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EFFECT OF PLANT GROWTH REGULATORS AND METHODS OF APPLICATION ON THE GROWTH AND YIELD OF WATERLEAF (*Talinum triangulare (Jacq.)* (Jacq.))

A.N. Muhammad[1], O.A Adediran[2],A. Usman[3], Y.J. Abdulkareem[1], A.G. Musa[1]
[1]Department of Agronomy, University of Abuja, Nigeria
[2]Department of Horticulture, Federal University of Technology, Minna, Nigeria
[3]Samaru College of Agriculture, Division of Agricultural Colleges, Ahmadu Bello University, Zaria, Kaduna State, Nigeria.
*Corresponding Author's phone and email: +2348076767609; alameen0041@gmail.com

ABSTRACT

Screen house trial was conducted to study the effect of plant growth hormones and methods of application on the growth and yield of waterleaf. The treatments consisted of three growth regulators (salicylic acid at the rate of 0.4g/L, coconut water at the rate of 100ml, and brassinolide at the rate of 0.1mg/L) with distilled water as control, and two methods of application of growth regulators viz; soaking and spraying, laid out in Completely Randomized Design (CRD) with six replicates. Healthy juvenile stem cuttings of uniform length (10cm) were obtained and growth hormones were applied using the quick dip method for soaking and hand sprayer for spraying in accordance with the treatments. Number of days to first foliage sprout, number of leaves per plant, leaf area, plant height, stem diameter, number of branches, number of days to flowering, shoot and root green biomass were studied at 7days interval. Results indicated that growth hormones significantly ($p< 0.05$) influenced plant height, number of leaves, days to first sprout, number of branches, absolute growth rate, fresh shoot and root weight. The fresh biomass yield of waterleaf was significantly increased by growth hormones. Salicylic acid recorded 41% and 44%, Coconut water, 27% and 25%, and Brassinolides 23% and 27% in the first and second trials respectively, relative to the control. Methods of application of the growth regulators did not significantly influenced growth of waterleaf implying that both soaking and spraying of salicylic acid, coconut water and brassinolides to stem cuttings could be adopted for improved growth and yield performances of waterleaf.

Keywords: Screen house, Distilled water, Growth regulators

INTRODUCTION

Water leaf (*Talinum triangulare (Jacq.)*) is an alien vegetable crop introduced to Nigeria and other African countries from the banks of the Amazon River where it is believed to have originated (Schippers, 2000). It is a small perennial fibrous herb that belongs to the family Portulacaceae (Rice *et al*., 1987) and has consumable soft leaves on succulent stem that grows to a height of about 80-100cm (Abdul *et al.,* 2011). It is well adapted to local hot and humid weather conditions and does well in areas of low soil fertility (Cardoso, 1997). Nutritionally, waterleaf is a reliable source of crude-protein (22.1%), ash (33.98%), and crude fiber (11.12%) (Orlujukwu & Poripo, 2014); and an excellent source of vitamins (C & E), Omega-3 fatty acids, calcium, magnesium, soluble fibres (Pectin), potassium, B-carotene and dietary fibers. Medicinally, waterleaf contains chemical substances (flavonoids, alkaloids and tannins) that are important in liver disease treatment and enhancing cerebral functioning, suitable for hepatic ailment and managements of cardiovascular diseases (Bioltif & Edward, 2020). Water leaf is a short duration crop due for harvest between 35-45 days after planting (Rice *et al.,* 1986) with simple agronomic requirements, some inherent characteristics, which make it more attractive to small-holder farmers and consumers from the Southern part of Nigeria where it is much cherished to other parts where it is gradually and increasingly utilized as food delicacy (Orlujukwu & Poripo, 2014). It is mostly propagated through cuttings 10–15 cm long (Ibeawuchi *et al.,* 2007), a vegetative propagation technique recognized as a method of mass propagation of desirable plants for commercial purposes. The initiation of growth is an important step in this vegetative propagation with great economic implications (Pandey and Husen, 2022) and the success of growth depends on the initial sprouting and adventitious rooting capacity of the cuttings which can be improved by the application of plant growth regulators/hormones. These hormones are natural substances that have the ability to stimulate rooting and subsequent growth (Peter, 1935). Hormones like Salicylic acid, brassinolides and coconut water can be artificially applied to improve such sprouting and are commercially available (Rajan, 2021).

Salicylic acid (SA) is a potent plant hormone that plays diverse regulatory roles in numerous physiological processes. From defense responses to the regulation of processes, such as seed germination, seedling development, nodulation in legumes, plant vegetative growth, flowering time, fruit yield, respiration (Khan *et al.*, 2015; Vlot *et al.,* 2009). SA is also important in response to ultra-violet (UV-B) radiation, ozone, metals, drought, temperature and salinity stresses by plants. Similarly, brassinolides are group of steroid phyto-hormones that play important roles in plant growth, development and stress responses (Zhu *et al., 2013;* Xia *et al., 2015*). Exogenous application of brassinolides enhances plants resistance to biotic and abiotic conditions like drought, temperature and pathogen attacks (Xia *et al.,* 2009; Ahmed *et al.,* 2012*;* Xi *et al.,* 2013). In similar vein, coconut water promotes growth of plants. Though it contains mainly water (94%), the remaining constituents are growth promoting substances that can influence in vitro

cultures including inorganic ions, amino acids, organic acids, vitamins, sugars, alcohols, lipids, nitrogenous compounds and phyto-hormones (Yong *et al.,* 2009). Coconut water contains cytokinin which helps stimulate root and shoot growth (Yong *et al*., 2013). The cytokinin found in coconut water support cell division, and along with other chemical components promotes plant growth (Muhammad *et al.,* 2015).

Generally, the success of regeneration of propagated stem cuttings, growth and the survival of stem cuttings depend primarily on the physiological nature of the cuttings and the type of growth regulators present (Owosu & Kuavedzi, 2020) and method application used (Blythe *et. al.*, 2007). To encourage commercial production, this research therefore, seeks to evaluate the effect of three growth hormones and two methods of application on the growth of water leaf stem cuttings and by extension on the general performance of the crop.

MATERIALS AND METHODS

Study Location

The experiments were conducted concurrently in screen houses at two locations. The first trial was carried out at the Department of Crop Production, Federal University of Technology, Minna, Niger State (9°36'N, 6°33'E) while the second trial was conducted at the Department of Agronomy, University of Abuja (6°45'N, 7°39'E), both in the southern guinea savanna of Nigeria.

Treatments and Experimental Design

The experiment consisted of a factorial combination of eight treatments: three growth hormones (salicylic acid at the rate of 0.4g/L, coconut water at the rate of 100ml, and brassinolide at the rate of 0.1mg/L with distil water as control) and two application methods (soaking and spraying) which were laid out in Completely Randomized Block (CRD) replicated six times.

Experimental Procedure:

Healthy, uniform stem cuttings of 10cm length, 5cm thick were obtained and treated with salicylic at the rate of 0.4g/L (Isa *et al*., 2017), coconut water (Brintha and Kumunthini,2016) at the rate of 100ml, and brassinolide at the rate of 0.1mg/L (Sun *et al*., 2017). The quick-dip method, as described by Hartmann *et al.* (1997)**,** was used for the soaking treatment. The basal portion (approximately 0.5 cm) of each cutting was dipped into the respective hormone solution for about 5 seconds before planting. For the spraying treatment, the hormone solutions were applied using a hand pressure sprayer (Thomas glass sprayer product) also before planting. Treated cuttings were planted in plastic pots (approximately 25 cm height × 17 cm diameter) containing 7 kg of topsoil (≈5.4 L; bulk density ≈1.30 g cm^{-3})**.** About 1.5 cm space was left from the rim of the pot to facilitate irrigation**.** Watering was carried out twice daily (morning and evening) to maintain soil moisture near field capacity with approximately 500ml of water per pot at each watering. Weeds were handpicked regularly to keep the experimental pots weed free.

Observations and Data collection

Observations and data were collected and evaluated on per plant basis at 7days interval i.e. 7, 14, 21 and 28 days after planting (DAP). Number of days to first foliage sprout and number of days to flowering were determined by recording the number of days before the appearance of first foliage and flower respectively, number of leaves and number of branches were determined by visual counting, leaf area was determined using handheld leaf area meter (RC-70), plant height was measured using meter rule, stem diameter was measured using Vernier caliper (SKADIOO Digital Vernier caliper), three harvest was carried with only fresh leaves harvested at 28 and 35 DAP while whole plant was harvested at 42 DAP. Shoot (sum of leaf harvests and shoot whole shoot harvest at 45 DAP) and root fresh (harvested at 45 DAP) harvests were weighed using Mettler balance (Toledo 16001) and recorded as green biomass at 28DAP. Absolute growth rate (AGR) was analyzed according to Williams (1946).

$$AGR\ cm\ day^{-1} = \frac{h_2 - h_1}{t_2 - t_1}$$

Where, h_1 and h_2 are the plant height at t_1 and t_2 times respectively.

Statistical Analysis

The data collected were subjected to statistical analysis of variance (ANOVA) to test treatment effects for significance using F-test as described by Snecoder and Cochran (1967). The differences between treatments means were compared using the Least Significant Difference (LSD) at P = 0.05).

Results

Number of Days to First Foliage Sprout

The number of days to first foliage sprout (Table 7) was significantly (P = 0.05) influenced by plant growth hormones in the second trial, where hormone-treated plants sprouted significantly earlier than the control (untreated plants). Although the same trend was observed in the first trial, the differences were not statistically significant. The method of application had no significant effect on the days to first foliage sprout, and there was no significant interaction between growth hormone type and method of application.

Number of Leaves of Waterleaf

The number of leaves in waterleaf was significantly (P < 0.05) influenced by growth hormone application (Table 1). Salicylic acid treated plants consistently produced significantly more leaves than the control across all sampling periods in both trials, except at 7 and 14 DAP, where the differences were not significant. Brassinolide and coconut water treated plants produced a statistically comparable number of leaves at all sampling periods. These were significantly lower than salicylic acid treatments at

early stages (7 and 14 DAP) but became statistically similar at later stages (21 and 28 DAP). The method of application and its interaction with hormone treatment had no significant effect on the number of leaves produced.

Leaf Area

Leaf area was not significantly different between hormone treated and control plants at both early (7 DAP) and late (28 DAP) growth stages in both trials (Table 2). However, in Trial 1, brassinolide-treated plants had higher leaf area at 14 DAP, which was statistically similar to other treatments but significantly greater than coconut water treated plants at 21 DAP. Neither the method of application nor its interaction with hormone treatment had a significant effect on leaf area.

Plant Height

Plant height was significantly influenced by growth hormones (Table 3). Treated plants were significantly taller than the control across all sampling periods in both trials, except at 7 and 28 DAP in Trial 1, where heights of coconut water treated plants were statistically similar to the control. The method of application and its interaction with hormone treatment did not significantly affect plant height.

Number of Branches

Growth hormone application significantly influenced the number of branches in waterleaf (Table 4). Brassinolide-treated plants consistently produced more branches than the control. All hormone treatments resulted in similar branch numbers, except at 14 and 28 DAP, where brassinolide treatments had significantly more branches than coconut water treated plants. Method of application and its interaction with hormone treatment had no significant effect on branch number.

Stem Diameter

Stem diameter was not significantly affected by hormone treatment at most sampling periods (Table 5), except at 21 DAP in Trial 2 and 28 DAP in Trial 1, where salicylic acid treated plants had significantly thicker stems than the control. The method of application and its interaction with hormone type had no significant effect on stem diameter.

Absolute Growth Rate

Absolute growth rate (AGR) responses to hormone application were inconsistent across sampling periods and trials (Table 6). In Trial 1, hormone-treated plants grew significantly faster than the control from planting to 7 DAP. Brassinolide and salicylic acid treatments had significantly higher AGR than coconut water. However, no significant differences were observed in Trial 2. At 21 DAP in Trial 1, brassinolide treated plants had the slowest growth rate. Treatments effects interaction was not significant effect on AGR.

Number of Days to Flowering

Plants treated with coconut water and brassinolide flowered significantly earlier than the control (Table 7). In Trial 1, salicylic acid-treated plants flowered at the same time as the control. In Trial 2, no significant differences were observed among treatments. There was no significant interaction between method of application and hormone treatment on days to flowering.

Shoot and Root Fresh Biomass

Fresh biomass of both shoot and root was significantly higher in hormone treated plants than in the control (Table 7). Salicylic acid treated plants produced the highest biomass. Coconut water and brassinolide treated plants had statistically similar shoot and root weights. The method of application significantly influenced fresh biomass in Trial 1, where soaking resulted in higher yields than spraying. This trend was not observed in Trial 2. There was no significant interaction between hormone treatment and application method.

DISCUSSION

At early growth stage, plant height, number of leaves, leaf area, stem diameter and absolute growth rate of waterleaf did not significantly differ in response to applied treatments. These non-significant differences observed at early growth stages could be due to a delayed response to the applied treatments. As the roots and essential photosynthetic structures developed, the effects of the hormones became more pronounced, continuing throughout the crop's active vegetative and reproductive stage, this in line with report of Muhammad (2021) on the seaming utilization of nutrients at early growth stage in sweet sorghum. At later growth stages, treatments with salicylic acid, coconut water, and brassinolide led to increased stem thickness and earlier flowering and significant biomass accumulation. Higher values were also recorded for plant height, number of leaves, leaf area, and number of branches. This significant improvement in growth and yield parameters may be attributed to the biological effects of these hormones. The role of salicylic acid Negasubramaniam *et al.,* 2007; Hayat *et al.* 2015; Singh *et. al*. 2018), as well as the growth-promoting constituents in coconut water and brassinolide, likely contributed to these results. The earlier flowering, increased growth and higher biomass accumulation observed with salicylic acid application could be attributed to its role in stimulating flowering, enhancing ion absorption and nutrient translocation which contributed to increased levels of nucleic acids and amino acids, enhancing vegetative growth along with greater dry matter accumulation. This aligns with the findings of Hayat *et al.* (2015), who reported that salicylic acid promotes both cell division and cell enlargement. Similarly, Singh *et. al*. (2018) observed that foliar application of salicylic acid improved growth through enhanced nutrient uptake, water relation, stomatal regulations and photosynthesis. Negasubramaniam *et al.,* (2007) also demonstrated that salicylic acid treatment increased plant height. Shakirova *et al.* (2003) also noted that the beneficial effects of salicylic acid on plant growth and yield may be attributed to its influence on other phytohormones. Salicylic acid has been

shown to alter the balance of auxins, cytokinins, and ABA in wheat, thereby increasing growth and yield under both normal and saline conditions (Javaheri *et al*., 2012). Similarly, Hassoon & Abduljabbar (2020) reported that SA acts in opposition to abscisic acid (ABA), which is known to induce leaf senescence. This antagonistic effect explains the significant differences observed in leaf retention up to later stages of growth with SA application.

In similar vein, the significant increases in vegetative growth and biomass accumulation observed with exogenous application of brassinolides could be attributed to its role in improving plant growth, development and stress responses. This corroborates the findings of Zhu *et al.,* 2013 and Xia *et al.,* 2015 who reported that brassinosteroid played significant roles in signaling development in plants. Additionally, Niu *et al.* (2016) reported that exogenous application of brassinolide improves stress tolerance in plants by enhancing their growth performance.

The stimulation of cell elongation and division by the hormonal components of coconut water could be responsible for the increased performance observed with its application. Karunarathna and Harris (2016) reported that the application of coconut water increased the number of leaves in Ixora cuttings. Also, Murray *et al.*, 2007 reported that coconut, water is rich in cytokines, played a vital role in promoting cell division and shoot formation. Similarly, Amrut and Rajput (2013) found that coconut water treatment increased the number of branches in fenugreek plants, suggesting that its hormonal components are responsible for stimulating cell elongation and division.

Soaking slightly improved biomass yield in both trials than spraying but the non-significant difference observed between methods of application and the non-significant interactions noted between growth hormones and methods of application suggest that growth hormones' nature and concentration are more vital than application methods in stimulating responses and regulating growth processes in plants. This is corroborated by the report of Blythe *et. al.*, (2007) who noted similar findings on methods of auxin application in Ixora cutting propagation.

CONCLUSION

The application of plant growth hormones; salicylic acid, brassinolide, and coconut water had a significant positive impact on the growth and yield performance of waterleaf (*Talinum triangulare (Jacq.)*). Salicylic acid treatment consistently resulted in superior vegetative growth, including increased leaf production, plant height, branch number, and biomass accumulation. Brassinolide and coconut water also enhanced several morphological and physiological parameters, though to a lesser extent than salicylic acid. The method of application (soaking vs. spraying) generally did not significantly influence most growth traits, although soaking slightly improved biomass yield in the first trial. These findings suggest that exogenous application of plant growth regulators, especially salicylic acid, is beneficial for enhancing the productivity of waterleaf.

Table 1: Effect of plant growth regulator and method of application on Number of leaves of Waterleaf

Treatments	7DAP		14DAP		21DAP		28DAP	
Growth hormones (H)	1st Trial	2nd Trial	1st Trial	2nd Trial	1st Trial	2nd Trial	1st Trial	2nd Trial
Control	5.05b	3.83	10.52b	7.67	13.86c	14.83b	35.25b	19.17b
Coconut water	6.00b	4.17	13.15b	8.00	21.06b	16.50ab	46.50a	22.67ab
Brassinolide	6.133b	4.33	14.19b	9.17	23.18b	17.17a	48.00a	23.67ab
Salicylic acid	8.75a	4.67	18.02a	9.83	30.41a	17.33a	52.38a	26.67a
LSD (0.05)	1.749	1.549	3.732	3.170	5.560	2.592	10.28	4.571
Method of application (M)								
Soaking	6.48	4.25	14.04	8.67	22.29	16.25	47.25	22.00
Spraying	6.48	4.25	13.89	8.67	21.96	16.67	43.81	23.08
LSD (0.05)	1.237	1.096	2.639	2.242	3.932	1.833	13.630	3.232
Interaction								
H x M	NS	NS	NS	NS		NS	NS	NS

Means having similar alphabets are not significantly different using LSD ($P < 0.05$); DAP = Days after planting

Table 2: Effect of plant growth regulator and method of application on leaf area of Waterleaf

Treatments	7DAP		14DAP		21DAP		28DAP	
Growth hormones (H)	1st Trial	2nd Trial	1st Trial	2nd Trial	1st Trial	2nd Trial	1st Trial	2nd Trial
Control	0.14	2.24	2.30b	4.85	11.44ab	10.73	16.19	19.51
Coconut water	0.18	2.36	5.56a	5.81	10.53b	10.82	17.70	16.67
Brassinolide	0.17	3.03	6.83a	5.67	12.58a	10.30	18.31	17.29
Salicylic acid	0.15	2.34	6.28a	5.14	11.36ab	10.05	18.14	20.24
LSD (0.05)	0.05	1.164	2.29	2.263	2.010	2.627	6.740	5.186
Method of application (M)								
Soaking	0.17	2.37	5.28	5.16	11.72	10.51	17.80	18.72
Spraying	0.15	2.61	5.20	5.58	11.21	10.44	17.37	18.13
LSD (0.05)	0.040	0.823	1.620	1.600	3.370	1.858	4.760	3.667
Interaction								
H x M	NS	NS	NS	NS	NS	NS	NS	NS

Means having similar alphabets are not significantly different using LSD ($P < 0.05$); DAP = Days after planting

Table 3: Effect of plant growth regulator and method of application on plant height of Waterleaf

Treatments	7DAP		14DAP		21DAP		28DAP	
Growth hormones (H)	1st Trial	2nd Trial	1st Trial	2nd Trial	1st Trial	2nd Trial	1st Trial	2nd Trial
Control	5.75b	4.80	8.25b	8.33b	13.50b	14.30b	23.00b	25.15b
Coconut water	7.88ab	5.81	11.75ab	11.66a	18.19a	21.24a	25.88a	36.02a
Brassinolide	9.13a	5.12	14.38a	10.67a	18.88a	21.02a	25.94 a	37.53a
Salicylic acid	9.25a	6.60	13.31a	11.29a	18.75a	21.31a	24.63ab	37.50a
LSD (0.05)	3.270	1.841	4.140	2.330	4.050	6.698	2.500	2.341
Method of application (M)								
Soaking	8.12	5.45	12.22	10.25	17.59	20.48	24.91	37.49
Spraying	7.88	5.72	11.63	11.70	17.06	20.85	24.81	35.45

LSD (0.05)	2.310	1.301	2.930	1.648	3.990	4.736	5.300	5.120
Interaction								
H x M	NS	NS	NS	NS	NS	NS	NS	NS

Means having similar alphabets are not significantly different using LSD (P < 0.05); DAP = Days after planting

Table 4: Effect of plant growth regulator and method of application on number of branches of Waterleaf

Treatments	**7DAP**		**14DAP**		**21DAP**		**28DAP**	
Growth hormones (H)	1st Trial	2nd Trial	1st Trial	2nd Trial	1st Trial	2nd Trial	1st Trial	2nd Trial
Control	2.00b	1.33	2.50b	2.33b	3.00b	4.83b	3.25b	5.50b
Coconut water	3.00a	1.33	4.00a	2.67b	4.13a	5.17ab	4.50a	5.83b
Brassinolide	3.50a	1.50	4.75a	3.67a	5.13a	6.33a	5.63a	7.17a
Salicylic acid	3.50a	1.33	4.75a	2.83ab	4.88a	5.33ab	4.88a	6.00b
LSD (0.05)	1.000	0.746	2.010	0.993	1.030	1.417	1.210	1.452
Method of application (M)								
Soaking	3.31	1.42	4.31	3.17	4.50	5.17	4.75	8.50
Spraying	2.69	1.33	3.69	2.58	4.06	5.67	4.38	8.75
LSD (0.05)	1.490	0.528	1.860	0.702	2.130	1.002	2.050	1.020
Interaction								
H x M	NS	NS	NS	NS	NS	NS	NS	NS

Means having similar alphabets are not significantly different using LSD (P < 0.05); DAP = Days after planting

Table 5: Effect of plant growth regulator and method of application on stem diameter of Waterleaf

Treatments	**7DAP**		**14DAP**		**21DAP**		**28DAP**	
Growth hormones (H)	1st Trial	2nd Trial	1st Trial	2nd Trial	1st Trial	2nd Trial	1st Trial	2nd Trial
Control	0.517	0.40	0.86	0.66	1.16	0.94ab	1.20c	1.46
Coconut water	0.415	0.33	0.91	0.60	1.46	1.11a	1.91b	1.58
Brassinolide	0.38	0.32	0.89	0.56	1.45	0.84b	2.17ab	1.42
Salicylic acid	0.419	0.35	0.97	0.53	1.59	0.94ab	2.82a	1.54
LSD (0.05)	0.143	0.123	0.281	0.161	0.478	0.177	0.692	0.382
Method of application (M)								
Soaking	0.43	0.35	0.91	0.58	1.42	0.97	2.06	1.47
Spraying	0.43	0.35	0.90	0.59	1.40	0.95	1.99	1.53
LSD (0.05)	0.101	0.084	0.199	0.114	0.339	0.125	0.489	0.270
Interaction								
H x M	NS	NS	NS	NS	NS	NS	NS	NS

Means having similar alphabets are not significantly different using LSD (P < 0.05); DAP = Days after planting

Table 6: Effect of plant growth regulator and method of application on absolute growth rate of Waterleaf

Treatments	**7DAP**		**14DAP**		**21DAP**		**28DAP**	
Growth hormones (H)	1st Trial	2nd Trial	1st Trial	2nd Trial	1st Trial	2nd Trial	1st Trial	2nd Trial
Control	0.82c	0.73	0.39c	0.50b	0.72b	0.85b	0.84c	1.55b
Coconut water	1.13b	0.83	0.60b	0.84a	0.88a	1.36a	1.10b	2.11ab
Brassinolide	1.30a	0.69	0.81a	0.79a	0.59c	1.48a	1.01b	2.36a
Salicylic acid	1.32a	0.94	0.63b	0.67ab	0.73b	1.43a	1.36a	2.31ab
LSD (0.05)	0.062	0.194	0.029	0.254	0.045	0.479	0.068	0.806
Method of application (M)								
Soaking	1.16	0.78	0.59	0.69	0.77	1.46	1.05	2.45
Spraying	1.12	0.82	0.63	0.85	0.69	1.31	1.11	2.09
LSD (0.05)	0.043	0.138	0.021	0.243	0.033	0.410	0.047	0.641
Interaction								
H x M	NS	NS	NS	NS	NS	NS	NS	NS

Means having similar alphabets are not significantly different using LSD ($P < 0.05$); DAP = Days after planting

Table 7: Effect of plant growth regulator and method of application on yield attributes of Waterleaf

Treatments	Days to first sprout		Days to flowering		Fresh shoot weight		Fresh root weight	
Growth hormones (H)	**1st Trial**	**2nd Trial**	**1st Trial**	**2nd Trial**	**1st Trial**	**2nd Trial**	**1st Trial**	**2nd Trial**
Control	2.75	4.5a	30.00a	28.33	220.5c	213.16c	105.00b	79.12b
Coconut water	2.63	2.67b	28.13c	25.17	280.00b	267.50b	107.69b	102.60ab
Brassinolide	2.63	3.33b	29.25bc	26.00	270.38b	270.73b	159.05a	110.09ab
Salicylic acid	2.50	2.67b	29.63ab	26.50	310.63a	307.27a	162.26a	123.22a
LSD (0.05)	0.910	1.114	1.440	4.172	17.764	30.941	9.814	39.846
Method of application (M)								
Soaking	2.69	3.17	28.86	28.00a	310.38a	282.35	154.21a	106.24
Spraying	2.56	3.42	28.63	25.00b	230.38b	246.98	112.79b	101.28
LSD (0.05)	0.640	0.788	1.020	3.000	12.561	45.069	6.940	28.175
Interaction								
H x M	NS		NS		NS		NS	

Means having similar alphabets are not significantly different using LSD ($P < 0.05$); DAP = Days after planting

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