Further Study on Genotypic Variation of Salt Tolerance to Wild Soybean (Glycine soja Sieb. & Zucc.)

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Introduction

Soil salinity has a major impact on plant growth and affects about 6% of the total global land area (Flowers and Yeo 1995). The development of salt tolerant crops including soybean could greatly help to meet demands on the food supply. The wild perennial Glycine species have been suggested as a potential source of germplasm to improve soybean for agronomic traits including salt tolerance (Brown et al 1984;Pantalone & Kenworthy 1989). It is well known that the annual wild soybean Glycine soja Sieb. & Zucc. is the unique close relative of cultivated soybean and has been effectively used in soybean breeding. Hu and Wang (1997) first reported the variation of salt tolerance of each plant in natural populations of Glycine soja by using a new method for evaluating salt tolerance efficiencies (STEs) of individual plants based on the timing of the leaf injury. In their experiments however continuous illumination and a constant temperature(21oC) were maintained and only the seedlings were tested. The present work further evaluates the salt tolerance of wild soybean in two saline populations under different temperature schedules and developmental stages in order to elucidate salt tolerance of Glycine Soja in the real and natural situation.

Materials and Methods

Seedlings and adult plants were grown from seeds individually harvested in the field originally collected from the saline populations No.3 and No.4 of Glycine soja in Kenli County of Shandong Province where the delta of the Yellow River is formed from the Bohai Sea(Wang et al. 1997). The cultivars Lee, Jackson, and Morgan were included as checks to compare their salt reaction with the wild soybean. The experimental conditions are listed in Table 1. The salt tolerance efficiency (STE) of each genotype was calculated by the procedure of Hu and Wang (1997). In most cases leaf injury for a given individual or cultivar occurred in the same day and experimental variability of a few individuals was around 1 to 2 days.

Results and Discussion

Salt tolerance efficiencies (STE) of wild soybean in two saline populations in different experiments (Table 1) were determined and the values of STEs were listed in Table 2. In experiments I, II, IV, V, and VI, the seedlings were treated with salt in the first pair of euphylis stage plants in experiment III were in the podding stage. In experiments II, III and IV the seedlings or adult plants were planted outdoors experiencing large differences in temperature between day and night. The seedlings in experiments II, II, and IV, however, were grown in the relatively constant temperature and continuous illumination. Temperature was maintained at 21oC during experiment VI (Wang et al 1997; Table 1). In accordance with our previous work (Hu and Wang 1997) the STEs in every experiment varied widely in wild soybean populations. However the highest STE (3-2: 30.00; Table 2) was determined in experiment II in which the seedlings were planted in sand and outdoors in the early summer. In solution cultures the highest STE (3-5, 3-6, 3-7, 3-8: 16.20; Table 2) was determined when the adult plants were in podding stage in experiment III in the late autumn. Furthermore the lowest STE (3-2, 3-13, 4-17: 0.20) was determined in experiment IV(the seedlings were planted outdoors and the lowest temperature was 5oC) after the seedlings were treated with 2% NaCl for 1 day. Consequently salt tolerance could be lowered substantially as a result of low temperature.

In experiment I the STEs of soybean cultivars such as Morgan, Lee, and Jackson were also determined (Table 4). The average value of STEs in soybean cultivars (3.18) was lower than that of wild soybean populations (Table 2 and Table 4). However in the experiment IV the average value of

STE in cultivars (3.0) was much higher than that of wild soybean and the STE of "Morgan" was the highest value (Table 2 and Table 4). In experiments I and V the most salt-tolerant individual 3-11(Table 3) became a salt-sensitive one in the experiments II, III, and IV. In addition the most salt-sensitive individuals in the experiment IV 3-2 and 4-17 became the most salt-tolerant ones in experiment VI. Hence it could be presumed that salt tolerance was in close correlation with the temperature and the level of energy metabolism in plants. Moreover It was similar to soybean cultivar "Lee" demonstrated by Läuchli (1984).

Therefore this study indicated that there is considerable variation in salt tolerance among individuals of Glycine soja populations and the STEs are dependent on the experimental conditions. Moreover our results are in support of the view that salinity and other environmental effects interact in several ways that may obscure inheritance studies of salt tolerance (Nieman and Shannon 1976; Mass and Nieman 1978). It is extremely important that researchers have a basic understanding of salinity-environment interactions so that accurate assessments of salt tolerance can be made and reported (Shannon 1984).

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