of the fresh weight of germinated maize seedlings, measured in g/5 cm², between day 3 and day 15 under different plant growth regulator treatments. The results show a high degree of similarity in fresh weights for all treatments at the beginning of the experiment, day 3, at a level of approximately 22.00 g. However, a clear differentiation emerged by day 15. In T4 the highest increase in fresh biomass exceeding 40g, followed closely by T3 and T2 which showed, nearly identical strong response. T1 record, lowest increase in fresh weight stabilizing at a value of approximately 30g. These data indicate that growth regulators effectively contribute to increasing water content and biomass accumulation in maize seedling tissues, with T4 demonstrating a clear advantage in enhancing total fresh weight.

The results in Figure 5 reflect the efficiency of the growth regulator treatments in increasing the fresh biomass of maize seedlings compared to the control group T1. The difference became evident on day 15, where experimental treatments T2, T3, and T4 resulted in a surge in wet weight exceeding 40.00 units, compared to only 30.00 units in T1. This qualitative advantage, particularly in treatment T4, is attributed to the regulator's role in stimulating cell division and increasing the tissue's osmotic capacity for water absorption and storage, thus doubling the total wet weight [17]. These results demonstrate that the chemical intervention significantly enhanced physical growth rates compared to the limited normal growth in the control group.

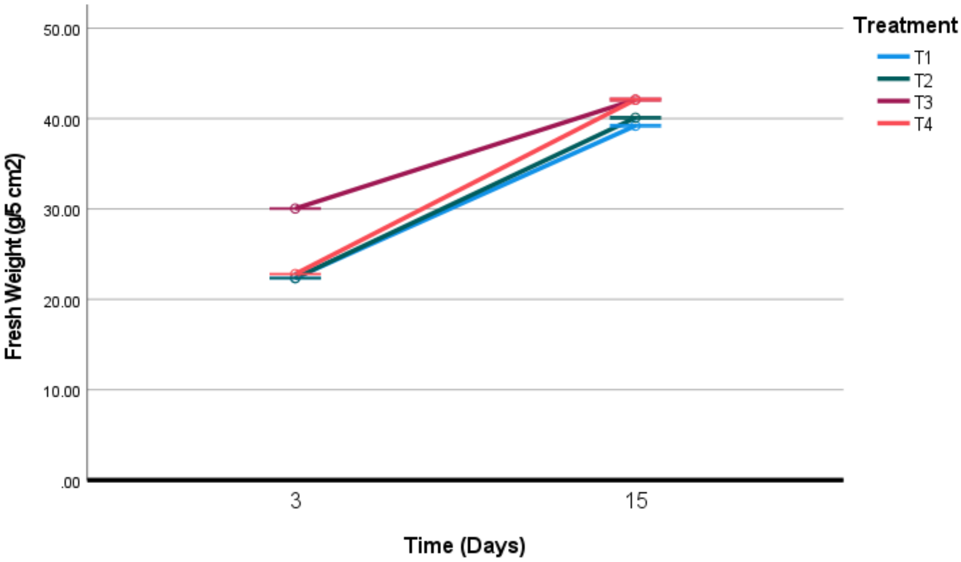

Figure 6. Comparison of Seedling Fresh Weight g/5 cm2 for Germinated Millet Seeds at Day 3 and Day 15 under Different Growth Regulator Treatments.

Figure 6, showed a comparison of the fresh weight of millet seedlings measured in: g/5 cm^2, on days 3 and 15 under different treatments of a plant growth regulator. The results indicate that all treatments were marked increase in biomass over time, with T3, starting with a significant higher fresh weight on day 3 compared to the other treatments. By day 15, the results of all treatments converged considerably in T4 and T3 achieving the highest values exceeding 40.00 g, followed by treatments T2 and T1 with very slight differences. This pattern reflects the ability of the growth regulator to promote balanced biomass accumulation in millet seedlings, by the end of the measurement period, despite the initial variation in early growth rates.

The response of fresh biomass, accumulation in millet seed to effect of the growth regulator when compared to the T1. Despite the initial marked, superiority of T3 in day 3, the time course of the experiment revealed a high degree of physiological convergence among all treatments, in day 15 with T4 and T3 registering is the highest values. This pattern, is attributed to the ability of the growth regulator in the experimental treatments, to stimulate water uptake and biomass accumulation at balanced rates, thus narrowing the productivity gap [18] with the T1 at end of the measurement period. The discussion concludes all concentrations used, were effective in supporting total fresh weight, with a slight advantage for the higher concentration treatments in achieving maximum seedling productivity.

Table 3. The Effect of Growth Regulator Treatment on Dry Weight Dynamics and Moisture Content of Germinated Millet Seeds.

	before	**after**	**moisture**
T1	4.16±0.033a	11.66±0.033c	64.33±0.33c
T2	4.80±0.057b	16.10±0.057a	70.33±0.33a
T3	4.80±0.057b	14.50±0.057b	67.00±0.57b
T4	5.10±0.057a	14.40±0.057b	65.00±0.57c

In Table 3 illustrates, the effect of growth regulator treatments on the dry weight and moisture, content dynamics of germinated millet seed , data reveal clear statistical variations among the treatments in study. The results indicate on the T2 achieved that a highest values for final (dry weight) and (moisture) content reaching 16.10 and 70.33, respectively, demonstrating its high efficiency, in stimulating dry matter accumulation and water absorption. On the other hand the T1 recorded a lowest values across all indicators while T3 and T4, show moderate and similar levels, in their final dry weights. These results is reflect the crucial role of growth regulator concentration, used on physiological processes related to metabolism and water balance within millet seed tissues during germination. Data in Table 3 showed a high significant superiority on growth regulator treatments in improving on biomass quality of millet seeds, compared to T1. This variation is clearly evident in efficacy of T2 which recorded the high significant final dry weight and moisture content, reflecting the efficiency of this specific concentration, in stimulating metabolic processes and enhancing the tissues ability to retain water [19]. Decline in values in T1 is attributed to the absence of sufficient hormonal stimulation, to accelerate energy conversion, while convergence of results between T3 and T4, indicates that the plant reached a metabolic stabilization stage at these concentrations. The discussion concludes T2 provided that optimal balance between (dry matter) accumulation and (moisture) content granting seedlings greater physiological resilience, during the early germination stages compared to normal growth in T1.

Table 4. Dynamics of Water Content and Dry Weight in Germinated *Zea mays L.* Seeds under the Influence of Different Growth Regulator Levels.

	before	after	Moisture
T1	4.47±0.03c	15.63±0.03a	71.43±0.19b
T2	6.40±0.06a	20.10±0.06d	68.16±0.26c
T3	4.40±0.06c	16.40±0.06b	73.17±0.32a
T4	5.60±0.06b	19.30±0.12c	70.98±0.41b

Table 4 presents the dynamics of water content and dry weight of germinated maize seeds (*Zea mays L.*) under different levels of a plant growth regulator. The results show in each treatment statistically significant variations in seed response. The data indicate, that T2 recorded the highest final (dry weight) at 20.10% despite having a lowest moisture content at 68.16%. demonstrating its high efficiency in (energy conversion) and (dry matter) accumulation. In contrast in T3 achieved the highest moisture content at 73.17% while, T1 recorded the lowest final dry weight. These figures reflect a direct effect of the growth regulator levels on metabolic processes and tissue water retention capacity, as the concentrations used appear to balance increased solid biomass with the water uptake required for growth. The data in Table 4 demonstrate a varied physiological response of maize seeds to the growth regulator levels when compared to the control group T1. The qualitative superiority of treatment T2 is evident in feed conversion efficiency, as it achieved the highest final dry weight, indicating the ability of this concentration to stimulate solids formation more effectively than normal growth in T1. The lower moisture content in T2 compared to T3 is attributed to the plant's different energy allocation strategies between dry matter accumulation and water retention [20]. These results demonstrate that the growth regulator in the experimental treatments significantly altered metabolic processes. Treatment T2 provided maximum efficiency in biomass formation, while T3 enhanced the osmotic capacity of the tissues, compared to the control group, which exhibited the lowest dry matter accumulation efficiency.

CONCLUSIONS

Fundamental Finding: ATONIK significantly enhances early seed growth in Zea mays and Pennisetum glaucum, with the highest concentration (T4) proving optimal over 15 days to achieve maximum root and stem length, as well as maximum wet and dry biomass. **Implication:** Consequently, applying ATONIK effectively boosts green fodder productivity in controlled environments. **Limitation:** The study was conducted over a short duration of 15 days in controlled environments during the early seed growth stage. **Future Research:** Further research should evaluate the long-term effects of ATONIK under field conditions beyond the initial 15-day early growth stage.

REFERENCES

[1] R. L. Bhardwaj, A. Parashar, H. P. Parewa, and L. Vyas, "An Alarming Decline in the Nutritional Quality of Foods: The Biggest Challenge for Future Generations' Health.," *Foods (Basel, Switzerland)*, vol. 13, no. 6, Mar. 2024, doi: 10.3390/foods13060877.

[2] P. Tiwari and K.-I. Park, "Seed Biotechnologies in Practicing Sustainable Agriculture: Insights and Achievements in the Decade 2014–2024," *Appl. Sci.*, vol. 14, no. 24, 2024, doi: 10.3390/app142411620.

[3] Z. Garban and G. Ilia, "Structure-Activity of Plant Growth Bioregulators and Their Effects on Mammals," *Molecules*, vol. 29, no. 23, 2024, doi: 10.3390/molecules29235671.

[4] A. Przybysz, H. Gawrońska, and J. Gajc-Wolska, "Biological mode of action of a nitrophenolates-based biostimulant: case study.," *Front. Plant Sci.*, vol. 5, p. 713, 2014, doi: 10.3389/fpls.2014.00713.

[5] J.-Y. Choi, Y.-H. Ju, A. Nakamichi, S.-W. Cho, S.-H. Woo, and J.-I. Sakagami, "Effect

of Seed Hydropriming on the Elongation of Plumule and Radicle During the Germination Process and Changes in Enzyme Activity Under Water-Deficient Conditions," *Plants*, vol. 13, no. 24, 2024, doi: 10.3390/plants13243537.

[6] S. Hao, Y. Wang, Y. Yan, Y. Liu, J. Wang, and S. Chen, "A Review on Plant Responses to Salt Stress and Their Mechanisms of Salt Resistance," *Horticulturae*, vol. 7, no. 6, 2021, doi: 10.3390/horticulturae7060132.

[7] W. Zhang *et al.*, "Effects of Different Plant Growth Regulators on Growth Physiology and Photosynthetic Characteristics of Pinus koraiensis Seedlings," *Plants*, vol. 14, no. 23, 2025, doi: 10.3390/plants14233671.

[8] H. Gao *et al.*, "Physiological and molecular mechanisms of drought adaptation in foxtail millet: insights and future perspectives," *Front. Plant Sci.*, vol. Volume 16-2025, 2025, doi: 10.3389/fpls.2025.1701035.

[9] M. Schiefloe, Ø. M. Jakobsen, A. Pannico, C. Quadri, and A.-I. K. Jost, "From urine to food and oxygen: effects of high and low NH(4)(+):NO(3)(-) ratio on lettuce cultivated in a gas-tight hydroponic facility.," *Front. Plant Sci.*, vol. 14, p. 1229476, 2023, doi: 10.3389/fpls.2023.1229476.

[10] N. IBM Corp, "IBM SPSS statistics for windows," 2020, *IBM corp Armonk, NY*.

[11] M. Otroshy, Z. Khalili, M. A. Ebrahimi, M. K. Nekoui, and K. Moradi, "Effect of growth regulators and explant on plant regeneration of Solanum lycopersicum L. var. cerasiforme," *Russ. Agric. Sci.*, vol. 39, no. 3, pp. 226–235, 2013, doi: 10.3103/S1068367413030178.

[12] D. Van Yen and J. Li, "Effect of Growth Regulators on In Vitro Micropropagation of Stahlianthus thorelii Gagnep," *Agriculture*, vol. 12, no. 11, 2022, doi: 10.3390/agriculture12111766.

[13] A. Mourya, S. Singh, and M. Scholar, "Effect of Bio-fertilizers and plant growth regulators on growth and yield of Pearl millet (Pennisetum glaucum L.)," Feb. 2022.

[14] Ü. Erol, "Pepper Fruits at Different Ripening Periods Have Potential Phyto-Biochemical and Enzymatic Responses to Irrigation Levels," *J. Food Qual.*, vol. 2024, Jul. 2024, doi: 10.1155/2024/9082436.

[15] N. Sun, X. Chen, H. Zhao, X. Meng, and S. Bian, "Effects of Plant Growth Regulators and Nitrogen Management on Root Lodging Resistance and Grain Yield under High-Density Maize Crops," *Agronomy*, vol. 12, no. 11, 2022, doi: 10.3390/agronomy12112892.

[16] M. A. Lastiri-Hernández, D. Álvarez-Bernal, E. Conde-Barajas, M. L. X. de la Negrete-Rodríguez, and J. Pérez-Inocencio, "The impact of growth regulators on Sesuvium verrucosum seedling germination and growth in saline environments," *Plant Growth Regul.*, vol. 106, no. 1, p. 18, 2026, doi: 10.1007/s10725-026-01430-x.

[17] J. Adzigbe *et al.*, "The responses and adaptations of rice (Oryza sativa L.) to drought stress: A review," *Clim. Smart Agric.*, vol. 2, no. 4, p. 100080, 2025, doi: https://doi.org/10.1016/j.csag.2025.100080.

[18] I. Świca, J. Kazimierowicz, and M. Dębowski, "Prospects and Potential for the Use of Microalgae and Cyanobacteria Biomass in Agriculture," *Phycology*, vol. 6, no. 1, 2026, doi: 10.3390/phycology6010019.

[19] D. Koch *et al.*, "Evaluation of drying kinetics models and functional properties of Etlingera linguiformis (Roxb.) R.M.Sm.: An aromatic ginger from North East India," *Ind. Crops Prod.*, vol. 225, p. 120569, 2025, doi: https://doi.org/10.1016/j.indcrop.2025.120569.

[20] H. H. A. El-Sharkawy, N. A. Mostafa, S. A. M. Yousef, S. A. S. El-Blasy, and O. A. El Badeea, “Enhancing Trichoderma efficacy in managing wheat stem rust disease and boosting production through the application of certain chemical inducers.,” *BMC Plant Biol.*, vol. 25, no. 1, p. 562, Apr. 2025, doi: 10.1186/s12870-025-06434-9.

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