Effects of Irrigation Water Salinity on the Growth, Gas Exchange Parameters, and Ion Concentration of Hot Pepper Plants Modified by Leaching Fractions

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Abstract. In this experiment, the responses of plant growth, gas exchange parameters, and ion concentration to different levels of irrigation water salinity (ECi, of 0.9, 1.6, 2.7, 4.7 and 7.0 dS m−1) and leaching fractions (LFs of 0.17, 0.29) were investigated in hot pepper plants. The pot experiment was conducted using a completely randomized block design with four replications in a rain shelter. Results showed that the height of the hot pepper plants decreased as the ECi was increased from 25 d after transplanting (DAT) and increased when the LF was increased from 55 DAT. Neither the ECi nor the LF influenced the root length. An increase in the ECi caused the suppression of the stem diameter (SD); leaf length; leaf area; leaf chlorophyll content (CCI); dry biomass of roots, stems, and leaves; net photosynthesis (Pn); stomatal conductance (gs); transpiration rate (Tr); and intercellular CO2 concentration (Ci). An increase in the LF caused the SD, leaf length, leaf area, and dry biomass of stems and leaves to increase. However, the dry biomass of roots and the Pn, gs, Tr, and Ci were not significantly affected by the LF, except for the Ci measured on 23 DAT and the Tr on 76 DAT. The Na+ concentrations in the roots and stems increased, whereas the K+/Na+ ratios decreased as the ECi increased. An increase in the LF led to a decrease in the Na+ concentration of the roots and stems, whereas there was an increase in the K+ concentration in the stems and the K+/Na+ ratios in the roots and stems. Collectively, an increase in the ECi had an adverse effect on plant growth and gas exchange and led to the accumulation of the Na+ concentration in the roots and stems, whereas an increase in the LF enhanced plant growth, leaf transpiration, and K+ concentration and reduced the accumulation of the Na+ concentration in the roots and stems. We suggest that higher quality of water should be applied in higher salinity irrigation for satisfactory performance for hot pepper growth.

In many plants, salinity has been found to set a number of biochemical and physiological mechanisms in motion, leading to a corresponding reduction in plant growth (Hatamnia et al., 2013; Hossain and Dietz, 2016). For instance, salinity restricts water uptake by roots, which quickly inhibits the growth rate, along with a suite of changes in metabolic activity of photosynthesis and biosynthesis of photosynthesis pigments (Munns, 2002). Salinity can induce the absorption of excessive mineral nutrition, causing an ionic imbalance as a result of the accumulation of particular salts within the plant, and the consequence restriction of gs, photosynthesis, and Ci in plants (Hannachi and Van Labbeke, 2018; Munns, 2002). Salinity stress is also revealed as oxidative stress and has a number of deleterious effects (Azuma et al., 2010). The analysis of minerals in the plant tissues and the relationship between the mineral concentrations in the leaves and osmotic stresses are also often examined to understand the mechanism of salt tolerance (Munns and Tester, 2008). The mechanisms used to defend a variety of plant species against salt stress may be dissimilar (Greenway and Munns, 1980), with environmental conditions and cultural practices potentially also influencing these mechanisms. Hot peppers, one of the most popular vegetables used in sauces and condiments, as well as an important source of vitamin C in the human diet, are particularly susceptible to salinity stress (Aktas et al., 2006; Lycoskoufis et al., 2005). Lycoskoufis et al.’s aforementioned study shows that both Pn and gs are reduced by a high level of salinity. Salt-stressed peppers also show a severe reduction in growth, water uptake, and ionic balance (Cabañero et al., 2004; Hannachi and Van Labbeke, 2018; Navarro et al., 2003; Yang and Guo, 2018). Nevertheless, the effects that salt stress have on plants are still unclear because of the complex nature of salt stress in plants (Aktas et al., 2006).

Irrigation with saline water leads to a successive accumulation of salts in the soil. One of the methods adopted to reduce salt concentration in the soil involves the application of extra water to compensate for the leaching of salts from the root zone (Aktas et al., 2006). A suitable LF can maintain favorable root-zone salinity under varying levels of irrigation water salinity (Dudley et al., 2008), and consequently enhance plant growth. An improved understanding of the mechanisms enabling hot pepper plants to adapt to salt stress and maintain growth under a suitable LF is incredibly important to ensure the successful production of hot peppers. In addition, to better understand the mechanisms by which LFs affect growth under varying ECiw, the K+, Na+, and Ca2+ concentrations and K+/Na+ ratio in hot pepper roots and stems were also studied.

The aim of this study is to evaluate the effects of ECiw on growth (i.e., plant height; SD; leaf length; leaf area; and the dry weight of roots, stems, and leaves), gas exchange (i.e., Pn, gs, Tr, and Ci), and the uptake of ions (i.e., the Na+, K+, and Ca2+ concentrations and K+/Na+ ratio) by hot pepper plants and to test whether LFs are able to modify the effects of the ECiw with respect to the aforementioned parameters.

Materials and Methods

Experimental setup. The experiment was conducted in a rain shelter at the Agrometeorology Research Station at Nanjing University of Information Science and Technology in Nanjing City, Jiangsu Province in China (lat. 32° 28′ N, long. 118° 17.7′ E, altitude 14.4 m) from 28 Apr. to 22 July 2015. The white plastic pots used were 27 cm high, with the top and bottom diameters of the pots measuring 26 and 22 cm, respectively. A 2-cm hole was drilled in the bottom of each pot to collect the drainage water. Each pot
was filled with 11 kg of air-dried soil with a sandy loam texture consisting of sand (75.7%), silt (20.4%), and clay (3.9%) sifted through a 5-mm sieve. The bulk density of soil is 1.47 g-cm⁻³. The field water capacity and wilting point are 0.27 and 0.04 (cm⁻³-cm⁻³), respectively. The available N, P, and K contents of the soil were 28.0, 16.3, and 47.7 mg-kg⁻¹, respectively.

The hot pepper plants (Bocuilwang cultivar) were transferred to plastic pots with one plant per pot on 28 Apr. 2015. Each pot was saturated with tap water before the transplanting took place. All the plants were then irrigated using tap water at 5 DAT, with 0.9 L for each pot. After the plants were established (10 DAT), saline water treatments with two LFs were initiated.

Five levels of saline irrigation water (ECw of 0.9, 1.6, 2.7, 4.7, and 7.0 dS-m⁻¹) and two LFs of 0.17 and 0.29 were used and each treatment was repeated four times. The 40 pots were subjected to a completely randomized block design. A half strength Hoagland solution was used as a nonsaline control (in mmol-L⁻¹: 2.0 Ca(NO₃)₂ × 4H₂O, 2.0 KNO₃, 0.5 NH₄NO₃, 0.5 MgSO₄ × 7H₂O, 0.25 KH₂PO₄, and in mmol L⁻¹: 40 Fe-EDTA, 25 H₃BO₃, 2.0 MnCl₂ × 4H₂O, 2.0 ZnSO₄ × 7H₂O, 0.5 CuSO₄ × 5H₂O, 50 KCl, 0.075 (NH₄)₂MoO₄ × 4H₂O, 0.15 CoCl₂ × 6H₂O (Heeg et al., 2008), which added an EC of 0.9 dS-m⁻¹ to the irrigation water used in all the treatments. To achieve the desired treatment salinity levels, 1:1 milli equivalent concentrations of NaCl and CaCl₂ were added to the half-strength Hoagland solution.

The amount of applied irrigation water was 120% and 140% of the evapotranspiration (ET) for the LF of 0.17 and 0.29, respectively, according to the equation proposed by Letey et al. (2011). Evapotranspiration (g) was calculated as follows:

\[ ET = W_n - W_{n+1} + (1 - D) \times p \]  

where \( W_n \) and \( W_{n+1} \) are the pot weights before the \( n \)th and \((n + 1)\)th irrigation (g), \( D \) and \( p \) are the percentages of applied drainage and irrigation water (L), respectively, and \( p \) is the water bulk density (1000 g-L⁻¹).

Right before each irrigation event, all pots were weighed and the crop ET and the amount of irrigation water for each pot were calculated. A glass bottle was set underneath each pot to collect the leachates. The volume of leachate for each pot was measured using graduated cylinder after each irrigation event. The plants were irrigated every 2–5 d.

**Plant measurements.** Plant heights were obtained using a tape measure every 7–17 d. The diameters of the plant stems were measured with a digital vernier caliper (PD 151; Prokit’s Industries Co., China) at the end of the experiment. All the leaf lengths and the maximum leaf widths of each plant were also measured at the end of the experiment. The leaf area was then estimated by summing the length × maximum width of each leaf and multiplying by a factor of 0.54 (our measurement). The roots of each plant were washed in fresh water. The maximum length of root was measured by a ruler. Plant materials, i.e., the roots, leaves, and stems, were then dried in an oven at 70 °C to obtain the constant dry weight.

**The CCI and gas exchange of the leaves.** The CCI of the leaves was determined using an SPAD 502 chlorophyll meter (Minolta, Tokyo, Japan) on 17, 26, 69, and 84 DAT. The SPAD 502 calculates an index in SPAD units (dimensionless), which is an objective measurement for leaf greenness (Qiu et al., 2015). Readings were taken from five leaves in the upper layers of each plant and the average CCI were used for each pot.

The gas exchange parameters of the leaves including the \( \mu \) rate, leaf \( g_s \), \( T_r \), and \( C_i \) were obtained using an LI-6400 photosynthesis system (LI-COR, Lincoln, NE). Measurements of three–five fully grown leaves per treatment were made at 9:00–11:00 AM on 23, 39, and 76 DAT (sunny days), with a fixed PPFD level of 1200 μmol-m⁻²-s⁻¹.

The Na⁺, K⁺, and Ca²⁺ concentrations of hot pepper roots and stems. The dried roots and stems were ground into powder. The leaf material was ground into powder and sieved through a 5-mm sieve. The bulk density of soil was 28.0, 16.3, and 76 DAT (sunny days), with a fixed ECiw and LF on the CCI and gas exchange of the leaves.

**Results**

**Effects of the ECw and LF on plant growth**

Plants height and SD. The effects of the ECw and LF on plant height were analyzed and compared statistically using a two-way variance model (Table 2). The height of the hot peppers increased rapidly until 37 DAT, increasing with an increase in the ECw. There was no significant interaction between the ECw and the LF in terms of the SD. There was, however, a significant \( P < 0.01 \) negative linear relationship between the SD and the ECw, regardless of the LF (SD = –0.31 ECw + 11.97, \( R^2 = 0.73, n = 10 \)).

Leaf length and leaf area. The leaf length and leaf area declined significantly \( P < 0.05 \) as the ECw was increased (Table 2). Across the ECw treatments, the leaf length and leaf area in the LF of 0.29 were significantly \( P < 0.05 \) higher than those in the LF of 0.17. There was no significant interactive effect between the ECw and the LF in terms of leaf length and leaf area. However, a significant negative linear relationship between the leaf area and the ECw was found for both LFs (for LF of 0.17, \( Y = -0.345 \times ECw + 0.333, R^2 = 0.91, P < 0.05 \) and for LF of 0.29, \( Y = -0.364 \times ECw + 0.386, R^2 = 0.99, P < 0.001 \)). Neither was there any notable difference between the slopes of the regression functions, whereas the intercept in the LF of 0.29 was significantly higher than that in the LF of 0.17.

Root length and the dry weight of roots, stems, and leaves. Neither the ECw nor the LF had any significant effect on the root length of the hot peppers. An increase in the ECw apparently led to a significant decrease in the dry weight of roots, stems, and leaves (Table 2), especially when the ECw was high. For both the LFs, the dry weight of roots, stems, and leaves in the ECw of 7.0 dS-m⁻¹ decreased by 54.4%, 55.4%, and 51.3%, respectively, when compared with the ECw of 0.05 dS-m⁻¹. The LF had no effect on the dry weight of roots. The dry weight of stems and leaves did increase because of the increase in the LF, however. Across the ECw, the dry weight of the stems and leaves in the LF of 0.29 increased by 10.2% and 11.5%, respectively, as compared with the LF of 0.17. There was no significant interactive effect between the ECw and the LF with regard to the dry weight of roots, stems, and leaves. A significant \( P < 0.001 \) negative linear correlation was observed in the dry weight of the roots, stems, and leaves and the ECw, regardless of the LF (for roots, \( Y = 0.55 \times ECw + 6.24, R^2 = 0.87, n = 10 \); for stems, \( Y = 1.68 \times ECw + 20.47, R^2 = 0.91, n = 10 \); and for leaves, \( Y = 1.25 \times ECw + 15.74, R^2 = 0.93, n = 10 \)).

Effects of the ECw and LF on the CCI and gas exchange of the hot peppers. Neither the ECw nor the LF had any significant effect on the CCI on 16 DAT. On 69 and 84 DAT, it decreased with an increase in the ECw.
measurements taken between 9:00 and 11:00 AM in the LF of 0.17 on 26, 69, and 84 DAT. The LF of 0.29 was significantly higher than that between the

Significantly negative linear relationships between the dry weight of stems and the K+/Na+ ratio in the roots and stems, but an increase in K+ concentration in the stems and the K+/Na+ ratio, but a significant increase in Na+ concentrations in the roots, as well as between Na+ concentrations and the K+/Na+ ratio in the hot pepper roots and stems under different salinity stress. Shivakumara et al. (2017) reported that the dry weight of the whole hot pepper plant in the ECiw of 13.3 dS m⁻¹ was only reduced by 29% relative to the control (a similar response in the ECiw of 8 dS m⁻¹ was reported by Lycoskoufis et al. (2005), in which salinity stress (recirculating the nutrient solution) reduced the dry weight in the stems and roots in the pepper plants by 50%, compared with that when standard nutrition (1.9 dS m⁻¹) was used. Azuma et al. (2010) showed, however, that the dry weight of the whole hot pepper plant in the ECiw of 13.3 dS m⁻¹ was not affected by either the ECiw or the LF.

In the stems, an increase in the ECiw caused a significant decrease in the K⁺ concentration and the K⁺/Na⁺ ratio, but a significant increase in the Ca²⁺ and Na⁺ concentrations. An increase in the LF apparently caused a significant decrease in the Na⁺ concentration in the roots and stems, but an increase in K⁺ concentration in the stems and the K⁺/Na⁺ ratio in the roots and stems. Significant negative linear correlations between the dry weight and the K⁺ and Na⁺ concentrations in the roots were found, whereas the linear relationship between the dry weight of stems and the K⁺/Na⁺ ratio in the stems was positive (Table 6).

Discussion and Conclusions

In this study, the growth of hot pepper plants was found to be reduced when the ECiw was higher than 1.6 dS m⁻¹ and reduction was more significant as the ECiw further increased to 7.0 dS m⁻¹ (Table 2). The dry weight of roots, stems, and leaves in the ECiw of 7.0 dS m⁻¹ was reduced by 51.3% to 54.4%, as compared with that of ECiw of 0.9 dS m⁻¹. A similar response in the ECiw of 8 dS m⁻¹ was reported by Lycoskoufis et al. (2005), in which salinity stress (recirculating the nutrient solution) reduced the dry weight in the stems and roots in the pepper plants by 50%, compared with that when standard nutrition (1.9 dS m⁻¹) was used. Azuma et al. (2010) showed, however, that the dry weight of the whole hot pepper plant in the ECiw of 13.3 dS m⁻¹ was only reduced by 29% relative to the control (a nutrient solution containing no NaCl). These results show that the response may, in fact, vary with different cultivars. Niu et al. (2010) found that the reduction of the dry weight of shoots in an ECiw of 4.1 dS m⁻¹ ranged from 22% to 92% for eight chili peppers (five cultivars of Capsicum annuum L., two cultivars of Capsicum chinense, and one accession of C. annuum). The maximum length of roots was unaffected by the ECiw and LF because the pot size was limited, which is different from the report by Shivakumara et al. (2017).

However, the plant height, SD, leaf length, and leaf area were also markedly diminished when the ECiw was higher than 1.6 or 2.7 dS m⁻¹. The inhibition of leaf development is largely because of the osmotic effect of the salinity (Munns and Tester, 2008), and the mechanism behind decreased leaf growth, which is independent of carbohydrate supply and water status, must be regulated by long distance signals in the form of their precursors or hormones (Munns et al., 2000). In addition, water deficit caused by salinity is one of the major reasons behind the suppression of plant growth in saline soils (Bhatt et al., 2008).

Table 1. Dynamics of mean values of plant height (cm) under varying irrigation water salinity levels (ECiw, dS m⁻¹) and leaching fractions (LFs), and the output of the two-way analysis of variance (ANOVA) with regard to the height of the hot peppers.

| Days after transplanting | 13 | 25 | 37 | 44 | 55 | 67 | 84 |
|--------------------------|----|----|----|----|----|----|----|
| ECiw                     |    |    |    |    |    |    |    |
| 0.9                      | 25.0| 35.5 a| 41.6 ab| 42.4 ab| 46.1 a| 51.6 a| 54.1 ab|
| 1.6                      | 25.1| 35.7 a| 42.1 a| 45.1 a| 49 a| 52.7 a| 55.9 a|
| 2.7                      | 24.0| 34.4 ab| 40.1 ab| 43.4 a| 45.7 ab| 49.3 ab| 53.4 ab|
| 4.7                      | 24.9| 32 ab| 37.9 b| 38.4 bc| 41.6 bc| 46.6 bc| 49.6 b|
| 7.0                      | 23.3| 31.3 b| 33.9 c| 35.1 c| 38.8 c| 43.1 c| 43.3 c|
| LF                       | 0.17| 24.3| 32.9| 38.2| 40.2| 43.7 b| 46.9 b| 49.6 b|
| 0.29                     | 24.6| 34.8| 40| 41.4| 45.6 a| 50.3 a| 52.3 a|

ANOVA

|                      | NS | NS | NS | NS | * | * | NS |
|----------------------|----|----|----|----|----|----|----|
| ECiw                 | NS | NS | NS | NS | NS | NS | NS |
| LF                   | * | *** | *** | *** | *** | *** | *** |
| LF × ECiw            | NS | NS | NS | NS | NS | NS | NS |

Table 2. Mean values of plant growth variables under varying irrigation water salinity levels (ECiw, dS m⁻¹) and leaching fractions (LFs), and the output of the two-way analysis of variance (ANOVA) for plant growth variables.

| Factors | Stem diam (mm) | Leaf length (cm) | Leaf area (m²/plant) | Maximum root length (cm/plant) | Dry weight (g) Root Stem Leaf |
|---------|----------------|------------------|----------------------|-------------------------------|-----------------------------|
| ECiw    |                |                  |                      |                               |                             |
| 0.9     | 11.6 a         | 6.3 a            | 0.32 a               | 29.8                          | 5.5 a                       |
| 1.6     | 11.6 a         | 6.2 a            | 0.32 a               | 32.4                          | 5.9 a                       |
| 2.7     | 10.9 ab        | 6.1 ab           | 0.26 b               | 32.0                          | 4.5 b                       |
| 4.7     | 10.8 b         | 6.0 b            | 0.18 c               | 31.7                          | 3.4 c                       |
| 7.0     | 9.7 c          | 5.5 c            | 0.12 d               | 30.3                          | 2.5 d                       |
| LF      | 0.17           | 10.6 b           | 5.9 b                | 31.6                          | 4.2                         |
| 0.29    | 11.3 a         | 6.1 a            | 0.26 b               | 30.9                          | 4.6                         |

ANOVA

|                      | * | NS | NS | * | NS | NS | NS |
|----------------------|---|----|----|---|----|----|----|
| ECiw                 | *** | *** | *** | *** | *** | *** | *** |
| LF                   | NS | NS | NS | NS | NS | NS | NS |
| LF × ECiw            | NS | NS | NS | NS | NS | NS | NS |

Table 3. Variation of leaf chlorophyll content under varying irrigation water salinity levels (ECiw, dS m⁻¹) and leaching fractions (LFs), and the output of the two-way analysis of variance (ANOVA) for leaf chlorophyll content.

| Days after transplanting (d) | 17 | 26 | 69 | 84 |
|-----------------------------|----|----|----|----|
| ECiw                        |    |    |    |    |
| 0.9                         | 62.9| 62.3| 72.9 a| 75.8 a|
| 1.6                         | 62.3| 62.0| 72.2 a| 75.8 a|
| 2.7                         | 63.3| 61.7| 72.4 a| 74.9 a|
| 4.7                         | 61.8| 62.4| 72.3 a| 73.7 a|
| 7.0                         | 63.6| 62.3| 68.8 b| 61.9 b|
| LF                          | 0.17| 62.0| 61.1 b| 70.8 b| 70.7 b|
| 0.29                        | 63.5| 63.1 a| 72.7 a| 74.1 a|

ANOVA

|                      | NS | NS | NS | NS | NS | NS | NS |
|----------------------|----|----|----|----|----|----|----|
| ECiw                 | NS | NS | NS | NS | NS | NS | NS |
| LF                   | NS | NS | NS | NS | NS | NS | NS |
| LF × ECiw            | NS | NS | NS | NS | NS | NS | NS |
Excessive amounts of ions enter the plant, restricting photosynthesis and growth rate (Munns, 2002). Excessive Na+ has an adverse effect on plant growth (Niu et al., 1995), whereas K+ is of great importance in a number of physiological processes (e.g., turgor maintenance, enzyme activation, stomatal behavior, osmotic adjustment, cell expansion, and membrane polarization) (Hatamnia et al., 2013). High K+ and low Na+ in the cytoplasm play a critical role for the maintenance of a series of enzymatic processes (James et al., 2006). Salinity stress causes excessive Na+ and a reduction in K+ in plant tissues (Li et al., 2010), which may cause nutritional imbalance.

In this study, we observed that the Na+ concentration increased and the K+/Na+ ratio decreased in the roots (Table 5), indicating competitive inhibition between the absorption of K+ and Na+ in hot peppers under higher salinity stress (Li et al., 2010). There is also a correlation between the accumulation of Na+ in plants and the Na+/Ca2+ ratio in root and stems, regardless of the leaching fraction.

The ECiw could strongly affect the gas exchange parameters. That salinity stress can cause a dramatic reduction of Pn, and the inhibition of K+ in stems (Table 5) can result in a lower uptake of water by the roots and the Tn, in turn, reduces growth (Romero-Aranda et al., 2001). The ECiw could affect the gas exchange parameters. That salinity stress can cause a dramatic reduction of Pn, and the inhibition of K+ in stems (Table 5) can result in a lower uptake of water by the roots and the Tn, in turn, reduces growth (Romero-Aranda et al., 2001).

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### Table 4. Effects of irrigation water salinity (ECiw, dS m⁻¹) and leaching fractions (LFs) on photosynthesis rate (Pn, μmol CO₂ m⁻² s⁻¹), leaf stomatal conductance (gs, mol H₂O m⁻² s⁻¹), transpiration rate (Tn, mmol H₂O m⁻² s⁻¹), and intercellular CO₂ concentration (Ci, μmol CO₂ mol⁻¹) measured on 23, 39, and 76 d after transplanting (DAT), and the output of the two-way analysis of variance (ANOVA) for the aforementioned parameters.

| ECiw  | Pn  | gs  | Tn  | Ci  | 23 DAT | 39 DAT | 76 DAT |
|-------|-----|-----|-----|-----|--------|--------|--------|
| 0.9   |     |     |     |     |        |        |        |
| 1.6   |     |     |     |     |        |        |        |
| 2.7   |     |     |     |     |        |        |        |
| 4.7   |     |     |     |     |        |        |        |
| 7.0   |     |     |     |     |        |        |        |

### Table 5. Effects of irrigation water salinity (ECiw, dS m⁻¹) and leaching fractions (LFs) on the K⁺ (mg g⁻¹ DW), Ca²⁺ (mg g⁻¹ DW), and Na⁺ (mg g⁻¹ DW) concentrations and K⁺/Na⁺ ratio of hot pepper roots and stems.

| ECiw  | Roots | Stems | | | | | |
|-------|-------|-------|---|---|---|---|---|
| 0.9   |       |       | | | | | |
| 1.6   |       |       | | | | | |
| 2.7   |       |       | | | | | |
| 4.7   |       |       | | | | | |
| 7.0   |       |       | | | | | |

### Table 6. Linear correlation between dry weight of roots and stems and the Na⁺ concentration, K⁺ concentration, and K⁺/Na⁺ ratio in root and stems, regardless of the leaching fraction.

| Independent variable (Y) | Independent variable (X) | Determination coefficient (R²) |
|-------------------------|--------------------------|------------------------------|
| Root dry weight         | K⁺ concentration in roots | 0.65**                       |
| Root dry weight         | Na⁺ concentration in roots | 0.70**                       |
| Stem dry weight         | K⁺ concentration in stems | 0.58**                       |
| Stem dry weight         | Na⁺ concentration in roots | 0.60**                       |
| Stem dry weight         | K⁺/Na⁺ ratio in stems     | 0.70**                       |

NS, *, **, *** Nonsignificant or significant differences between means at 0.05, 0.01, and 0.001 level of probability, respectively. Different letters within a column for each experimental factor indicate significant difference at P < 0.05 by Duncan’s multiple range tests.
Our research showed that high LF can relieve Na stress and encourage the growth of hot pepper plants. Therefore, higher saline water should be applied with higher quantity of water for satisfactory performance for hot pepper production. However, there was a time lag for the LF effect on leaf transpiration and plant growth, also on ET, ECw, and yield [see our previous studies (Qiu et al., 2017a, 2017b)], due to the gradual building up of soil salinity during the growth season, which deems further studies for the other crop. This result is valuable for saline irrigation and salinity management, especially in arid and semiarid regions in the response of pepper to salinity. Sciencia Hort. 110:260–266.

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