

增硝营养对不同基因型水稻苗期氮素吸收同化的影响

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Effect of partial replacement of NH_4^+ by NO_3^- on nitrogen uptake and utilization by different genotypes of rice at the seedling stage

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摘要 利用控制条件下的溶液培养方法,研究了增硝营养(NH_4^+ : NO_3^- 比例为100: 0和50: 50)对4种不同的基因型水稻(常规籼稻、常规粳稻、杂交籼稻、杂交粳稻)苗期生长和氮素吸收同化的影响。结果表明,增 NO_3^- 营养可以增加水稻叶片的光合速率,促进水稻对氮素的吸收,提高氮素利用率,进而促进水稻生长;不同基因型水稻在增 NO_3^- 营养下氮积累量增幅不同主要是由于其生物量增幅不同,而整株氮素含量增幅差异不大; NO_3^- 的存在可增强谷氨酰胺合成酶和硝酸还原酶的活力,促进水稻对 NH_4^+ 和 NO_3^- 的同化利用,从而增加了氮素在植株地上部的积累同化;籼稻与粳稻相比,杂交粳稻与杂交籼稻相比,前者在氮素吸收利用上均表现出更为明显的优势。

关键词: 水稻 NO_3^- 氮素 吸收 利用 水稻 NO_3^- 氮素 吸收 利用

Abstract: There has been increased evidence of enhanced effect by nitrate (NO_3^-) on the growth of rice although rice prefers the ammonium (NH_4^+) to nitrate. Furthermore, rice is being increasingly cultivated in the soil intermittently irrigated or even in aerobic soil in which nitrate nutrition is becoming more important in rice than ever before. Moreover, the rhizosphere of rice is actually exposed to partially oxidized status due to the released oxygen by rice roots. Solution culture experiments were carried out to study the effects of nitrate on the growth and photosynthesis, nitrogen (N) uptake by plant, the glutamine synthetase activity (GSA) and the nitrate reductase activity (NRA) in the leaves of four typical rice (*Oryza sativa* L.) cultivars (Conventional Indica, Conventional Japonica, Hybrid Indica, Hybrid Japonica) at the seedling stage (28-day-old). The results obtained were as follows: On average, the dry weight of shoots and roots of rice treated with N at the ratio of 50/50 (NH_4^+ -N/ NO_3^- -N) was increased by about 20% compared with that at 100/0 (NH_4^+ -N/ NO_3^- -N), while chlorophyll content and photosynthesis rates were increased by 4.6% and 16%, respectively, and total N in shoots and roots by 42% and 57%, respectively. It was not the N content but the increased dry matter that contributed to rice production by partial replacement of NH_4^+ by NO_3^- . Conventional Indica responded to nitrate in a greater way than any other cultivars tested. The activities of nitrate reductase (NR) and glutamine synthetase (GS) in the leaves of Indica and hybrid Indica were higher than in Japonica or hybrid Japonica, suggesting that Indica rice could use more NO_3^- than Japonica rice. The high activity of NR [$0.92\text{--}4.34 \text{ NO}_2^-$ -N, $\mu\text{mol}/(\text{g}\cdot\text{h})$, FW] showed that rice was also efficient in absorbing and assimilating nitrate. The increased GSA in the leaves showed that the partial replacement of NH_4^+ by NO_3^- could improve the assimilation of NH_4^+ in the leaves. The increased assimilation of inorganic nitrogen caused by some NO_3^- was the main contributor to the improved growth of rice. In conclusion, rice, if supplied with partial NO_3^- , could grow better than without any nitrate and thus nitrification to some degree in paddy soil is of great significance for rice production.

Keywords:

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