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About Journal@rchive

Journal List

Journal/
Society Search

GO

News



Science Links Japan

JST Japan Science and Technology Agency

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The Crop Science Society of Japan [Info](#) [Link](#)[TOP](#) > [Journal List](#) > [Available Issues](#) > [Table of Contents](#) > [Abstract](#)

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Reduction of Growth and Symbiotic Nitrogen Fixation in Soybean as Affected by the Site of Simulated Acid Rain Application

Xianyu WANG, Makoto TSUDA and Tetsuro TANIYAMA

- 1) Faculty of Bioresources, Mie University
- 2) Faculty of Bioresources, Mie University
- 3) Faculty of Bioresources, Mie University

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Abstract:

Reductions of growth and symbiotic nitrogen fixation were studied in soybean exposed to simulated acid rain (SAR) applied to different sites. Soybean cultivar Okuharawase was grown in 1/5000a pots under a rain shelter. The plants were exposed to SAR from 15 days after sowing (DAS) to the flowering stage at 36 DAS. The sites of SAR application were foliage, soil and both foliage and soil, and the pH of SAR used was 2.7, 3.5, 4.5 and 7.0 (control). At the flowering stage, leaf area per plant, apparent photosynthetic rate and root dry weight per plant decreased in proportion to decrease in the pH of SAR. The degree of decrease was similar between the plants exposed to SAR in foliage and soil and those in foliage, but the application of SAR to soil alone did not cause any change in the parameters. There was a consistent reduction in the number of nodules per plant, the fresh weight of nodules per plant and the rate of symbiotic nitrogen fixation, or acetylene reduction activity (ARA) regardless of the site of SAR application. ARA decreased in proportion to the decrease in the number and fresh weight of nodules. The root dry weight significantly correlated with nodule number or nodule fresh weight. The reduction of growth and symbiotic nitrogen fixation in plants with exposure to SAR in foliage was similar to that with exposure in both foliage and soil, whereas SAR applied to soil alone suppressed modulation only.

Keywords:

Acetylene reduction activity, Acid rain, Nodule, Photosynthesis, Soybean, Symbiotic nitrogen fixation

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