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Plant Growth Regulators Improve Yield and Yield Components of Wheat under Deficit Irrigation Treatments With Considering the Productive Capacity

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ABSTRACT

Wheat (*Triticum aestivum* L.) is one of the major crop plants, which is an important source of various compounds such as carbohydrates, lipids, proteins, and nutrients. Several methods have been used so far to improve wheat growth, seed yield and yield competition under drought stress, and one of the most important one is application of different plant growth regulators (PGRs). In order to determine the effects of different PGRs on the grain yield and yield components of wheat under water shortage treatments, an experiment was designed as a split plot on the basis of a complete randomized block design with three replications in two different experimental locations, namely Abarkuh and Faragheh in 2018-2019. Main plots were the evaporation from the pan class A, namely control treatment (80 mm), 100 mm, and 120 mm evaporation from pan class A, and subplots were control treat (water), foliar application of PGRs of gibberellic acid (GA_3 at 100 mgL-1), salicylic acid (SA at 1.5 mM), benzyl adenine (BA at 60 mgL^{-1}), GA_3+SA, as well as superoxide dismutase (SOD at 5 gL^{-1}). In this experiment the effects of irrigation treatments and foliar application of PGRs were significant on all experimental characteristics, such as plant height, spike length, the number of tillers per plant, and peduncle length. The highest values of plant height (68.06 cm), spike length (8.81 cm), the number of tillers per plant (3.37), and peduncle length (9.55 cm) was related to 80 mm evaporation from pan class A, and combined application of gibberellic acid and salicylic acid also had obtained the maximum plant height (69.47 cm), spike length (9.23 cm), the number of tillers per plant (3.93), and peduncle length (10.40 cm). The maximum value of plant height (71.27 cm), spike length (10.53 cm), the number of tillers per plant (5.47), and peduncle length (11.69 cm) was related to interaction between 80 mm evaporation from pan class A, and combined application of gibberellic acid and salicylic acid. Other experimental characteristics such as leaf area index (LAI), the number of grains per spike, one thousand grain weight, grain yield, biological yield and harvest index (HI) were significantly affected by irrigation treatments and different PGRs. The highest values of LAI at anthesis stage (187.71), the number of grains per spike (28.53), one thousand grain weight (32.35 g), grain yield (555.18 ton/ha), biological yield (1178.92 ton/ha), and harvest index (47.11 %) were obtained for interaction between 80 mm evaporation from pan class A and combined application of gibberellic acid and salicylic acid. According to the findings, the combined application of gibberellic acid and salicylic acid was the most effective treatments followed by usage of superoxide and benzyl adenine which reveal the importance of application of plant hormones for wheat growth under drought conditions. To sum up, it is important to use tested PGRs to increase wheat yield and yield components particularly under drought stress condition.

***Keywords**:* Benzyl adenine, Gibberellic acid, Grain protein, Irrigation, Salicylic acid, Superoxide dismutase, Wheat.

INTRODUCTION

Drought is one of the main constraints influencing wheat productivity globally (Shahrajabian *et al*., 2017a,b; Khojastehnazhand and Roostaei, 2022), and drought patterns be affected by various parameters such as soil, climatic, and crop growth characteristics (Shahrajabian *et al*., 2011; Rahimi-Moghaddam *et al*., 2023). Wheat is an important food resources in Iran, and wheat farming in Iran is executed using irrigated and rain-fed methods, which are more sensitive to changes temperature hikes, precipitation levels, harvesting dates, evaporation rates, snowing patterns, land fertility, and water access (Khoshnevisan *et al*., 2013; Houshyar *et al*., 2018; Pakrooh and Kamal, 2023; Shahrajabian and Sun, 2023a,b; Sun and Shahrajabian, 2023). Gibberellins (GA_3) are endogenous plant growth regulators, including diterpenoid and tetracyclic compounds which act as promoters of development and growth of many crops (Sun *et al*., 2020; Sun *et al*., 2021; Sun *et al*., 2022; Shahrajabian *et al*., 2023). As a phytohomone, it has important role in promoting the change from vegetative to reproductive development with important functions in flower development and fertilization (Saluja *et al*., 1987; Saluja *et al*., 1989; Mathur *et al*., 1992; Ghanbary *et al*., 2020). Salicylic acid is a class of plant regulators which play various functions in plant development as well as abiotic and biotic stress responses (Agami and Mohamed, 2013; Shakirova *et al*., 2016; Zhang *et al*., 2018; Shahrajabian and Sun, 2023). Salicylic acid, a phytohormone, is a promising component which can decrease the sensitivity of plants to environmental stresses via modulation the antioxidant defense system, regulation of stomatal movement, photosynthetic rate, and transpiration rates (Shakirova *et al*., 2003; Sahu *et al*., 2010; Ding *et al*., 2016; Soleymani *et al*., 2017; Akbulut *et al*., 2018). Superoxide dismutase (SOD) are defence-related proteins, which are involved in detoxifying reactive oxygen species (ROS) which can increase grain yield and yield components of wheat (Tyagi *et al*., 2017), and improve tolerance of plants to different stresses such as drought and salt stress (Barra *et al*., 2016; Shen *et al*., 2018). SOD catalyzes the conversion of superoxide (O_2^-) into oxygen (O_2) and hydrogen peroxide (H_2O_2), and it has also important function in stress resistance, plant growth and development (Romao, 2015; Guo *et al*., 2023). This article aims to investigate the impacts of different PGR including water, gibberellic acid 3 (GA_3), salicylic acid, benzyl adenine and superoxide dismutase on wheat yield and yield components under water deficit conditions.

MATERIALS AND METHODS

In order to experiment the effects of different kinds of plant growth regulators on yield, yield components, biochemical and nutritional properties of wheat under various field drought conditions, an experimented was conducted at two different experimental stations in Yazd, Iran. The first experimental station was Abarkuh (E53°14´and N31°7´) with altitude of 1530 m, and Faragheh (E53°14´and N31°3´) with the altitude of 1713 m. Table 1 has shown the data related to climatic conditions of two experimental locations, and the climate of region is dry and hot with the annual rainfall of 75 mm (Table 1). The soil physical and chemical properties of the experimental stations (0-30 cm) are presented in Table 2. The trial was done according to split plot, on the basis of a complete randomized block design with three replications, and the name of wheat cultivar which has been used in this experiment was Sistan. The main plots were drought levels at 80 (S1), 100 (S2), and 120 mm (S3) evaporation from pan class A, and the subplots including the experimental treatments of water (control treatment, T1), plant growth regulators (PGRs) of gibberellic acid (GA_3 at 100 mgL^{-1}, T2), salicylic acid (SA at 1.5 mM, T3), benzyl adenine (BA at mgL^{-1}, T4), GA3+SA (T5), and super oxide dismutase (SOD at 5 gL^{-1}, T6) were tested. The plots (including a non-treated plot as control) measuring 3 × 4 m with the plant density of 400 were established in the fields (cultivated and disked), with a 2.5 m distance from the irrigation canals. The plots were irrigated until the tillering stage and were then treated according to the experimental treatments including spraying with the PGRs at two different stages of tillering and heading. Weeds were controlled by using 2,4-Dichlorophenoxyacetic acid (2,4-D). The plants were harvested at the physiological maturity when 50% of the plots were matured, and plants were sampled by collecting 10 plants from each plot. In this experiment, we have analyzed plant height (cm), spike length (cm), the number of tillers per plants, peduncle length (cm), leaf area index (LAI) at anthesis stage, the number of grains per spike, one thousand grain weight (g), grain yield (ton/ha), biological yield (ton/ha), and harvest index (HI) (%). The plant height was taken from five randomly selected plants of each plot, and the height of the plant was evaluated from the base of the plant to the tip of the upper most spikelets per spike. Tillers per plant that had at least one visible leaf was counted with considering both non-effective and effective tillers. Leaf area index is defined as the one-sided green leaf area of a canopy or plant community per unit ground area; the leaf area of wheat using the formula given as follows: Leaf Area index (LAI): Leaf area (m^2)/ground area (m^2). Spike length was taken from basal node of the rachis to the apex of last grains of each spike. Grain yields were assessed by harvesting crops grown one square meter area at the center of each plot, and the harvested samples were then threshed, dried, weighted and the values expressed in ton/ha. Harvest index calculated according to the following formula, to analysis data of variance, SAS 9.3 was used.

Harvest index (%) = Grain yield/biological yield × 100

Table 1.The climatic data of the experimental stations.

Month	Max Temperature (°C)	Min Temperature (°C)	Average Temperature (°C)	Humidity (%)	Monthly Rainfall (mm)
Abarkuh					
Nov	27.2	7.8	13.8	48	2
Dec	21.6	2.3	9.5	42	4.7
Jan	22.6	1.1	8.3	40	5.1
Feb	21.5	1.8	8.3	44	26
Mar	22.3	3.4	9.9	37	4.6
Apr	28	9.6	16.2	42	16
May	32.1	13.8	20.70	29	28.4
Jun	39.3	19.9	27.5	21	0.1
Faragheh					
Nov	25.9	6.9	12.7	51	2.2
Dec	20.9	2.1	9.1	46	4.8
Jan	21.4	1	7.9	42	4.9
Feb	20.4	1.5	8	45	26.8
Mar	21.7	3.2	9.7	39	5.2
Apr	27.6	8.9	15.4	40	17.1
May	30.10	12.8	19.5	39	29.6
Jun	34.4	18.7	25.6	26	0.15

Table 2. The chemical and physical properties of the experimental field (0-30 cm).

Experimental station	pH	EC (dSm^{-1})	OC (%)	P	K	Sand (%)	Silt (%)	Clay (%)
Abarkuh	7.2	0.94	0.79	9.55	398	25.2	40.80	34.0
Faragheh	6.8	0.89	0.74	9.98	410	23.1	43.60	33.3

EC: Electrical conductivity (Salinity); OC: Organic carbon; P: Phosphorous; K: Potassium

RESULTS AND DISCUSSION

The effects of irrigation treatments on plant height were meaningful, and the maximum plant height (68.06 cm) was obtained for application of 80 mm evaporation from pan class A which had significant differences with 100 mm and 120 mm evaporation from pas class A (Table 3). According to the mean comparison of experimental characteristics, plant height in 100 mm evaporation from pan class A was 66.50 cm, which had significant difference with the value of plant height in 120 mm evaporation from pan class A (65.38 cm). The higher value of spike length was 8.81 cm which was related to 80 mm evaporation from pan class A, followed by 100 mm evaporation (7.98 cm) and 120 mm evaporation from pan class A (7.63 cm). Moreover, the difference between 100 mm and 120 mm evaporation from pan class A was significant. The number of tillers per plant was significantly influenced by irrigation treatment. The maximum and the minimum values of the number of tillers per plant was related to 80 mm evaporation from pan class A (3.37), and the minimum one was achieved in 120 mm evaporation from pan class A (1.77), which had significant difference with each others. The number of tillers per plant in 100 mm evaporation from pan class A was 2.60, which had significant differences with other treatments. The higher value of peduncle length was related to 80 mm evaporation from pan class A (9.55 cm), followed by 100 mm evaporation from pan class A (8.79 cm), and 120 mm evaporation from pan class A (7.80 cm). All differences between treatments were significant (Table 3). The effects of foliar application of different plant growth regulators was significant on plant height, spike length, the number of tillers per plant and peduncle length. The highest and the lowest values of plant height was related to application of gibberellic acid + salicylic acid (69.47 cm), and control treatment (62.38 cm), respectively. On the basis of mean comparison, plant height was 66.03 cm in application of gibberellic acid, 67.20 cm in salicylic acid, 66.49 cm in usage of 66.49 cm, and 68.30 cm in application of superoxide dismutase. All differences between different treatments were significant. In many researches, it has been reported that gibberellic acid induced elongation of wheat coleoptile sections and its connection with endogenous indole acetic acid (Akiyama and Suzuki, 1981; Chattopadhyay *et al*., 1984; Saluja *et al*., 1989). Gibberellic acid is an important signaling plant hormone, stimulate different physiological processes and plant developmental, which includes cell division and maturity, and increase tolerance to many stress (Iftikar et al., 2019). The maximum and the minimum spike length was obtained in control treatment (6.84 cm), and application of gibberellic acid + salicylic acid (9.23 cm), which had meaningful differences with each others. There was not meaningful difference in spike length between application of gibberellic acid (7.70 cm), and benzyl adenine (7.96 cm), but these two treatments had significant differences with other treatments. Spike length was 8.38 cm, and 8.75 cm for foliar application of salicylic acid, and superoxide dismutase, respectively. It has been proved that salicylic acid is a stress-signal molecule which can activate abiotic stress-responsive gene expression, which can induce the expression of biosynthetic proteins and enzymes in plants under environmental stresses (Sharma *et al*., 2017; Wang and Zhang, 2017; Khalvandi *et al*., 2021; Munsif *et al*., 2022). The higher value of the number of tillers per plant was related to application of gibberellic acid + salicylic acid (3.93), followed by usage of superoxide dismutase (3.23), benzyl adenine (2.61), salicylic acid (2.57), and gibberellic acid (2.01). There was not significant difference in the number of tillers per plant between application of salicylic acid and benzyl adenine, but all other differences in this experiment were significant. Salicylic acid can alleviate the ameliorative impacts stresses, leading to more oxidative stress, and can increase the tolerance of stressed wheat plants by non-enzymatic and enzymatic antioxidant defence system components (Colak *et al*., 2021). The highest value of peduncle length was related to application of gibberellic acid + salicylic acid (10.40 cm), which had meaningful difference with other treatments. Control treatment has obtained the minimum peduncle length which was 5.50 cm. Peduncle length for other treatments, namely gibberellic acid, salicylic acid, benzyle adenine and superoxide dismutase were 8.24 cm, 8.88 cm, 9.36 cm, and 9.92 cm, respectively. All differences between treatments were significant (Table 3).

Table 3.The mean comparison of experimental characteristics.

Treatment	Plant height (cm)	Spike length (cm)	The number of tillers per plant	Peduncle length (cm)
Irrigation				
80 mm evaporation from pan class A	68.06a	8.81a	3.37a	9.55a
100 mm evaporation from pan class A	66.50b	7.98b	2.60b	8.79b
120 mm evaporation from pan class A	65.38c	7.63c	1.77c	7.80c
Foliar application of PGRs				
Control treatment	62.38e	6.84e	1.14e	5.50f
Gibberellic acid (GA_3)	66.03d	7.70d	2.01d	8.24e
Salicylic acid (SA)	67.20c	8.38c	2.57c	8.88d
Benzyl adenine (BA)	66.49d	7.96d	2.61c	9.36c
Gibberellic acid + Salicylic acid	69.47a	9.23a	3.93a	10.40a
Superoxide dismutase (SOD)	68.30b	8.75b	3.23b	9.92b

Mean values followed by the same letters are not significantly different at $P < 0.05$ using least significant difference (LSD).

The highest plant height was obtained in usage of control treatment (80 mm evaporation from pan class A), and application of gibberellic acid + salicylic acid which was 71.27 cm, and it showed significant differences with other treatments. Application of 120 mm evaporation from pan class A and control treatment has obtained the lowest value of plant height which was 60.57 cm (Table 4). Gibberellic acid can influence the wheat plants via antioxidant enzyme activities, and photosynthetic pigments (Alharby *et al*., 2021; Al-Huqail *et al*., 2023; Sun *et al*., 2023). The maximum spike length (10.53 cm), and the number of tillers per plant (5.47) was related to control treatment (80 mm evaporation from pan class A), and application of gibberellic acid with salicylic acid (S1T5). All differences between interaction of 80 mm evaporation from pan class A and application of gibberellic acid + salicylic acid with other treatments were significant. Superoxide dismutase, can decrease superoxide concentration plays an important function in the elimination of reactive oxygen species, improved the status of other antioxidant enzymes, and it is an important tool for depicting drought tolerance of wheat genotype (Huseynova *et al*., 2014; Kaouthar *et al*., 2016; Kumar *et al*., 2020). The maximum and the minimum peduncle length was achieved in interaction between 80 mm evaporation from pan class A and combined usage of gibberellic acid + salicylic acid (11.69 cm) (S1T5), and interaction between 120 mm evaporation from pan class A and control treatment (4.96l) (S3T1). The difference between these two treatments and other treatments were significant (Table 4).

Table 4. The mean comparison of interaction of experimental characteristics.

Treatment	Plant height (cm)	Spike length (cm)	The number of tillers per plant	Peduncle length (cm)
S1T1	63.48j	7.51ij	1.27k	6.03j
S1T2	61.67de	7.90gh	2.23h	8.71f
S1T3	68.69c	8.84c	3.43d	9.64d
S1T4	67.77d	8.38def	3.37d	10.03c
S1T5	71.27a	10.53a	5.47a	11.69a
S1T6	69.56b	9.70b	4.47b	11.22b
S2T1	63.09j	6.82k	1.1l	5.51k
S2T2	65.43hi	7.78hi	2.50g	8.22gh
S2T3	66.85f	8.31def	2.67f	9e
S2T4	65.97gh	8.06fgh	2.63f	9.70d
S2T5	69.34b	8.55cde	3.68c	10.29c
S2T6	68.30c	8.33def	3e	10.06c
S3T1	60.57k	6.20l	1.05l	4.96l
S3T2	65.07i	4.70j	1.30k	7.80i
S3T3	66.05g	7.90gh	1.60j	8.01hi
S3T4	65.74gh	7.44ij	1.83i	8.36g
S3T5	67.81d	8.60cd	2.63f	9.23e
S3T6	67.03ef	8.21efg	2.23h	8.48g

S1 (control, 80 mm), S2 (100 mm), and S3 (120 mm), T1 (control), T2 (Gibberellic acid), T3 (Salicylic acid), T4 (Benzyl adenine), T5 (GA_3 + SA), T6 (Superoxide dismutase).

Foliar application of interaction between 80 mm evaporation from pan class A and combination of gibberellic acid + salicylic acid could obtain the highest value of LAI at anthesis stage (187.71), which had significant differences with other treatments, except the interaction between 100 mm evaporation from pan class A and combination application of gibberellic acid + salicylic acid (176.44). The minimum value of LAI at anthesis stage was related to interaction between 120 mm evaporation from pan class A and control treatment (101.87)(S3T1) (Table 5). The maximum and the minimum number of grains per spike was achieved in interaction between 80 mm evaporation from pan class A and combination of gibberellic acid + salicylic acid (28.53)(S1T5), and interaction between 120 mm evaporation from pass class A and control treatment (11.42)(S3T1) which had meaningful difference with each others. Salicylic acid introduced as an important signaling molecule which plays an important function in plant defense responses induced by different pathogens, and improve tolerance of plants to many stress factors (Gordon *et al*., 2004; Agarwal *et al*., 2005; Tasgin *et al*., 2006; Kang *et al*., 2012). The higher values of one thousand grain weight was related to interaction between 80 mm evaporation from pan class A and combination of gibberellic acid + salicylic acid (32.35g)(S1T5), followed by the interaction between 80 mm evaporation from pas class A and superoxide dismutase (30.85 g)(S1T6), the interaction between 100 mm evaporation from pan class A and combination of gibberellic acid + salicylic acid (29.63 g)(S2T5), and other treatments. On the other side, the interaction between 120 mm evaporation from pan class A and control treatment (18.26g)(S3T1), which had significant differences not only with S1T5, but also other treatments. The positive impacts of gibberellic acid on grain weight of wheat has been reported in other researches (Hartung *et al*., 2010; Pfleger *et al*., 2011; Endler *et al*., 2015). The highest and the lowest values of grain yield was obtained in interaction between 80 mm evaporation from pan class A and combination of gibberellic acid + salicylic acid (555.18 ton/ha)(S1T5), and the interaction between 120 mm evaporation from pan class A and control treatment (194.05 ton/ha)(S3T1) which had significant difference with each others. After S1T5, the highest values of grain yield were found in interaction between 800 mm evaporation from pan class A and superoxide dismutase (484.32 ton/ha)(S1T6), and interaction between 100 mm evaporation from pan class A and combination of gibberellic acid + salicylic acid (483.54 ton/ha)(S2T5). Iqbal and Ashraf (2013) also reported that application of gibberellic acid can increased grain yield because of modulation of ions uptake and partitioning withing roots and shoots, and hormones homeostasis under saline conditions. In agreement with the results of this experiment application of salicylic acid can significantly increase grain yield of wheat plants in salinity stress, and it can mitigate the adverse impacts of both salt stress and water deficit by significantly increasing biochemical traits, physiological characteristics, and finally grain yield in seedlings (Soleymani *et al*., 2013; Yadav *et al*., 2020; Kadam *et al*., 2021; Shahrajabian and Sun, 2023; Shahrajabian *et al*., 2023a,b). The interaction between 80 mm evaporation from pan class A and combination of gibberellic acid + salicylic acid (S1T5) had obtained the maximum biological yield (1178.92 ton/ha), and harvest index (47.11%), which had significant differences with other treatments of experiment. Kovacs *et al*. (2014), and Sedaghat *et al*. (2017) also reported that the application of salicylic acid could improve grain yield and yield component of wheat and improve tolerance of wheat plants to drought. According to the results of Table 5, the lowest values of biological yield (826.41 ton/ha), and harvest index were (23.50%) related to the interaction between application of 120 mm evaporation from pan class A and control treatment (S3T1) which showed significant differences with the highest values and other treatments. Rebetzke *et al*. (2012) and Bhat *et al*. (2023) showed that application of gibberellic acid could increase grain yield and harvest index of wheat plants. Aminifard *et al*. (2020) observed that application of salicylic acid and benzyl adenine is a simple and important technique for the natural incensement of nutritional components in coriander, and their application can increase yield, growth, essential oil, and biochemical indices of coriander.

CONCLUSION

Iran is climatically located in semi-arid and arid regions, which shows researches are needed about different responses of plants into stress factors, and wheat is one of the main important cereal crops and main staple food worldwide. Moreover, wheat grain is nutritious and composed of fiber, starch, vitamins E and B, antioxidants, iron and significant among of gluten content. GA_3 and salicylic acid are one of the most important plant growth regulators in the agricultural practices which is most appropriate for improving and promoting plant-growth of different plants. In this experiment the combined application of GA_3 and salicylic acid was the most effective treatment, followed by the application of superoxide dismutase. Combined application of GA_3 and salicylic acid with 80 mm evaporation from pan class A could lead to the highest values of plant height, spike length, the number of tillers per plant, peduncle length, LAI at anthesis stage, the number of grains per spike, one thousand grain weight, grain yield, biological yield and harvest index. GA_3 and salicylic acid application could ameliorate the negative effects of water shortage on growth, yield and yield components, and salicylic acid which is considered as a signaling compound for signal transduction pathways, can help plants in protection against adverse impacts of drought. In conclusion, it is important to use tested PGR to increase barley yield and yield components particularly under drought stress condition.

Table 5.The mean comparison of experimental characteristics.

Treatment	LAI at anthesis stage	The number of grains per spike	One thousand grain weight (g)	Grain yield (ton/ha)	Biological yield (ton/ha)	Harvest index (HI) (%)
S1T1	112.32k	15.03f	23.13fg	321.96k	916.49e	35.13k
S1T2	160.19cde	19.37d	26.99e	404.07g	945.59d	42.73efg
S1T3	168.27bc	22.00c	27.99d	427.08e	984.86c	43.36ef
S1T4	163.70bcd	21.40c	26.70e	413.34gh	978.40c	42.24g
S1T5	187.71a	28.53a	32.35a	555.18a	1178.92a	47.11a
S1T6	174.86b	25.58b	30.85b	484.32c	1073.54b	45.14cd
S2T1	115.13jk	13.25g	20.97h	290.95m	875.07f	33.25l
S2T2	133.77gh	15.00g	23.78g	357.39j	900.70e	39.67i
S2T3	152.92ef	16.67e	25.39f	389.99h	918.78e	42.45fg
S2T4	144.86fg	15.33f	24.44f	396.65gh	900.24e	44.07de
S2T5	176.44ab	21.50c	29.63c	483.54b	1081.86b	46.27bc
S2T6	164.31bcd	19.92d	27.44e	459.45d	983.02c	46.74ab
S3T1	101.87l	11.42i	18.26i	194.05n	826.41g	23.50m
S3T2	120.66ij	12.42h	20.27h	298.77m	831.55f	35.97j
S3T3	126.51hi	14.25g	22.31g	329.32k	870.80f	37.83j
S3T4	121.50hij	12.67h	21.22h	304.81l	861.42f	35.40j
S3T5	149.01ef	20.00d	26.90e	426.12e	981.43c	43.42def
S3T6	130.92hi	15.67ef	24.87f	379.05i	916.59e	41.38n

Common letters within each column do not differ significantly ($P < 0.05$).

S1 (control, 80 mm), S2 (100 mm), and S3 (120 mm), T1 (control), T2 (Gibberellic acid), T3 (Salicylic acid), T4 (Benzyl adenine), T5 (GA_3 + SA), T6 (Superoxide dismutase).

Disclosure statement

The authors declare that they do not have any conflict of interest

Author contributions

All authors have contributed equally to this manuscript.

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