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X射线能谱和FTIR分析铜胁迫对玉米幼苗的影响

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摘要:

应用X射线能谱和傅里叶变换-衰减全反射红外光谱(FTIR-ATR)分析方法结合一些生理指标的变化及幼苗叶片下表皮扫描电镜观察,研究一定浓度(0、200、400、800、1000mg·kg⁻¹)Cu²⁺胁迫对玉米幼苗的影响。结果表明,随着Cu²⁺浓度增高,叶绿素含量呈下降趋势,抗氧化酶(SOD、CAT、POD、APX)活性均先升高后降低。利用SEM及X射线能谱检测玉米表面发现,高浓度的Cu²⁺胁迫会使玉米叶片细胞扭曲、拉长,而且细胞表面铜元素含量升高,并影响其他营养元素的吸收。铜处理导致幼苗叶片3338cm⁻¹、2918 cm⁻¹、2849 cm⁻¹及 1377 cm⁻¹吸收峰强度较对照增强,整体呈现先升后降的趋势。

关键词: 铜胁迫 玉米 X射线能谱 FTIR-ATR 抗氧化酶

EFFECTS OF CU STRESS ON MAI ZE SEEDLINGS USING X-RAY ENERGY SPECTRUM AND FTIR SPECTRA METHODS

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Abstract:

The effects of Cu²⁺ stress on maize seedlings by using scanning electron microscope, X-ray energy spectrum and Fourier transform infrared attenuated total reflection(FITIR-ATR) spectrometry were investigated, and antioxidative enzymes activities such as SOD, CAT, POD, APX were measured. Results showed that, with the increasing of Cu²⁺ concentration, the content of chlorophyll decreased, and antioxidative enzyme activities increased at first and then decreased at higher concentration stress. High concentration Cu²⁺ treatment twisted the cells' shape and increased copper content on leaf surface, and absorption of other nutrients were also affected The result of FTIR-ATR analysis showed that the organic content of leaf were changed by Cu²⁺ stress.

Keywords: copper stress maize X-ray energy spectrum FTIR-ATR antioxidative enzymes

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参考文献:

[1] Intawongse M, Dean J R. Uptake of heavy metals by vegetable plants grown on contaminated soil and their bioavailability in the human gastrointestinal tract [J]. Food Addit Contam, 2006,23(1): 36-48

[2] Baryl A, Laborde C, Montillet J L, et al. Evaluation of lipid peroxidation as a toxicity bioassay for

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plants exposed to copper
[J]. Environ Pollut, 2000,109: 131-135

[3] Chen L M, Lin C.C and C H Kao. Copper toxicity in rice seedlings: changes in antioxidative enzymes, H₂O₂ level and cell wall peroxidase activity in roots

[J]. Bot Bull Acta Sinica,2000,41: 99-103

[4] 徐镇坚,田兵,华跃进. 不同金属辅基和酶剂量对超氧化物歧化酶抗氧化、促氧化作用的影响

[J]. 核农学报,2006,20(4): 349-352

[5] 葛才林,骆剑锋,刘冲,殷朝珍,王泽港,马飞,罗时石. 重金属对水稻光合作用和同化物输配的影响

[J]. 核农学报,2005,19(3): 214-218

[6] 张军,束文圣. 植物对重金属镉的耐受机制

[J]. 植物生理与分子生物学报,2006,32(1): 1-8

[7] Chamseddine M, Wided B A, Guy H, Marie-Edith C, et al. Cadmium and copper induction of oxidative stress and antioxidative response in tomato(*Solanum lycopersicon*) leaves

[J]. Plant Growth Regulation,2009,57: 89-99

[8] 张志峰,刘园,张浩. 傅里叶变换红外光谱法并结合主要成分分析法鉴别灯盏花和多舌飞蓬的研究

[J]. 光谱学与光谱分析, 2009,29(12): 3263-3266

[9] Bureau S, Ruiz D, Reich M, et al. Application of ATR-FTIR for a rapid and simultaneous determination of sugars and organic acids in apricot fruit

[J]. Food Chemistry, 2009,115: 1113-1140.

[10] Boulet J C, Williams P, Doco T. A fourier transform infrared spectroscopy study of wine polysaccharides

[J]. Carbohydrate Polymers, 2007,69: 79-85

[11] Komatsu H, LIU L, Murray Ian V J, et al. A Mechanistic link between oxidative stress and membrane mediated amyloidogenesis revealed by infrared spectroscopy

[J]. Biochimica et Biophysica Acta, 2007,1768: 1913-1922

[12] Beyer W F, Fridovich Y. Assaying for superoxide dismutase activity: some large consequences of minor changes in conditions

[J]. Anal Biochem, 1987,161: 559-566

[13] Chance B, Maehly A C. Assay of catalases and peroxidases

[J]. Methods Enzymology, 1955, 2: 764-775

[14] Maehly A C. Plant peroxidase

[J]. Methods Enzymology, 1955, 2: 801-813

[15] Nakano Y, Asada K. Hydrogen peroxide is scavenged by ascorbate specific peroxidase in spinach chloroplasts

[J]. Plant Cell Physiol, 1981,22: 867-886

[16] Arnon D I. Copper Enzymes in isolated Chloroplasts: polyphenoloxidase in *Beta vulgaris*

[J]. Plant Physiology, 1949,24: 1-15

[17] Chen L Q, Guo Y F, Yang L M. Synergistic defensive mechanism of phytochelatin and antioxidative enzymes in *Brassica chinensis* L. against Cd stress

[J]. Chinese Science Bulletin, 2008,53(10): 1503-1511

[18] 张自坤,刘作新,张颖,舒乔生. 铜胁迫对嫁接和自根黄瓜幼苗光合作用及营养元素吸收的影响

[J]. 中国生态农业学报,2009,17(1): 135-139

[19] Vardake E, Cook C M, Lanaras T. Interelemental relationship in the soil and plant tissue and photosynthesis of field cultivated wheat growing in naturally enriched copper soils

[J]. Journal of plant nutrition, 1997,20(4-5): 441-453

[20] 徐照丽,张晓梅. 利用铁、铜间相互作用减轻烤烟铜毒害的研究

[21] Liu J, Xiong Z T, Li T Y. Bioaccumulation and ecophysiological responses to copper stress in two populations of *Rumex dentatus* L. From Cu contaminated and noncontaminated sites [J]. *Environ Exp Bot*, 2004, 52: 43-51

[22] Kinraide T B, Pedler J F, Parker D R. Relative effectiveness of calcium and magnesium in the alleviation of rhizotoxicity in the wheat induced by copper, zinc, aluminum, sodium and low pH [J]. *Plant Soil*, 2004, 259(1-2): 201-208

[23] 周长芳, 吴国荣, 施国新, 等. 水生抗氧化系统在抵御 Cu^{2+} 胁迫中的作用 [J]. *植物学报*, 2002, 43(4): 389-394

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1. 张志勇, 陈梅, 李晚忱, 付凤玲. 以玉米幼胚为受体转化海藻糖合成酶基因 [J]. *核农学报*, 2009, 23(5): 743-746
2. 周柱华, 徐立华, 王丽丽, 许方佐, 邢燕菊, 张风云, 邱登林, 阴卫军, 韩金龙, 徐相波, 丁一. 玉米自交系鲁原92的选育及应用 [J]. *核农学报*, 2009, 23(6): 986-989
3. 郭锋, 樊文华. 不同浓度 Hg^{2+} 、 Cr^{3+} 和 Pb^{2+} 单一胁迫对绿豆膜脂过氧化物含量及抗氧化酶活性的影响 [J]. *核农学报*, 2009, 23(6): 1060-1064
4. 曹墨菊, 黄文超, 潘光堂, 荣廷昭, 朱英国. 首例航天诱变玉米细胞核雄性不育株与可育株的株高生长分析 [J]. *核农学报*, 2004, 18(04): 261-264
5. 王殿轩, 李淑荣, 温贤芳, 原锴. 电子束辐照谷物中玉米象不同虫态的生物效应 [J]. *核农学报*, 2004, 18(02): 131-133
6. 齐延芳, 许方佐, 周柱华, 邢燕菊, 徐立华, 邱登林. 种植密度对玉米鲁原单22光合作用的影响 [J]. *核农学报*, 2004, 18(01): 14-17
7. 左元梅, 陈清, 张福锁. 利用 ^{14}C 示踪研究玉米/花生间作玉米根系分泌物对花生铁营养影响的机制 [J]. *核农学报*, 2004, 18(01): 43-46
8. 金阳, 葛才林, 杨小勇, 王译港, 罗时石. 氯苯对小麦抗氧化酶活性的影响 [J]. *核农学报*, 2003, 17(04): 296-300
9. 齐延芳, 杨景成, 周柱华, 邢燕菊, 徐立华, 许方佐, 邱登林. 玉米自交系及F₂分离群体花药培养中的过氧化物同工酶分析 [J]. *核农学报*, 2003, 17(03): 191-195
10. 袁佐清, 张怀渝, 王化新, 李晚忱, 陈志渝. 不同玉米自交系的抗旱力与超弱发光关系的研究 [J]. *核农学报*, 2003, 17(01): 35-40
11. 周柱华, 齐延芳, 许方佐, 邢燕菊, 徐立华, 邱登林. 辐照花粉对玉米F₁M₁结实及后代植株的影响 [J]. *核农学报*, 2002, 16(06): 347-350
12. 刘应红, 秦嘉岳, 黄小珍, 胡育峰, 黄玉碧. 外源激素和糖类对玉米zSs1表达的影响 [J]. *核农学报*, 2011, 25(3): 432-435, 505
13. 傅俊杰, 冯风琴, 包志毅, 夏晓峰. 甜玉米辐照保鲜研究 [J]. *核农学报*, 2002, 16(03): 144-147
14. 唐秀芝, 张维强, 任继明, 刘志芳. 粮饲兼用玉米中原单32号的育成与推广 [J]. *核农学报*, 2001, 15(06): 360-364
15. 潘家荣, 巨晓棠, 刘学军, 张福锁, 毛达如. 高肥力土壤冬小麦/夏玉米轮作体系中化肥氮去向研究 [J]. *核农学报*, 2001, 15(04): 207-212