

PLANTING SEED

Effect of NaCl on the Growth of Germinating Upland Cotton (*Gossypium hirsutum* L.) Seeds

F. R. Lehle and A. M. Zegeer

ABSTRACT

Responses to environmental stresses such as excess salinity are difficult to understand if not studied under defined conditions. The objective of this study was to determine if cottonseed radicle and cotyledon growth during germination was affected by exogenous NaCl. Cottonseeds were imbibed in moistened paper toweling for 24 h at 32°C before transfer to an agar media containing selected concentrations of NaCl for an additional 24 h. Radicle linear growth extension was stimulated at low NaCl concentrations (80 mM), but increasingly inhibited as NaCl concentrations increased from 160 to 400 mM. Radicle and cotyledon fresh weights were increasingly inhibited by NaCl concentrations between 0 and 400 mM. NaCl inhibition of radicle fresh weights was more pronounced than that of cotyledons. We conclude that the inhibitory effects of NaCl can be quantified as reductions in cottonseed radicle and cotyledon growth.

INTRODUCTION

Excess salinity limits agricultural productivity worldwide. To understand the range of inhibitory effects of NaCl on plant growth, the growth and physiological responses to NaCl must be studied under defined conditions. Our interest here was to define conditions in which the inhibitory effects of NaCl could be studied in germinating cotton (*Gossypium hirsutum*) seeds. The overall goal of this research was to identify strategies for improving cotton NaCl tolerance during germination, emergence, and stand establishment. The specific objective of this study was to access the effect of NaCl on cotyledon and radicle growth of germinating Upland cottonseeds under aseptic conditions. We show here that the inhibitory effects of NaCl are expressed as reductions in the growth of germinating cottonseed radicles and cotyledons.

MATERIALS AND METHODS

Cotton (*Gossypium hirsutum* L.) seeds were from a single high-quality (1988 harvest) seed lot of Deltapine 90. Seeds were surface-sterilized for 4 min with 10% (v/v) Chlorox and then imbibed in moistened paper toweling for 24 h at 32°C. Ten imbibed seeds were transferred to 9-cm polystyrene petri dishes containing different concentrations of NaCl in 26 mL of 1% (w/v) agar supplemented with inorganic nutrients. Radicle growth was determined as the difference between radicle length after transfer to agar and that present after 24 h incubation at 32°C. Fresh weights of cotyledons and radicles also were recorded at this time.

RESULTS AND DISCUSSION

Radicle growth (linear extension) was stimulated at low concentrations of NaCl, but inhibited at high concentrations. NaCl concentrations below 160 mM were without effect on growth or caused significant ($LSD_{0.05} = 3.19$) stimulation of radicle growth of imbibed cottonseeds (Fig. 1). Stimulation of radicle growth occurred in a narrow range of NaCl concentrations centered near 80 mM. Transfer of imbibed cottonseeds to media containing concentrations of NaCl higher than 160 mM resulted in inhibition of growth. Radicle growth was increasingly inhibited up to 64% after transfer to NaCl concentrations from 160 to 400 mM NaCl (Fig. 1). Thus, as a response, radicle growth was not a good measure of NaCl inhibition at concentrations below 160 mM. At higher concentrations of NaCl up to 400 mM NaCl, radicle growth inhibition appears directly related to NaCl level in the medium.

Radicles and cotyledons differed in their sensitivity to NaCl inhibition. Radicle fresh weight decreased steadily up to 67% between NaCl concentrations of 0 and 400 mM (Fig. 2). No significant stimulation of radicle fresh weight was measured at low concentrations of NaCl. Cotyledon fresh weight was less affected by NaCl than was radicle fresh weight (Fig. 3). Cotyledon fresh weight decreased gradually up to 25% between NaCl concentrations of 0 and 400 mM.

We conclude that the inhibitory effects of NaCl on cotton can be conveniently quantified as reductions in radicle and cotyledon growth which accompanies seed germination. Radicle growth shows more sensitivity to NaCl inhibition than does cotyledon growth. NaCl inhibition of radicle and cotyledon fresh weights, however, occurs over a broader range of NaCl concentrations than does linear extension growth of the radicle.

ACKNOWLEDGEMENT

Supported by Arizona Cotton Growers Association through Grant No. 88-856A from Cotton, Inc.

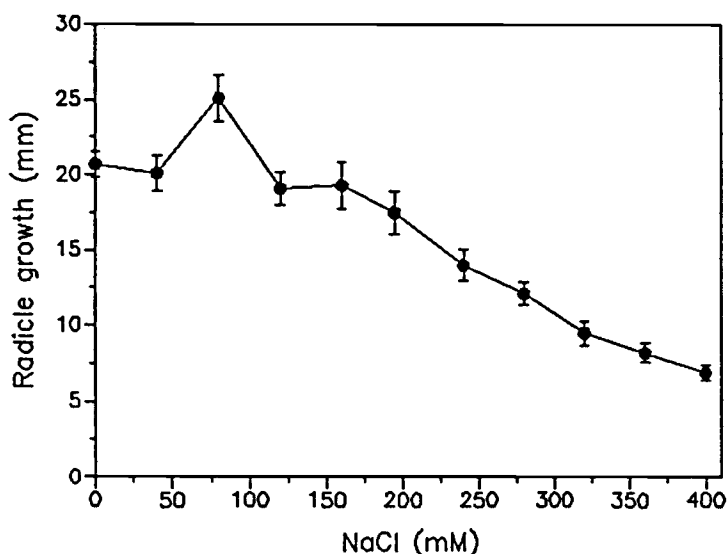


Figure 1. Effect of NaCl on cotton seed radicle growth. Seeds were imbibed for 24 h at 32°C before transfer to agar medium containing NaCl. Radicle growth after 24 h on NaCl treatments is shown \pm SE ($n=32$).

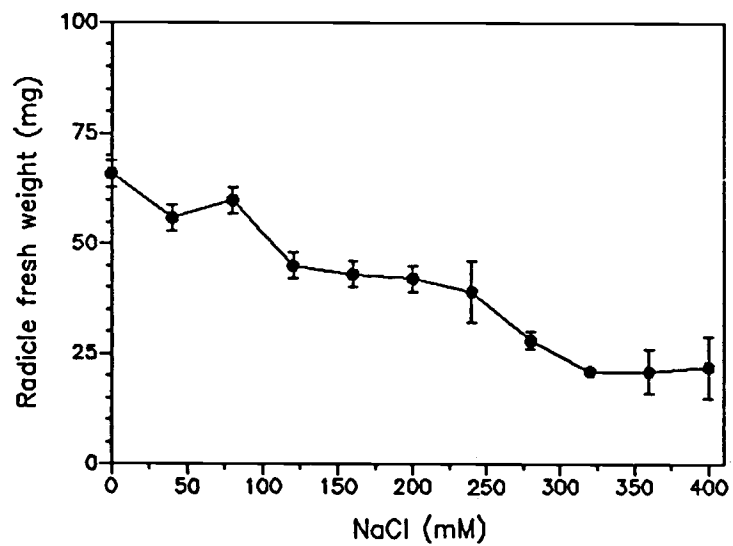


Figure 2. Effect of NaCl on cotton seed radicle fresh weight. Conditions as described in Fig. 1 caption. Radicle fresh weights after 24 h on NaCl treatments are shown \pm SE (n=32).

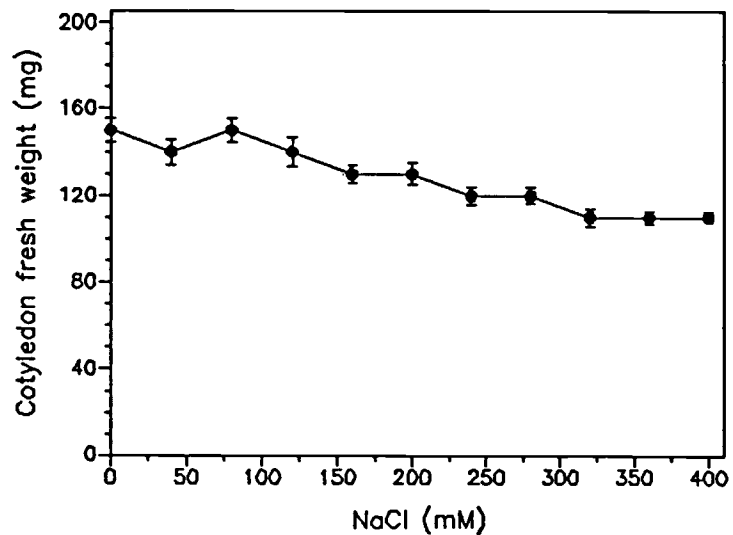


Figure 3. Effect of NaCl on cotton seed cotyledon fresh weight. Conditions as described in Fig. 1 caption. Cotyledon fresh weights 24 h after transfer to NaCl treatments are shown \pm SE (n=32).