

Passage VI

Tomato plants grow poorly in high-salt environments. This effect is caused by 2 processes:

- A net movement of H_2O between the cytoplasm of the plants' cells and the environment via osmosis
- An increase in the cytoplasmic Na^+ concentration

The plant *Arabidopsis thaliana* carries a gene, *AtNHX1*. The product of this gene, VAC, facilitates uptake of cytoplasmic Na^+ by the plant's vacuoles.

A researcher created 4 genetically identical lines of tomato plants (L1–L4). An *AtNHX1* gene from *Arabidopsis thaliana* was isolated and 2 identical copies of this gene were incorporated into L1's genome. This process was repeated with L2 and L3 using a different *AtNHX1* allele for each line, so that L1, L2, and L3 had different genotypes for *AtNHX1*. The researcher then did an experiment.

Experiment

Fifty seedlings from each of the 4 lines were grown in 10 L of nutrient solution for 80 days. The 10 L nutrient solution contained H_2O , 12 g of fertilizer, and 3 g of NaCl. The nutrient solution was replaced every 5 days. After 80 days, average height, average mass (without fruit), and average fruit mass (per plant) were measured (see Table 1).

Table 1			
3 g of NaCl/10 L nutrient solution			
Line	Height (cm)	Mass (kg)	Fruit mass (kg)
L1	124	1.2	2.1
L2	128	1.2	2.0
L3	120	1.2	2.1
L4	124	1.2	2.0

This process was repeated except the 10 L nutrient solution contained 60 g of NaCl instead of 3 g of NaCl (see Table 2).

Table 2			
60 g of NaCl/10 L nutrient solution			
Line	Height (cm)	Mass (kg)	Fruit mass (kg)
L1	119	1.1	1.9
L2	121	1.1	1.9
L3	61	0.4	1.1
L4	63	0.5	1.0

The process was repeated again except the 10 L nutrient solution contained 120 g of NaCl instead of 3 g of NaCl (see Table 3).

Table 3			
120 g of NaCl/10 L nutrient solution			
Line	Height (cm)	Mass (kg)	Fruit mass (kg)
L1	118	1.0	1.8
L2	115	1.0	1.7
L3	34	0.2	0
L4	36	0.3	0

Tables 1–3 adapted from Hong-Xia Zhang and Eduardo Blumwald, "Transgenic Salt-Tolerant Tomato Plants Accumulate Salt in Foliage But Not in Fruit." ©2001 by Nature Publishing Group.

30. One plant produced no fruit and had a height of 21 cm. Which of the following most likely describes this plant?
- It was from L2 and was grown in a 10 L nutrient solution containing 60 g of NaCl.
 - It was from L2 and was grown in a 10 L nutrient solution containing 120 g of NaCl.
 - It was from L4 and was grown in a 10 L nutrient solution containing 60 g of NaCl.
 - It was from L4 and was grown in a 10 L nutrient solution containing 120 g of NaCl.
31. During osmosis, water migrates through a semipermeable barrier. The osmosis referred to in the passage occurs through which of the following structures?
- Chromosomes
 - Nuclear envelope
 - Cell membrane
 - Rough endoplasmic reticulum
32. For each line, as the concentration of salt in the nutrient solutions increased, average plant mass:
- increased only.
 - decreased only.
 - increased, then decreased.
 - decreased, then increased.
33. Which of the following was an independent variable in the experiment?
- Whether a line received *AtNHX1*
 - Whether a tomato plant was used
 - Plant mass without fruit
 - Plant height
34. Suppose the data for all of the plants were plotted on a graph with height on the x-axis and mass (without fruit) on the y-axis. Suppose also that the best-fit line for these data was determined. Which of the following would most likely characterize the slope of this line?
- The line would not have a slope, because the line would be vertical.
 - The slope of the line would be zero.
 - The slope of the line would be negative.
 - The slope of the line would be positive.