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The Physiological Response of Germination and Growth in Solanaceae Plants (*Capsicum frutescens*, *Solanum melongena*, *Solanum lycopersicum*) at Different Salinity Levels

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ABSTRACT

High salinity causes osmotic stress and ion imbalance that can reduce plant productivity. Solanaceae can be developed for cultivation in saline land, but its growth is influenced by the type of species. This study aims to examine the tolerance level of three Solanaceae plants to salinity stress through observation of physiological responses of germination and growth. This study used a 3 x 4 factorial Completely Randomized Design (CRD). The first factor is salinity: 0 ppm, 2,500 ppm, 5,000 ppm and 7,500 ppm. The second factor is the Solanaceae species, namely Capsicum frutescens, Solanum melongena, *and* Solanum lycopersicum. *Germination parameters include germination power, wet weight and dry weight. The growth parameters observed include plant height, root length, stem diameter, leaf area, number of leaves, wet weight of leaves, roots and stems and dry weight of leaves, roots and stems. The results of the study showed that* C. frutescens *is a plant that is more tolerant to salinity up to a concentration of 5,000 ppm when compared to* S. melongena *and* S. lycopersicum *whose tolerance is up to 2,500 ppm.*

1. INTRODUCTION

Land conversion reduces the area of productive land for crop cultivation (Karolinoerita & Annisa, 2020). Therefore, it is necessary to carry out extensification by utilizing marginal land, including saline land which continues to increase, especially in coastal areas. Currently, saline land in Indonesia reaches around 1.2 million hectares (6.20% of the land area) (Sukarman *et al*., 2018). Although saline land has high productivity potential due to adequate water availability and gentle topography, the main challenge lies in the low tolerance of most plants to salinity. Therefore, selecting salt-tolerant plant types is crucial for optimizing production on saline land (Susilawati *et al*., 2016).

The main problem in saline land is salination, which is an increase in the concentration of dissolved salts in the soil, caused by the conversion of agricultural land to settlements and climate change (Karolinoerita & Annisa, 2020). Saline soil is generally found in coastal areas, especially in tidal areas with low rainfall (Sukarman *et al*., 2018). High salinity causes water deficiency, toxicity, and ion imbalance in plants, inhibits water absorption, germination, and growth, and triggers oxidative stress which has a negative impact on various physiological characteristics of plants (Sobir *et al*., 2018).

Reclamation efforts to overcome salinity include amelioration, soil improvement, and fertilization (Masganti *et al*., 2023). The use of salinity-tolerant plants can increase the productivity of saline land in agriculture (Sobir *et al*., 2018). Plants from the *Solanaceae* family, such as tomatoes, chilies, and eggplants are glycophyte plants to be developed on saline land, but the resistance of plant species varies, influenced by internal plant factors. Therefore, it is necessary to test the resistance of various species to different salinities.

Research on the effect of salinity stress on cultivated plants shows significant impacts on various species. Reducing the number of leaves in *Amaranthus tricolor* at concentrations of 2,500-7,500 ppm (Siswanti & Khairunnisa, 2021), and rice (Arifiani, 2019; Clermont-Dauphin *et al*., 2010), while in tomatoes it increases the content of vitamin C and flavonoids in the fruit during the generative phase (Biswas *et al*., 2017; Pratiwi *et al*., 2021). In eggplant, salinity and the use of biological inoculants affect growth (Sobir *et al*., 2018; Susilawati *et al*., 2016). This study aims to analyze the physiological response of *Solanaceae* plants to salinity through observation of germination and vegetative growth. The results of the study are expected to help in selecting plants and nursery that are suitable for certain salinity conditions.

2. MATERIALS AND METHODS

2.1. Tools and Materials

The tools used in this study were polybags (30 x 30 cm), hoes, rulers/meters, vernier calipers, digital scales, droppers, petri dishes, mortars and pestles, spectrophotometers, stirring rods, measuring cups, droppers and measuring pipettes, micropipettes, test tubes and racks, watch glasses, magnetic stirrers, water baths, ovens, vortexes, cayenne pepper seeds, eggplants, tomatoes, table salt, water, soil (sand:soil:manure 1:1:1), 3% carbofuran (Furadan 3G), 80% mancozeb, NPK, distilled water, ascorbic acid, 3% sulfosalicylic acid, acetone, ninhydrin, proline, phosphoric acid, toluene, and glacial acetic acid.

2.1.1. Preparation of Salt Solution and Seed Selection

The salt solution is made by dissolving table salt in water according to the treatment, namely successively 0 ppm, 2,500 ppm (dissolving 2.5 g of table salt in 1 liter of water), 5,000 ppm (dissolving 5 g of table salt in 1 liter of water) and 7,500 ppm (dissolving 7.5 g of table salt in 1 liter of water). Seed selection is done by soaking the seeds in water. The seeds used are drowned seeds.

2.1.2. Germination Treatment

Germination test was conducted in the laboratory by placing 10 seeds in a petri dish with a cotton base moistened with salt solution according to the treatment (0 ppm, 2,500 ppm. 5,000 ppm and 7,500 ppm). The medium was kept moist by adding salt solution according to the treatment. The study stopped after one treatment reached 100% germination.

2.1.3. Growth Treatment

The planting medium used was a mixture of sand, soil, and organic fertilizer with a ratio of 1:1:1. Before use, the media was sieved and cleaned, then put into a polybag up to ¾ of the part. To prevent pest attacks, Furadan 3G and Dithane M-45 2% were added, and the media was left for 2 days.

The seeds were sown in a planting medium which was a mixture of soil: sand: manure with a ratio of 1:1:1 with an optimal salinity level based on the results of germination tests from various Solanaceae species. The seeding process lasts until the seedlings reach 15 days old. After the seedlings are 15 days old, healthy and uniform seedlings are transferred to the treatment media. Watering is carried out with a salt solution according to the treatment as much as 200 ml every 2 days for one month. Pest control is carried out by spraying Furadan 3 G and Dhitane M-45, 2% on plants when symptoms of pest attack are detected. The harvesting process is carried out by removing the plants from the polybag and spraying water on the planting media to separate the roots from the soil.

2.2. Method

This study used a 4x3 factorial Completely Randomized Design (CRD) research design. Factor I is the salinity concentration consisting of 0 ppm (N0), 2,500 ppm (N1), 5,000 ppm (N2) and 7,500 ppm (N3). Factor II is the solanaceae species consisting of *Capsicum frutescens* L. (chili pepper), *Solanum melongena* L. (eggplant) and *Lycopersicon esculentum* (tomato), each with 3 replications. The germination parameters included germination power, fresh weight and dry weight of the sprouts. The vegetative growth parameters included plant height, root length, leaf

area, number of leaves, fresh weight of leaves, roots, and stems, and dry weight of leaves, roots, and stems. The collected data were analyzed using ANOVA and DMRT tests.

3. RESULTS AND DISCUSSION

3.1. Germination

3.1.1. Germination Power

Based on the data presented in Table 1, there was a decrease in the germination power *of C. frutescens, S. melongena,* and *S. lycopersicum*, along with the increase in salinity concentration. This study showed that in *C. frutescens*, the decrease in germination power was not significant at various levels of salt concentration. In contrast, *S. melongena* and *S. lycopersicum* began to experience a significant decrease in germination power at a concentration of 5,000 ppm. In the context of selecting optimal species for germination under salinity stress conditions, *C. frutescens* is the best choice because it maintains higher germination power despite increasing salinity. In *S. melongena* and *S. lycopersicum* maintained good germination only up to a concentration of 2,500 ppm, equivalent to 3.91 dS/m, indicating that both species are optimal in low salinity environmental conditions (EC = 2 - 4 dS/m) (Abdel-farid *et al*., 2020). There were significant differences between the species *C. frutescens, S. lycopersicum*, and *S. melongena* in the control treatment (0 ppm salt) caused by differences in seed morphology, where the *S. melongena* seed coat was thicker, so the water imbibition process was slower (Kurniahu, 2023). Thick seed coats slow down water absorption and inhibit germination (Soltani *et al*., 2021).

The decrease in germination percentage at high salinity is caused by the disruption of enzyme activity required for germination, resulting in delayed or failed germination (Abdel-farid *et al*., 2020). Drought stress due to salinity also results in the accumulation of toxic ions and nutrient imbalances that inhibit germination (Movafegh *et al*., 2012). Physiologically, salinity reduces the levels of gibberellin hormones (GAs), increases abscisic acid (ABA), and affects membrane permeability and water behavior in seeds. These mechanisms inhibit the physiological processes required for optimal germination, reducing the ability of seeds to germinate in saline environments (Lee & Luan, 2012).

Table 1. Germination power of Solanaceae (*C. frustescens*, *S. melongena,* and *S. lycopersicum*) at different salinity levels

Salinity	Germination Power (%)		
	S1 (*C. frustescens*)	S2 (*S. melongena*)	S3 (*S. lycopersicum*)
N0 (0 ppm)	100 ± 0.00 ^{a}	77 ± 15.28 ^{bc}	87 ± 5.77 ^{abc}
N1 (2,500 ppm)	97 ± 5.77 ^{ab}	70 ± 10.00 ^{c}	80 ± 36.06 ^{abc}
N2 (5,000 ppm)	93 ± 5.77 ^{ab}	43 ± 5.77 ^{d}	30 ± 20.00 ^{d}
N3 (7,500 ppm)	90 ± 11.55 ^{abc}	30 ± 10.00 ^{d}	10 ± 0.00 ^{e}

Note: Data in the table are the average ± standard deviation. Numbers followed by the same letter indicate no significant difference in the DMRT test at a significance level of 95% (α = 5%).

3.1.2. Wet Weight and Dry Weight of Sprouts

Based on ANOVA analysis, salinity has a significant effect on the wet weight of Solanaceae seedlings. The decrease in wet weight in all species increased with increasing salinity. The largest decrease in *C. frutescens* was able to maintain the wet weight of the seedlings up to a salinity of 5,000 ppm (Table 2). In dry weight, starting at 2,500 ppm it had decreased in both *C. frutescens, S. melongena* and *S. lycopersicum* (Table 3).

The decrease in fresh weight of sprouts is caused by salinity stress which increases osmotic pressure, inhibits water absorption, and causes cellular dehydration. This dehydration stimulates the production of abscisic acid (ABA), which inhibits the synthesis of gibberellin (GA) and α-amylase, thereby reducing starch hydrolysis and energy availability for growth (Liu *et al*., 2018; Shu *et al*., 2017). As a result, osmotic stress reduces cell turgor, inhibits protein and carbohydrate synthesis, and reduces biomass accumulation, which is reflected in a decrease in fresh and dry weight (Hasanuzzaman *et al*., 2014; Acosta-Motos *et al*., 2017). This study is in line with Amartani (2019), who stated that salinity stress can increase excessive ROS (reactive oxygen species) accumulation and accelerate cellular damage, thereby reducing the dry weight of corn sprouts.

Table 2. Wet weight (mg) of *Solanaceae* sprouts (*C. frustescens*, *S. melongena*, and *S. lycopersicum*)

Salinity	Fresh Weight of Sprouts (mg)		
	S1 (*C. frustescens*)	S2 (*S. melongena*)	S3 (*S. lycopersicum*)
N0 (0 ppm)	203.03 ± 3.73 ^{ab}	184.63 ± 16.81 ^{bc}	213.57 ± 6.92 ^{a}
N1 (2,500 ppm)	191.90 ± 5.73 ^{bc}	155.90 ± 8.52 ^{e}	183.37 ± 20.0 ^{c}
N2 (5,000 ppm)	179.88 ± 2.94 ^{cd}	96.80 ± 18.56 ^{f}	33.10 ± 21.11 ^{g}
N3 (7,500 ppm)	164.33 ± 7.26 ^{de}	21.87 ±0.81 ^{gh}	13.40 ± 1.00 ^{h}

Note: Data are the average ± standard deviation. Numbers followed by the same letter indicate no significant difference in the DMRT test at a significance level of 95% (α = 5%).

Table 3. Dry weight (mg) of *Solanaceae* sprouts (*C. frustescens*, *S. melongena*, and *S. lycopersicum*)

Salinity	Dry Weight of Sprouts (mg)		
	S1 (*C. frustescens*)	S2 (*S. melongena*)	S3 (*S. lycopersicum*)
N0 (0 ppm)	18.70 ± 0.52 ^{a}	12.77 ± 1.99 ^{bc}	13.10 ± 2.35 ^{bc}
N1 (2,500 ppm)	13.83 ± 2.45 ^{b}	10.10 ±1.21 ^{d}	12.37 ± 2.16 ^{bc}
N2 (5,000 ppm)	12.47 ± 2.06 ^{bc}	2.00 ± 0.26 ^{e}	3.50 ± 1.80 ^{e}
N3 (7,500 ppm)	10.53 ±3.35 ^{bc}	2.43 0.58 ^{e}	0.55 ± 0.15 ^{e}

Note: Data are the average ± standard deviation. Numbers followed by the same letter indicate no significant difference in the DMRT test at a significance level of 95% (α = 5%)

3.2. Growth

3.2.1. Plant Height and Root Length

ANOVA analysis showed that salinity and differences in Solanaceae species and their interactions had significant effects on plant height. The DMRT test showed significant differences between treatments, with N0S3 producing the best height (50.33 cm) and N3S2 the lowest (12.12 cm) (Table 4). All species experienced a decrease in height with increasing salinity, with significant differences starting at 5,000 ppm. A significant decrease in plant height indicates stress that inhibits important physiological processes such as cell division in meristem tissue. The significance of this stress-induced growth reduction varies between species, which is likely influenced by genetic and morphological differences. This finding is in line with Puvanitha & Mahendran (2017), who showed that differences in plant responses to salinity stress can be influenced by genetic factors, where At 307 cultivar rice is more tolerant to increasing salinity compared to Pachaiperumal cultivar based on plant height parameters. This variation in response indicates a complex interaction between plant genotype and salinity levels.

The ANOVA results also showed the significance of the influence of salinity, species and their interactions on root length. The N0S3 treatment produced the maximum root length (31.67 cm) and the shortest N3S1 (7 cm) (Table 5). All species showed significant differences between 0 ppm and 2,500 ppm and decreased for the three Solanaceae species. The decrease in plant height and root length indicates stress that disrupts cell division in the meristem tissue. High salinity increases osmotic pressure, decreases cell turgor, and slows down cell activity (Choirunnisa *et al*., 2021). Excess Na^+ and Cl^- ions damage cell membranes and disrupt ion balance, affecting the activity of cell division enzymes, such as cyclin-dependent kinase (CDK), with Na^+ replacing K^+ ions, so that the cell cycle is inhibited.

Table 4. Plant height (cm) of *Solanaceae* (*C. frustescens*, *S. melongena*, and *S. lycopersicum*) at different salinity levels

Salinity	Plant Height (cm)		
	S1 (*C. frustescens*)	S2 (*S. melongena*)	S3 (*S. lycopersicum*)
N0 (0 ppm)	30.4 ± 1.57 ^{c}	17.17 ± 0.76 ^{e}	50.33 ± 1.53 ^{a}
N1 (2,500 ppm)	31.17 ± 1.76 ^{c}	16.5 ± 1.32 ^{e}	47.67 ± 2.36 ^{a}
N2 (5,000 ppm)	24.33 ± 1.53 ^{d}	13.43 ±0.51 ^{f}	38.5 ± 2.50 ^{b}
N3 (7,500 ppm)	19.4 ±1.04 ^{e}	12.17 ± 0.29 ^{f}	36.33 ± 3.51 ^{b}

Note: Data are the average ± standard deviation. Numbers followed by the same letter indicate no significant difference in the DMRT test at a significance level of 95% (α = 5%)

Table 5. Root length (cm) of *Solanaceae* (*C. frustescens*, *S. melongena*, and *S. lycopersicum*) at different salinity levels

Salinity	Root Length (cm)		
	S1 (*C. frustescens*)	S2 (*S. melongena*)	S3 (*S. lycopersicum*)
N0 (0 ppm)	27.67 ± 1.53 ^{b}	16.33 ± 0.58 ^{d}	31.67 ± 2.31 ^{a}
N1 (2,500 ppm)	20.00 ± 1.73 ^{c}	12.67 ± 1.53 ^{f}	26.33 ± 1.53 ^{b}
N2 (5,000 ppm)	16.00 ± 1.73 ^{de}	12 ± 1.00 ^{f}	16.00 ± 1.00 ^{de}
N3 (7,500 ppm)	7.00 ± 3.00 ^{g}	8.67 ± 1.15 ^{g}	13.00 ± 2.00 ^{ef}

Note: Data are the average ± standard deviation. Numbers followed by the same letter indicate no significant difference in the DMRT test at a significance level of 95% (α = 5%).

High salinity also triggers reactive oxygen species (ROS) which damage mitochondria, disrupt ATP production and reduce the energy needed for cell growth, especially in the apical meristem tissue (Zhang & Shi, 2013). The data in Table 4 and Table 5 show a decrease in plant height and root length with increasing salinity. Salinity stress increases abscisic acid (ABA) biosynthesis and decreases auxin and cytokinin synthesis. ABA inhibits auxin biosynthesis by suppressing the YUCCA gene and reducing auxin transport to meristem tissues, which inhibits growth. In addition, ABA reduces cytokinin levels by suppressing isopentenyltransferase (IPT) enzyme activity, thereby disrupting cell division in root and shoot meristems (Bielach *et al*., 2017).

3.2.2. Number and Area of Leaves

Based on Table 6, salinity has a greater impact on the decrease in leaf number in *C. frutescens* compared to the other two species. This is due to the thinner leaf morphology of *C. frutescens*, with less mesophyll, resulting in lower water storage and hydration capacity. This condition accelerates dehydration and defoliation in the species under high salinity stress. In contrast, *S. melongena* is able to maintain leaf number, thanks to stellate-shaped trichomes that effectively reduce transpiration rates under high salinity conditions (Dewi *et al*., 2015).

Table 6. Number of leaves of *Solanaceae* (*C. frustescens*, *S. melongena*, and *S. lycopersicum*) at different salinity levels

Salinity	Number of Leaves		
	S1 (*C. frustescens*)	S2 (*S. melongena*)	S3 (*S. lycopersicum*)
N0 (0 ppm)	22.33 ± 2.08 ^{a}	8.33 ± 0.58 ^{e}	12 ± 1.00 ^{d}
N1 (2,500 ppm)	19.67 ± 1.53 ^{b}	6.33 ± 1.15 ^{ef}	11.33 ± 1.15 ^{d}
N2 (5,000 ppm)	14.33 ± 0.58 ^{c}	5.33 ± 0.58 ^{f}	10.67 ± 0.58 ^{d}
N3 (7,500 ppm)	11.33 ± 1.15 ^{d}	5.33 ± 1.15 ^{f}	8.33 ±0.58 ^{e}

Note: Data are the average ± standard deviation. Numbers followed by the same letter indicate no significant difference in the DMRT test at a significance level of 95% (α = 5%)

Table 7. Leaf area (cm^2) of *Solanaceae* (*C. frustescens*, *S. melongena*, and *S. lycopersicum*)

Salinity	Leaf area (cm^2)		
	S1 (*C. frustescens*)	S2 (*S. melongena*)	S3 (*S. lycopersicum*)
N0 (0 ppm)	15.33	83	44.17
N1 (2.500 ppm)	12.25	53.3	36.08
N2 (5.000 ppm)	9.25	43	28.33
N3 (7.500 ppm)	6.67	36.58	22.5

Table 7 shows that the decrease in leaf area is linearly correlated with increasing salinity, with the best results at 0 ppm salinity and the worst at 7,500 ppm. This finding is consistent with the research of Siswanti & Khairunnisa (2021), which reported that salinity stress of 2,500-7,500 ppm significantly affected the growth of Amaranthus tricolor leaves. Arifiani (2019) also found a decrease in rice leaf area at salinities starting from 2.5 dS/m (equivalent to <2,500 ppm salt).

The decrease in leaf area to reduce transpiration was offset by a decrease in the number of leaves (Tables 6 and 7). The decrease in the number and area of leaves in plants under salinity stress is an adaptation strategy to reduce water loss due to transpiration. Excess Na^+ and Cl^- ions cause osmotic stress, disrupting water balance, and plants adapt by reducing leaf surface area to minimize water use through stomata. This adaptation also allocates resources to maintain vital functions, such as photosynthesis, which tends to decline due to ion toxicity that inhibits chloroplast function (Acosta-Motos *et al*., 2017; Trivellini *et al*., 2023; Ashraf & Harris, 2013).

3.2.3. Wet Weight and Dry Weight of Leaves, Stems and Roots

Leaf wet weight decreased with increasing salinity. Treatment N0S2 had the highest wet weight (15.08 g), while N3S1 had the lowest (1.40 g). The species *C. frutescens* and *S. lycopersicum* showed no significant differences between salinity treatments. While *S. melongena* showed differences between 0 ppm and 2,500 ppm (Table 8).

Table 8. Wet weight of *Solanaceae* leaves (*C. frustescens*, *S. melongena*, and *S. lycopersicum*) at different salinity levels

Salinity	Leaf Wet Weight (mg)		
	S1 (*C. frustescens*)	S2 (*S. melongena*)	S3 (*S. lycopersicum*)
N0 (0 ppm)	4.92 ± 1.07 ^{b}	15.08 ± 1.43 ^{a}	14.74 ± 2.98 ^{a}
N1 (2,500 ppm)	4.53 ± 1.39 ^{b}	4.11 ± 1.17 ^{b}	14.66 ± 1.98 ^{a}
N2 (5,000 ppm)	3.51 ± 0.33 ^{b}	3.87 ± 1.79 ^{b}	12.77 ± 3.40 ^{a}
N3 (7,500 ppm)	1.40 ± 1.36 ^{b}	2.75 ± 1.19 ^{b}	13.56 ± 4.62 ^{a}

Note: Data are the average ± standard deviation. Numbers followed by the same letter indicate no significant difference in the DMRT test at a significance level of 95% (α = 5%).

Table 9. Dry weight (g) of Solanaceae leaves (*C. frustescens*, *S. melongena*, and *S. lycopersicum*) at different salinity levels

Salinity	Leaf Dry Weight (g)		
	S1 (*C. frustescens*)	S2 (*S. melongena*)	S3 (*S. lycopersicum*)
N0 (0 ppm)	0.69 ± 0.08^{b}	1.72 ± 0.14^{a}	1.67 ± 0.24^{a}
N1 (2.500 ppm)	0.65 ± 0.12^{bc}	0.61 ± 0.95^{bc}	1.53 ± 0.13^{a}
N2 (5.000 ppm)	0.40 ± 0.08^{bc}	0.55 ± 0.12^{bc}	1.37 ± 0.25^{a}
N3 (7.500 ppm)	0.29 ± 0.0 ^{c}	0.37 ± 0.96 ^{bc}	1.34 ± 0.36 ^{a}

Note: Data are the average ± standard deviation. Numbers followed by the same letter indicate no significant difference in the DMRT test at the 95% significance level (α = 5%).

Table 9 indicates a linear correlation between the decrease in leaf dry weight with increasing salinity. The highest dry weight was in the N0S2 treatment (1.72 g) and the lowest in N3S1 (0.29 g). The *S. lycopersicum* species showed no significant differences at each salinity level, while *C. lycopersicum* and *S. melongena* showed differences between 0 ppm and 2,500 ppm. The decrease in the number and area of leaves is an adaptive response to reduce transpiration, so that leaf biomass decreases, which causes a decrease in leaf wet and dry weight. Salinity stress causes physiological stress that inhibits photosynthesis and biomass formation, caused by disruption of cell turgor and water absorption due to accumulation of Na^+ and Cl^- ions, which affect cell expansion and leaf growth. Na^+ ions also inhibit photosystem II and reduce the efficiency of electron transport, resulting in decreased energy production for growth (Arifiani, 2019).

Table 10. Wet weight (g) of *Solanaceae* stems (*C. frustescens*, *S. melongena*, and *S. lycopersicum*) at different salinity levels

Salinity	Wet Weight of Stem (g)		
	S1 (*C. frustescens*)	S2 (*S. melongena*)	S3 (*S. lycopersicum*)
N0 (0 ppm)	3.19 ± 0.30^{e}	3.56 ± 0.32^{e}	15.03 ± 0.65^{a}
N1 (2.500 ppm)	2.87 ± 0.35^{e}	1.05 ± 0.14^{fg}	14.08 ± 0.64^{b}
N2 (5.000 ppm)	1.83 ± 0.43^{f}	0.65 ± 0.12^{g}	11.29 ± 0.81^{c}
N3 (7.500 ppm)	1.20 ± 0.26^{fg}	0.59 ± 0.03 ^{g}	9.98 ± 0.56 ^{d}

Note: Data are the average ± standard deviation. Numbers followed by the same letter indicate no significant difference in the DMRT test at a significance level of 95% (α = 5%)

Table 11. Dry weight (g) of *Solanaceae* stems (*C. frustescens*, *S. melongena*, and *S. lycopersicum*) at different salinity Levels

Salinity	Dry Weight of Solanaceae Stems		
	S1 (*C. frustescens*)	S2 (*S. melongena*)	S3 (*S. lycopersicum*)
N0 (0 ppm)	0.6	0.65	2.23
N1 (2,500 ppm)	0.48	0.30	1.99
N2 (5,000 ppm)	0.28	0.23	1.54
N3 (7,500 ppm)	0.17	0.19	1.27

Table 12. Wet weight (g) of *Solanaceae* roots (*C. frustescens*, *S. melongena*, and *S. lycopersicum*) at different salinity levels

Salinity	Root Wet Weight (g)		
	S1 (*C. frustescens*)	S2 (*S. melongena*)	S3 (*S. lycopersicum*)
N0 (0 ppm)	1.02 ± 0.43^{bc}	2.06 ± 0.15^{a}	1.36 ± 0.25^{b}
N1 (2.500 ppm)	0.68 ± 0.20^{cd}	0.78 ± 0.14^{cd}	0.79 ± 0.13^{cd}
N2 (5.000 ppm)	0.50 ± 0.14^{de}	0.73 ± 0.31^{cd}	0.45 ± 0.18^{de}
N3 (7.500 ppm)	0.14 ± 0.09^{e}	0.45 ± 0.23^{de}	0.49 ± 0.33^{de}

Note: Data are the average ± standard deviation. Numbers followed by the same letter indicate no significant difference in the DMRT test at a significance level of 95% (α = 5%).

Table 13. Dry weight (g) of *Solanaceae* roots (*C. frustescens*, *S. melongena*, and *S. lycopersicum*) at different salinity levels

Salinity	Root Dry Weight (g)		
	S1 (*C. frustescens*)	S2 (*S. melongena*)	S3 (*S. lycopersicum*)
N0 (0 ppm)	$0.190.43^{c}$	0.52 ± 0.34^{a}	0.50 ± 0.15^{a}
N1 (2.500 ppm)	0.12 ± 0.03^{cd}	0.14 ± 0.20^{cd}	0.34 ± 0.55^{b}
N2 (5.000 ppm)	0.06 ± 0.20^{de}	0.14 ± 0.28^{cd}	0.19 ± 0.95^{c}
N3 (7.500 ppm)	0.03 ± 0.02^{e}	0.13 ± 0.25^{cd}	0.19 ± 0.08^{c}

Note: Data are the average ± standard deviation. Numbers followed by the same letter indicate no significant difference in the DMRT test at a significance level of 95% (α = 5%).

There is a linear correlation between the decrease in leaf, stem and root wet weight along with increasing salinity. *C. frutescens* began to show a significant decrease in stem wet weight, root wet weight and root dry weight at a concentration of 5,000 ppm, while *S. melongena* and *S. lycopersicum* at a concentration of 2,500 ppm (tables 10, 11, 12 and 13). Purwaningrahayu & Taufiq (2017) explained that salinity stress disrupts root growth, resulting in a decrease in wet weight and dry weight due to excessive Na^{+} absorption. Overall, the decrease in wet and dry weight showed a linear correlation with increasing salinity, in line with the findings Abdel-farid *et al*. (2020), regarding the effect of salinity on the wet and dry weight of plants, including cucumbers which showed a significant decrease at high salinity (200 mM).

4. CONCLUSION

Salinity significantly affected the germination and growth of Solanaceae plants, where increasing salinity concentrations resulted in decreased germination, fresh weight, and dry weight of seedlings in all species, with the greatest impact occurring at a concentration of 7,500 ppm. Responses to salinity stress varied among species; *C. frutescens* showed resistance up to 5,000 ppm, while *S. melongena* and *S. lycopersicum* experienced significant declines at 2,500 ppm. There was a significant interaction between salinity and species, with *C. frutescens* being the most tolerant species.

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