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### 一氧化氮对NaCl胁迫下苜蓿种子萌发的影响

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**摘要:** 以甘农4号、阿尔冈金2个品种苜蓿为材料,用一氧化氮(NO)供体硝普钠、NO清除剂c-PTIO、一氧化氮合酶抑制剂N-硝基-L-精氨酸甲脂、硝酸还原酶抑制剂钨酸钾及硝普钠类似物亚铁氰化钠(不产生NO)处理苜蓿种子,研究NO对盐胁迫下苜蓿种子萌发的生理效应。结果表明,盐胁迫显著抑制了2个苜蓿品种的发芽率、胚芽和胚根长及幼苗干重( $P<0.05$ ),降低种子萌发过程中 $\alpha$ 、 $\beta$ -淀粉酶、蛋白水解酶活性,抑制淀粉水解和可溶性糖积累( $P<0.05$ );盐胁迫下添加外源NO则使2个品种苜蓿 $\alpha$ 、 $\beta$ -淀粉酶、蛋白水解酶活性、种子发芽率显著提高( $P<0.05$ ),淀粉含量降低,可溶性糖含量升高、胚芽和胚根长及幼苗干重显著增加( $P<0.05$ );NO供体SNP的类似物亚铁氰化钠对盐胁迫下苜蓿种子萌发的各项指标无明显影响;施用NO清除剂c-PTIO、硝酸还原酶抑制剂钨酸钾和一氧化氮合酶抑制剂N-硝基-L-精氨酸甲脂具有降低苜蓿种子萌发的效应( $P<0.05$ )。因此,盐胁迫抑制苜蓿种子的萌发,而添加外源NO是缓解这种抑制作用的有效途径,内源NO也可能参与盐胁迫下苜蓿种子萌发的调节,且通过NOS和NR途径产生的NO在缓解盐胁迫抑制苜蓿种子萌发中可能起关键作用。

**关键词:** 苜蓿 NO 盐胁迫 种子萌发

### EFFECT OF NITRIC OXIDE ON ALFALFA SEED GERMINATION UNDER NaCl STRESS

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**Abstract:** The seeds of two alfalfa varieties (*Medicago sativa* cv. Gannong No.4 and *Medicago. sativa* cv. Algonquin) pretreated with NO-donor SNP, NO-scavenger 2-(4-carboxyphenyl)-4, 4, 5, 5-tetramethylimidazoline-1-oxyl-3-oxide (c-PTIO), tungstate, the nitrate reductase (NR) inhibitor, nitric oxide synthase (NOS) inhibitor N<sup>G</sup>-nitro-L-Arg-methyl ester (L-NAME) and sodium ferrocyanide (SNP analogue that does not release NO) were used to study the physiological effect of NO on germination under NaCl stress. The results showed that the germination rate, epicotyl length, hypocotyl length and dry matter of seedlings were inhibited ( $P<0.05$ ), and the activity of  $\alpha$ -amylase,  $\beta$ -amylase and protease were decreased, and the hydrolysis of starch and the accumulation of soluble sugar were inhibited ( $P<0.05$ ) under NaCl stress. The activity of protease,  $\alpha$ -amylase and  $\beta$ -amylase was increased, the starch content was decreased and soluble sugar content was increased, the length of epicotyl and hypocotyls, germination rate and dry matter were increased by adding exogenous NO under NaCl stress ( $P<0.05$ ). The NO-donor SNP analogue (sodium ferrocyanide) had no effect on the germination indices ( $P>0.05$ ); whereas reduction effects on seed germination were found while the c-PTIO, tungstate and L-NAME were applied ( $P<0.05$ ). It could be concluded that NaCl stress inhibited the germination of alfalfa seeds, while the exogenous NO could effectively alleviate the inhibitive effect. Endogenous NO might also involved in the regulation of alfalfa seed germination under NaCl stress, and the NO released through NOS and NR pathway might play an important role in alleviating the inhibitive effect in alfalfa seed germination.

**Keywords:** Alfalfa nitric oxide salt stress seed germination

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