

铜、锌元素对香蕉枯萎病的防治效果与机理

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Effects and Mechanism of Copper and Zinc Elements on Controlling Fusarium-wilt Disease of Banana

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摘要 为寻找香蕉枯萎病防治措施, 通过盆栽试验和室内试验, 研究铜、锌 (EDTA-Cu、EDTA-Zn) 对香蕉尖孢镰刀菌 (*Fusarium oxysporum* f. sp. *cubense*) 生理特性的影响, 以及锌与拮抗菌21号 (SOR21[#], 多粘芽孢杆菌 *Paenibacillus polymyxa*) 配合使用对香蕉枯萎病的防治效果。结果表明: (1) 用尖孢镰刀菌培养得到的粗毒素处理香蕉幼苗96 h后, 对照植株萎蔫严重, 呈枯死状, 添加EDTA-Cu或EDTA-Zn, 显著减轻了粗毒素对香蕉幼苗的伤害。(2) 与对照相比, 添加EDTA-Cu或EDTA-Zn均显著增加了香蕉尖孢镰刀菌小型分生孢子数量和真菌生物量, 但显著降低了镰刀菌酸的产量, 分别降低73%和96%。(3) 盆栽试验中, 加锌 (ZnSO₄ · 7H₂O) 处理显著降低了香蕉枯萎病的病情指数。其中锌与拮抗菌21号菌同时使用防治效果最好, 处理75 d病情指数比直接接菌处理降低62%。(4) 21号菌显著降低了香蕉根际土壤尖孢镰刀菌数量, 与直接接菌处理相比降低了18%, 锌与21号菌同时使用显著增加了尖孢镰刀菌数量, 比直接接菌处理增加了30%。上述结果表明, 锌离子可能通过降低香蕉尖孢镰刀菌镰刀菌酸的产量以及增强拮抗菌21号菌的生防活性来有效降低香蕉枯萎病的发病率。

关键词: 香蕉 铜 锌 多粘芽孢杆菌 枯萎病 镰刀菌酸

Abstract: In order to find the measure of controlling the fusarium wilt disease of banana, through pot experiments and laboratory experiments, we investigated the applied effects of EDTA-Cu and EDTA-Zn on the physiological characteristics of *Fusarium oxysporum* f. sp. *cubense*, and the combined application of Zn²⁺ and the fungal antagonist of the No. 21 bacteria (SOR21[#], *Paenibacillus polymyxa*) on the suppression on the disease. The results were as follows: (1) Time of 96 hours after treatment the banana seedlings with crude toxin of *Fusarium oxysporum* f. sp. *cubense*, the seedlings of the control treatment wilted severely. However, the treatments of application of EDTA-Cu and EDTA-Zn significantly reduced the disease stress on banana. (2) Application of EDTA-Cu and EDTA-Zn significantly increased the total biomass and the microconidium number of *Fusarium oxysporum* f. sp. *cubense*, but significantly reduced the production of fusaric acid of *Fusarium oxysporum* f. sp. *cubense*. Compared with the control treatment, the fusaric acid production with treatments of EDTA-Cu and EDTA-Zn were reduced by 73% and 96%, respectively. (3) In pot experiments, only Zn²⁺ addition significantly reduced the banana fusarium wilt disease index. Furthermore, combined application of Zn²⁺ and the No. 21 bacteria had a good effect of controlling the disease, and after 75 days of inoculation of banana seedlings, the banana fusarium wilt disease indices were all reduced by 62% compared with the only fungi-inoculated treatment. (4) Only addition of the No. 21 bacteria reduced the spore number by 18% compared to the only fungi-inoculated treatment. However, when combined application of Zn and No. 21 bacteria, the number of the spores was increased significantly by 30%. It was concluded that Zn application might effectively reduce the occurrence of fusarium wilt disease of banana though reducing the fusaric acid production of the pathogen and enhancing the No. 21 bacteria biocontrol activity.

Keywords: banana, copper, zinc, *Paenibacillus polymyxa*, fusarium wilt disease, fusaric acid

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