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NaCl-Salinity-Dependent Conversion of ACC to Ethylene in the Halophyte, *Allenrolfea occidentalis*

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Salinity-induced ethylene production has been reported as correlated with leaf injuries in lemon trees irrigated with 0.085 *M* NaCl [1] and as an indicator of stress in tobacco callus cultures exposed to NaCl at concentrations 0.12 and 0.2 *M* [2]. In the mung bean hypocotyls, ethylene production was arrested at concentrations above 0.2 *M*, followed by greater production of ethane with increased severity of stress [3]. It is not known how NaCl affects the ethylene-producing system in plants which can tolerate high levels of salinity.

We investigated the ability of the halophyte, *Allenrolfea occidentalis* (S. Wats.) Kuntze (Chenopodiaceae) to metabolize an ethylene precursor 1-aminocyclopropane-1-carboxylic acid (ACC) in the presence of NaCl applied at various concentrations.

Plants were collected from a salt playa near Goshen, northwestern Utah. The fleshy stems were cut into 1-cm sections and six of them were placed into 7-ml serum bottles containing 200 μl of water or solutions of NaCl (0.2 to 4 *M*) or ACC (1 m*M*) alone or ACC combined with NaCl (0.2 to 4 *M*). After 24 h incubation on a rotating shaker (20 rpm) in darkness at 30 °C, ethylene content in the headspace of the bottles was determined by gas chromatography. The results obtained with the halophyte were compared with those of the glycophyte, mung bean [*Vigna radiata* (L.) Wilczek] a model system for studying ethylene metabolism [4]. Hypocotyls were cut into 1-cm sections from 3-day-old seedlings grown on water-saturated perlite and six sections were placed into similar serum bottles.

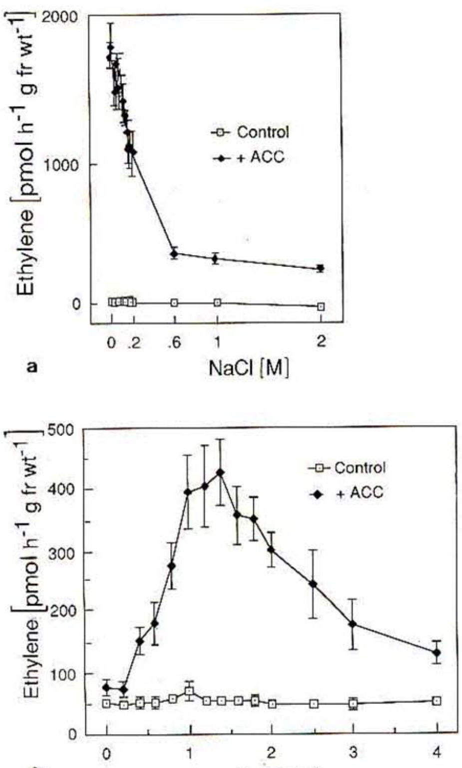

Fig. 1. The effect of NaCl on ACC → ethylene conversion a) in glycophyte, *Vigna radiata* (mean of three experiments), b) in halophyte *Allenrolfea occidentalis* (mean of six experiments)

ACC was applied to mung bean at the same concentration as to *A. occidentalis*. NaCl treatments ranged from 0.02 to 2 *M*. The NaCl concentrations for both plants studied were chosen to bracket the osmotic values of their sap which were determined by a vapor pressure osmometer to be 1.199 *M* NaCl (±0.042) for *A. occidentalis* and 0.162 *M* NaCl (±0.002) for *V. radiata* respectively.

In the absence of the exogenous ACC, both species produce ethylene at comparable rates around 50 pmol h^{-1} g^{-1} fr. wt. in the respective control treatments (no NaCl added). Over the NaCl concentration range of 0.02 to 2 *M*, ethylene evolution in *V. radiata* drops to 40 pmol h^{-1} g^{-1} fr. wt. at 0.02 *M* and to 20 pmol h^{-1} g^{-1} fr. wt. at 2 *M* (Fig. 1a). With *A. occidentalis*, the ethylene production remains steady within

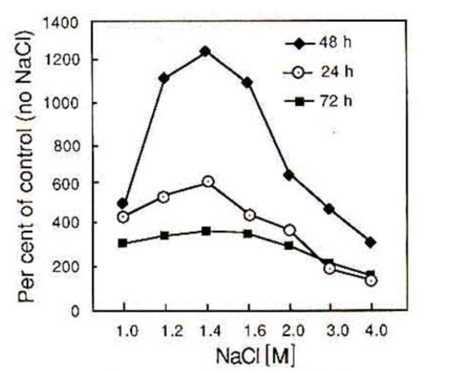

Fig. 2. The rate of ACC → ethylene conversion in *A. occidentalis* as affected by incubation period (mean of three experiments)

the range from 0.2 to 4 *M* NaCl (Fig. 1b).

When exogenous ACC is supplied, dramatic differences in relative conversion rates of both species appear (Fig. 1). In *A. occidentalis* the concentration of NaCl which produces the highest conversion rate for ACC to ethylene is at 1.4 *M* and that value is 5.7 times greater than the conversion rate when NaCl is absent. Even at 4 *M* NaCl the halophyte still produces 1.7 times as much ethylene as in distilled H_2O (Fig. 1b).

In contrast, *V. radiata*, the glycophyte, has the highest conversion rate at 0.02 *M* NaCl. The rate decreases rapidly at 0.2 *M* and levels off between 0.6 and 2 *M* (Fig. 1a).

It should be also stressed that *A. occidentalis* carries on the ACC conversion at a high intensity over a considerably longer period of time (Fig. 2). The conversion activity is even higher after 48 h than after 24 h. In the case of the ACC → ethylene converting system of *V. radiata*, hypocotyl sections display the highest activity during the first 8 to 12 h of incubation (unpublished data).

The results raise a number of questions. Is the ACC → ethylene conversion system in the halophyte salt (NaCl)-dependent? Is the halophyte system designed to permit ethylene production under conditions of salt stress in the plant? Are the rates of ethylene production higher in halophytes than in glycophytes under salt stress? These questions call for further research and the ACC → ethylene conversion system of *A. occidentalis* appears to be an excellent halophytic model to investigate these questions.

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