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施氮肥对盐胁迫下Bt棉生长和叶片Bt蛋白含量的影响

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Effects of Nitrogen Fertilization on Bt Cotton Growth and Bt Protein Concentration in Leaves under Salinity Stress

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摘要 以Bt棉品系K638为材料，在盆栽条件下研究了施氮肥对不同程度盐胁迫（土壤含盐量：0(CK)、0.15%(轻度胁迫)和0.3%（中度胁迫））下棉株生长、氮素吸收、Bt蛋白含量和Bt蛋白氮占全氮量比例的影响；同时，在水培条件下研究了不同形态氮素（硝态氮和铵态氮）对NaCl胁迫下Bt蛋白含量的效应。结果表明，氮肥与盐胁迫对棉叶Bt蛋白含量有显著的互作效应。非盐和低盐胁迫下，施氮肥促进了棉株生长（生物量分别提高了3.0和2.8倍）、Bt蛋白合成（分别提高41.0%和90.9%）和全N向Bt蛋白N的转化（分别提高9.3%和15.6%）；中度盐胁迫下，施氮肥虽也促进了棉株生长（1.4倍），并提高了叶片全N含量（98.8%）和Bt蛋白含量（83.3%），但并未提高Bt蛋白N占全N量的比例。无论盐胁迫与否，施NO_3^--N处理的生物量和叶片全氮含量都显著高于施NH_4^+-N的处理，但由于盐胁迫下NO_3^--N降低了Bt蛋白N占全氮的比例（11.0%），叶片Bt蛋白含量则略低于NH_4^+-N处理。据此认为，盐胁迫下施氮肥通过促进棉株对N素的吸收积累并影响全氮转化为Bt蛋白的比例，进而影响Bt蛋白含量。

关键词： 棉花 盐胁迫 氮肥 Bt蛋白

Abstract： It is well known that salinity stress inhibits plant growth and Bt protein synthesis in cotton(*Gossypium hirsutum* L.), but it is still not clear if fertilization alleviates the inhibitory effects. Two experiments with pot culture and hydroponic culture were conducted using Bt cotton strain K638 in a rain shelter and a greenhouse, respectively, to study the effects of N fertilization and its forms(NO_3^--N and NH_4^+-N) on plant growth, nitrogen uptake, Bt protein content and the ratio of N in Bt protein to total N under salinity stress. In the pot experiment, a significant interaction was detected between N fertilization and salinity stress on leaf Bt protein content. Under non-saline and low saline (total salt content≈0.15%) soils, N fertilization enhanced plant biomass by 3.0 and 2.8 times, and increased leaf Bt protein content by 41.0 and 90.9%, and the ratio of N in Bt protein to total N by 9.3% and 15.6%, compared with the non-fertilization treatment, respectively; under moderate saline soil(total soluble salt content≈0.30%), N fertilization also improved plant biomass(1.4 times), total N content(98.8%) and Bt protein level(83.3%), but decreased the ratio of N in Bt protein to total N(7.3%). In the hydroponics experiment, plant biomass and the total N content in NO_3^--N treatment were higher than that in NH_4^+-N with or without salinity stress, but the Bt protein levels was slightly lower than that in NH_4^+-N treatment owing to decreased ratio of N in Bt protein to total N under salinity stress(11.0%). It is concluded that Bt protein concentration in leaves was influenced by nitrogen fertilization under salinity stress through increasing nitrogen uptake and/or altering the ratio of N in Bt protein to total N.

Keywords： cotton salinity stress nitrogen fertilization Bt protein

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