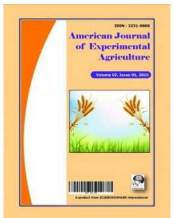

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The Effect of Jasmonic Acid (JA) as Seed Treatment and Soil Drench on Morphological Parameters of Moneymaker Tomatoe (*Solanum lycopersicum L.*)

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

The aim of this research was to determine the effect of Jasmonic Acid (JA) application on some morphological parameters of money maker tomatoe. This research was undertaken in Lancaster Environmental centre glasshouse, Lancaster university, United kingdom. Results showed that Tomatoe plants that received 3 mM JA seed treatment showed a reduction in their mean height and are significantly different ($p<0.001$) to control soil treated plants. Tomatoe plants of JA soil drench treatment also showed a significant reduction in their mean height ($p= 0.001$) compared to the control soil drenched plants. JA seed primed Moneymaker tomatoe plants showed significant increase in their mean root weight compared to the control at ($p=0.026$). However, there were no significant differences in mean dry weight between JA soil drenched plants and their controls at ($p=0.110$). Although, significant increase in mean root weight was found in soil-drenched plants compared to control seed treated plants ($p= 0.002$). Increase in total mean plant dry weight of

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Moneymaker tomato plant (*Solanum lycopersicum* L.) was detected in those of JA seed treatment (Fig. 1, p=0.018) compared to control seed treatment (Tukey's *post hoc* test). Similarly, there is significant increase in mean dry weight of JA soil drench plants than the control soil drenched plants (Fig. 1, p=0.001) using Tukey's *post hoc* test. Finally it was also observed that no growth cost was associated with priming by exogenous JA application except for stunting of plant height.

Keywords: Jasmonic acid; seed treatment; morphological parameters; soil drench; money maker.

1. INTRODUCTION

In inducible defence, plants are known to possess three key signaling hormones, which are Jasmonic acid (JA), Salicylic acid (SA) and Ethylene (ET). Each of these phytohormones has a dependent pathway that aids plants in battling particular class of pathogens [1]. In the wild, plants may be challenged with different forms of pathogenic invasions at the same time [2]. This as a result, builds- up the innate defense processes within the plant (inducible defense) against these simultaneous attacks. The plant makes use of defense mechanisms that are either destructive to all aggressors, or at least does not impede resistance to other attackers.

The main methods of exogenous chemical application for inducing prime state in plant includes soil drenching, leaf spraying and seed treatment. However, their usefulness are limited as they tend to reduce plant growth in the course of triggering strong plant defence [3]. However, as described by [4], exogenous chemical application may guarantee efficient and more reliable priming reactions in plants with insignificant cost on growth using appropriate concentrations.

In addition, [5], observed no growth cost as JA seed treated tomato plants with sustained priming response effective against *B. cinerea* and other necrotrophic pathogens, and was recommended for field trials. Leaf and root drench were familiar methods of priming plants by means of synthetic chemicals. Though it was recently discovered that priming plant defence by seed treatment is though very effective, it is unknown if its resistance, particularly to necrotrophic pathogens is mediated by hydrogen peroxide. However, it is the intention of this research to focus on the Effect of Jasmonic Acid (JA) seed treatment and soil drench on Some Morphological parameters of Moneymaker tomato (*Solanum lycopersicum* L.).

2. MATERIALS AND METHODS

2.1 Seed Treatment

Seeds of Moneymaker tomato cultivar (*Solanum lycopersicum* L.) of were supplied from moles seeds (www.molesseed.co.uk). The procedures for the treated seeds were carried out as reported by [5]. Approximately 100 seeds of each cultivar were soaked in 10 ml aqueous solution containing 25 µl of 3 mM JA (prepared from 1.19 molar (M) stock in absolute ethanol) at low temperature of 4℃ for a period of 24 hours. For control, equal numbers of seeds were soaked in 10 ml aqueous solution containing 25 µl of 100% ethanol. All the incubated seeds were put through three rounds of washing with deionized water, for approximately 15 minutes and sown in compost.

2.2 Plant Growing Conditions and Soil Drench

Seeds of Moneymaker tomato cultivar (*Solanum lycopersicum* L.) were grown within the Lancaster Environment Centre glasshouse, which as programmed has low and high temperature ranges of 20±4℃ and 30±4℃ respectively. The 600W Phillips Plantaster light bulbs in the glasshouse supplied 200±50 µmol $m^{-2}s^{-1}$ of photosynthetic photon flux at 14h photoperiod to supplement low natural photoperiods. The seeds were sown in 0.3 L pots filled with high nutrient compost (Levington M3), and seeds were watered two times a day (10 am and 4 pm) from a hose connected tap within the glasshouse. For soil- drench treatment, untreated seeds were sown directly into pots and watered, until seedlings emerged and grew to second leaf stages. A 0.1 mM JA concentration was prepared from the 1.19 M JA stock and administered to soils at a volume of 30mls per pot. Control seedlings were soil-treated with 30 mls of 0.09% aqueous ethanol solution per pot. At 3 weeks of age, the plants were repotted alongside the seed treated plants into 0.9 L pots containing new compost. However, roots of soil – drenched seedlings were carefully rinsed to remove compost that may contain chemicals before repotting. This was to avoid any further influence or effect the chemicals might have on subsequent plant growth. Growth parameters were measured at fourth leave stage

3. RESULTS

The effect of exogenous application of JA by seed treatment and soil drenching on height of Moneymaker tomato (*Solanum lycopersicum* L.) is showed in Fig. 1. Tomatoe plants that received 3 mM JA seed treatment showed a reduction in their mean height and are significantly different ($p<0.001$) to control soil treated plants. Also, tomatoe plants of JA soil drench treatment showed a significant reduction in their mean height ($p= 0.001$) compared to the control soil drenched plants (Tukey's *post hoc* test).

JA seed primed Moneymaker tomato plants showed significant increase in their mean root weight compared to the control (Fig. 2, $p=0.026$). However, there was no significant difference in mean dry weight between JA soil drenched plants and their controls (Fig. 2, $p=0.110$). Although, significant increase in mean root weight was found in soil-drenched plants compared to control seed treated plants, (Tukey's *post hoc* test).

Tukey's *post hoc* test revealed no significant difference in mean stem dry weight between 3mM JA seed primed plants and ethanol seed treated plants (control) (Fig. 3, $p=0.388$). However, JA soil drenched plants showed significant increase in their mean dry stem weight compared to that of the control soil drenched plants (Fig. 3, $p=0.034$) (Tukey's *post hoc* test).

Plants of JA seed treatment did not a show significant difference in their mean leaf weight (Fig. 4, $p=0.129$) compared to the control, but a significant increase was found in JA soil drenched plants than the control soil drenched plants (Fig. 4, $p=0.011$). Also, JA soil drenched plants showed a significant increase in their mean dry weight compared to those of control seed treatment (Fig. 4, $p= 0.026$).

Increase in total mean plant dry weight of Moneymaker tomato plant (*Solanum lycopersicum* L.) was detected in those of JA seed treatment (Fig. 5, $p=0.018$) compared to control seed treatment (Tukey's *post hoc* test). Similarly, there is significant increase in mean dry weight of JA soil drench plants than the control soil drenched plants (Fig. 5, $p=0.001$) using Tukey's *post hoc* test.

4. DISCUSSION

The data showed a significant reduction in height of JA seed treated plants and JA soil drench plants compared to their controls. This stunting is possibly the consequence of supressing other phytohormone pathways by exogenous JA application for priming defense against necrotrophic pathogens, which includes *B. cinerea* [6]. However, the data showed increase in stem dry weights and leaf dry weight of the primed plants. This is equivalent to the findings of [7], which showed how Jasmonic acid application on sweet basil, resulted to a reduction in the plant height but increased the stem and leaf dry weight of the plant. The data showed that the increase in all the mean dry weights of all the measured primed plant parts were only statistically significant in JA soil- drench plants, except for the root weight when compared to control. This indicates that application of JA as soil- drench might have inhibited root growth, however, [8] showed that exogenous JA or MeJA application on Japanese morning glory tends to reduce its root growth, and further increase in the Jasmonate concentration further increases the root reduction of the plant. In contrast, the data showed that JA seed treated plants showed increase in mean dry measurements, which were not statistically significant except for root dry weights. This further suggests that the significant root dry weight of JA seed treated plant compared to the control might be due to absence of direct contact between the plant hormone and the plant root.

In addition, a significant increase in total mean plant dry weight was observed in both JA seed treated and JA soil drenched plants. This might be because the exogenous application JA have induced some physical changes that led to increase in the dry weight of the primed plants such as increase in the number of trichomes per unit surface of the plant [9]. Link to the fact that JA application is known to increase trichome as though to inhibit the movement of the attacking herbivore on the plant [10]. The increase in dry weight could also be due some defense responses that led to cell wall strengthening.(4) also showed how exogenous application of plant growth regulators like SA, and JA at early stage of maize plant (*Zea mays*) development gave notable improvement in its subsequent growth stages.

Plant height

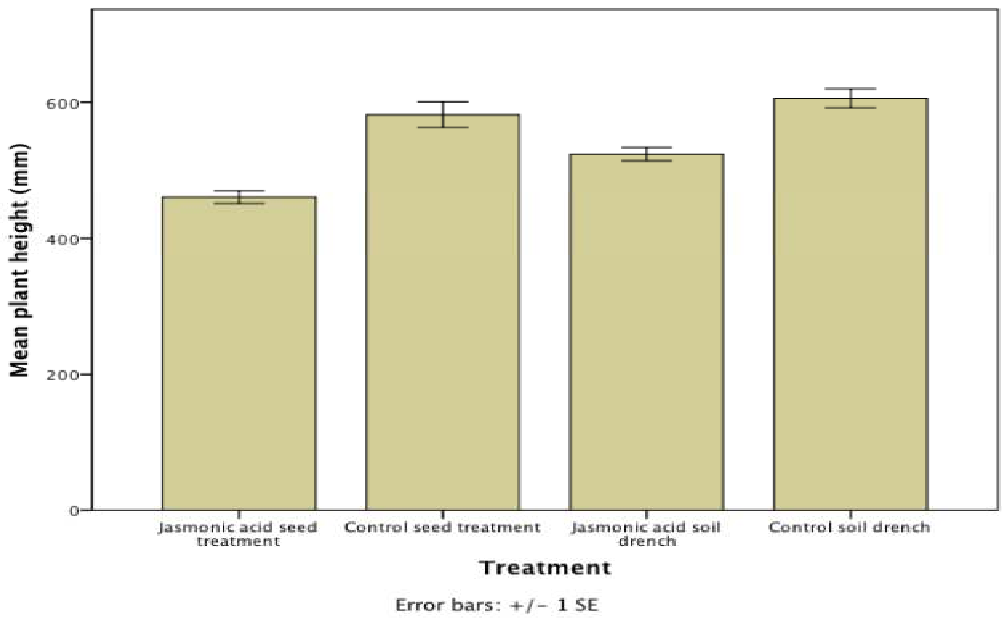

Fig. 1. Mean plant height of 4 weeks old Moneymaker tomato plant (*Solanum lycopersicum L.*) of 3 mM JA seed treatment, control seed treatment, JA soil drench or control soil drench. The measurement was carried out using a 100 cm wooden ruler. Values show means of 10 plant replicates for each treatment and vertical bars represent±1 SE

Root dry weight

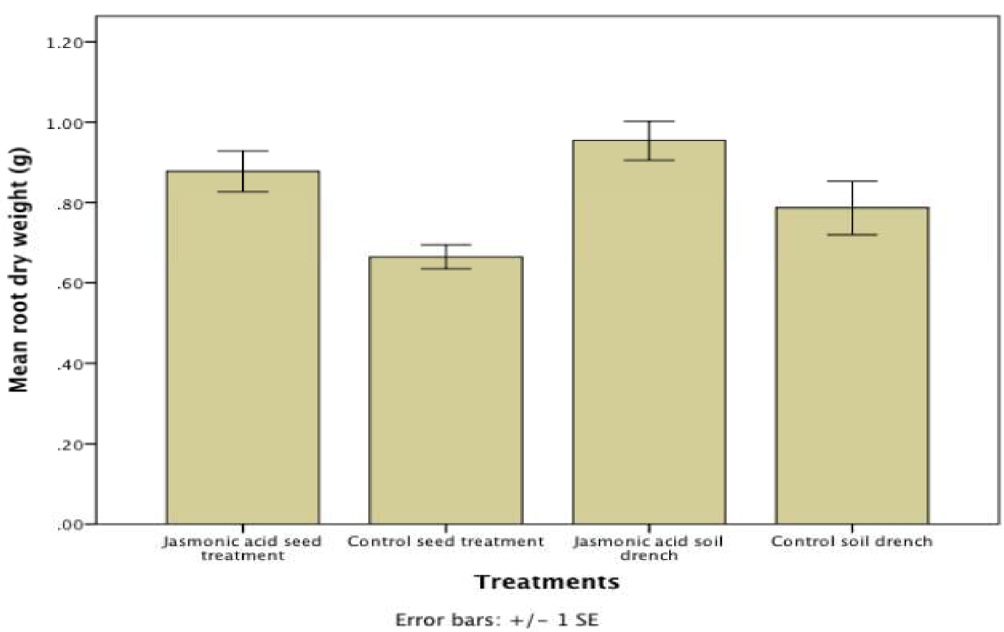

Fig. 2. Mean root dry weight of 4 weeks old Moneymaker tomato plants (*Solanum lycopersicum* L.) of 3 mM JA seed treatment, control seed treatment, JA soil drench or control soil drench. The measurement was carried out using a weighing balance. Values show means of 10 replicate plants for each treatment and vertical bars represent±1 SE

Stem dry weight

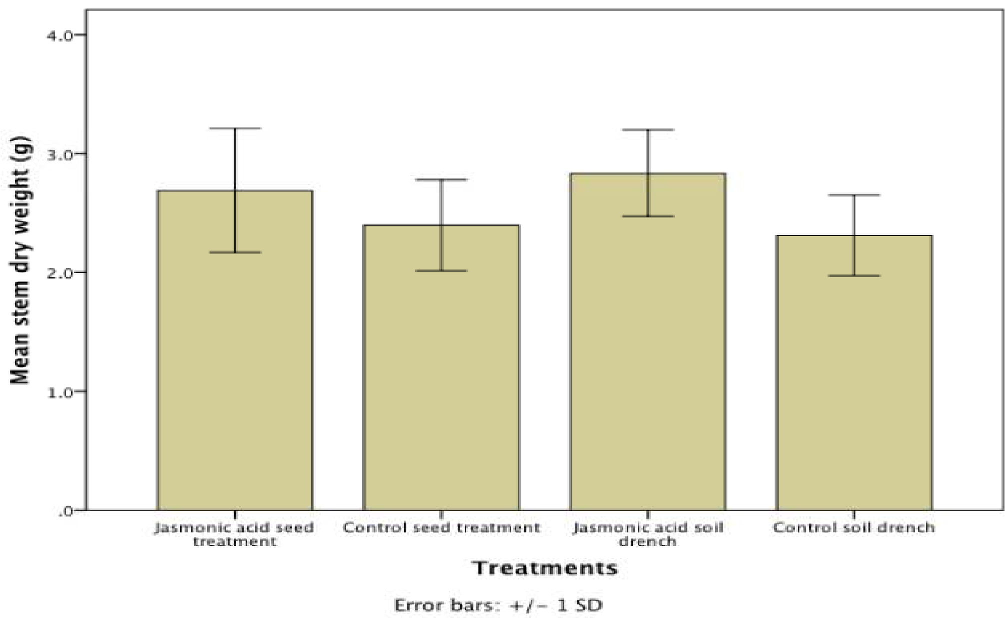

Fig. 3. Mean stem dry weight of 4 weeks old Moneymaker tomato plants (*Solanum lycopersicum* L.) of 3 mM JA seed treatment, control seed treatment, JA soil drench or control soil drench. The measurement was carried out using weighing balance. Values show means of 10 plant replicates for each treatment and vertical bars represent±1 SE

Leaf dry weight

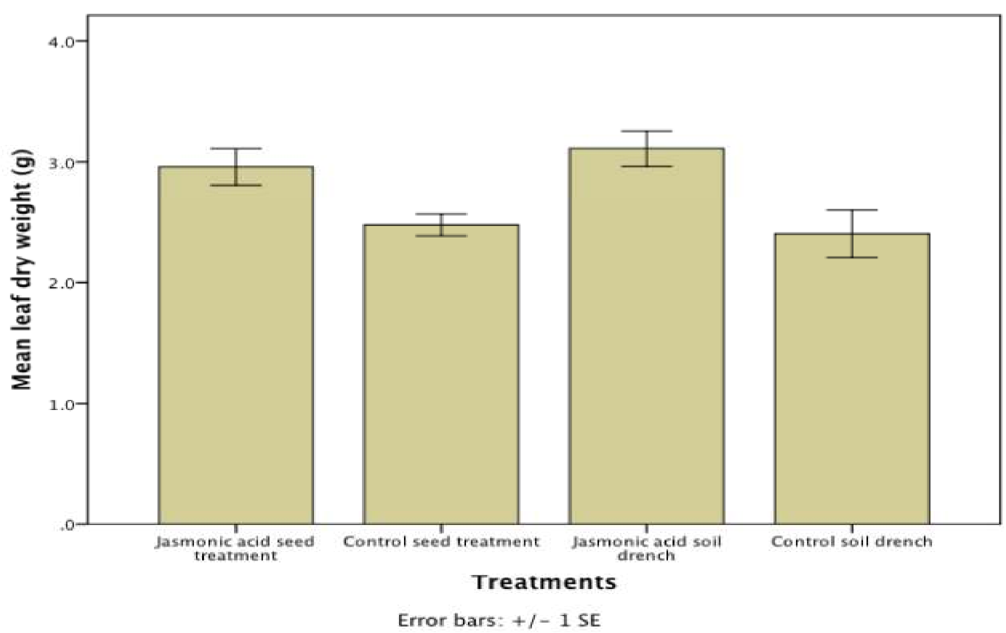

Fig. 4. Mean leaf dry weight of 4 weeks old Moneymaker tomato plants (*Solanum lycopersicum* L.) of 3 mM JA seed treatment, control seed treatment, JA soil drench or control soil drench. The measurement was carried out using a weighing balance. Values show mean replicates of 10 plants for each treatment and vertical bars represent±1 SE

Plant dry weight

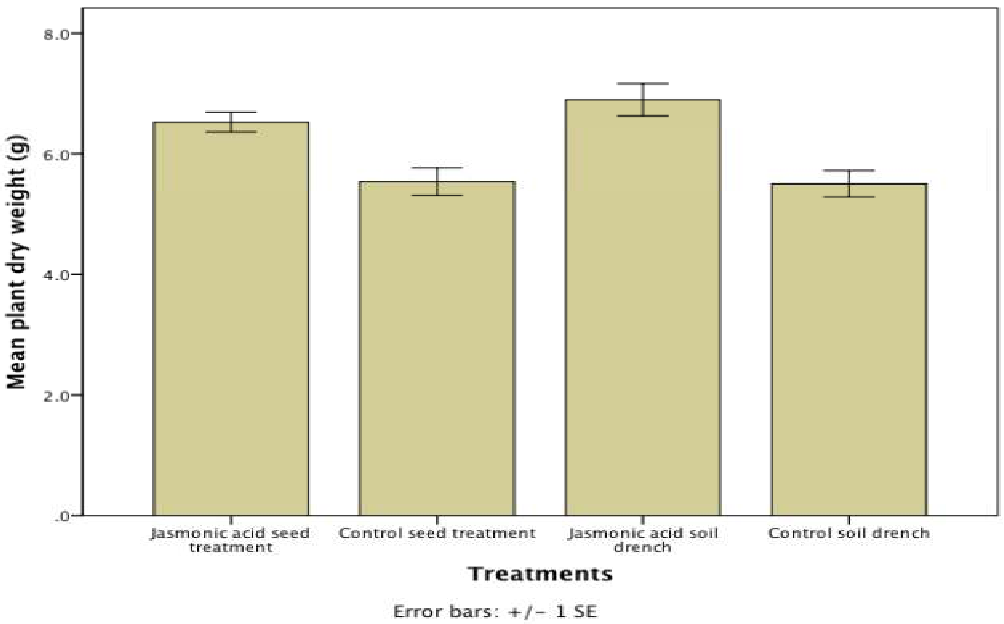

Fig. 5. Mean plant dry weight of 4 weeks old Moneymaker tomato plants (*Solanum lycopersicum* L.) of 3 mM JA seed treatment, control seed treatment, JA soil drench or control soil drench. The measurement was carried out using weighing balance. Values are mean replicates of 10 plants for each treatment and vertical bars represent±1 SE

5. CONCLUSION

Application of Jasmonic Acid (JA) at 3 mM Concentration either by seed treatment or soil drench increased the growth parameters studied except in plant height where there was decrease observed. Though this concentration (3 mM of Jasmonic Acid) can be useful and can serve as a tool for future tomatoe breeding programes

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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