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Research Progress in Detection and Control of Soil Borne Disease Fusarium Root Rot

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Abstract

Fusarium is a variety of species, which is difficult to distinguish in morphology. Traditionally, identification of pathogenic fusarium requires the separation of pathogenic bacteria, purification of pathogenic bacteria, separation and purification after tieback, sequencing and other processes, which are time-consuming and laborious. Molecular detection technology can make pathogen identification more efficient. Fusarium control mainly includes cultivating disease-resistant varieties, chemical control, physical control, biological control and crop rotation. In recent years, various root rot bacteria caused by Fusarium have shown an increasing trend. By reviewing the previous relevant research results, this study summarized the research progress of molecular detection and prevention measures of root rot caused by the soilborne disease fungus Fusarium, and explored the current research status and existing problems of fusarium. In order to provide theoretical reference for further study of soil-borne pathogenic fungi.

Keywords

Fusarium; Soil Borne Disease; Root Rot.

1. Introduction

Fusarium root rot is a worldwide soilborne fungal disease with a variety of specialized types, which can infect a variety of crops [1]. For example, Fusarium oxysporum has specialized types of coriander, pepper, onion, pea, cucumber and tobacco [2-7]. Fusarium root rot can occur in the whole growth period of tobacco. The pathogen can infect the root of tobacco and cause root rot and necrosis, which can lead to the death of the whole plant. Fusarium root rot of tobacco has become one of the most important root diseases in the Huang-Huai tobacco area at present, with the incidence of serious tobacco fields reaching more than 30% [8], and the incidence degree and the tobacco area are on the rise [9]. Fusarium root rot accounted for 52.6% of root rot diseases, among which Fusarium solanum and Fusarium oxysporum were the main pathogens causing tobacco root rot, followed by Phytophthora, rhizoctonia solanicus, Fusarium flexure and Fusarium oxysporum [2, 10], and the pathogenic tobacco strains almost disappeared.

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2. Organization of the Text

2.1. Research Progress in Molecular Detection of Fusarium Root Rot

2.1.1. Molecular Detection Technology of Fungal Universal Primers

There are many fusarium species and it is difficult to distinguish them in morphology. Traditionally, identification of fusarium in tobacco requires the separation of pathogenic bacteria, purification of pathogenic bacteria, separation and purification after tieback, sequencing and other processes, which are time-consuming and laborious. Molecular detection techniques can make The identification of pathogens more efficient. For example, the internal transcription spacer of the ribosome, the elongation factor 1-α (EF1-α) sequence and the RNA polymerase RPB2 (the second lar-gest RNA polymerase subunit) are highly conserved. It was used for the classification and identification of fungi in early stage [11-13]. Wang Guofen designed two pairs of specific primers for ITS region of Fusarium oxysporum f. sp. cubense, and PCR experiments showed that the preliminary identification of banana fusarium oxysporum and the detection of banana fusarium Fusarium specific type could be realized [14]. Yan Huangyan et al. invented a primer kit for identification of Fusarium oxysporum and Fusarium solanum based on TEF1-α as the target gene, which proved to be highly specific and of great significance for the early and rapid detection and disease control of melon root rot and fusarium wilt [15]. Chen Lida et al. used the gene sequence of Fusarium translation extension factor (TEF1-α) to screen and design a specific primer capable of detecting Fusarium. This primer can detect the dynamic changes of Fusarium content and Fusarium content in soil under different humidity environments by using fluorescence quantitative PCR technology [16]. However, a single common universal primer can no longer accurately identify fusarium species [17], so the establishment of a molecular detection system for a certain fusarium can improve the accuracy of fusarium identification.

2.1.2. Molecular Detection Technology Combining Universal Primers and Molecular Markers

Ye Jianjun et al. combined ITS sequencing with SCAR molecular marker technology to design molecular detection primers targeting FOC4, a pathogen of banana fusarium wilt [18]. Based on pgx4 gene of amt is static in combination with competitive allele specific PCR technology (system) KASP technology and galacturonic acid polymer circumscribed enzyme gene SNP molecular markers and primer group established to fusarium oxysporum tomato specialization and specialization neck rot root rot of molecular detection system, can be detected in the strain and the soil to pathogen [19]. Han Fuqing et al. designed a set of LAMP primers for ITS region of Fusarium oxysporum using loop-mediated isothermal amplification (LAMP) technology, which was specific for 8 pathogens including Fusarium oxysporum, anthrax, Trichospora, and Phytophthora. The method was characterized by fast detection speed, simple operation, and naked eye observation with SYBR Green I as indicator. It is more suitable for basic technical personnel [20]. Wang Ling et al. searched for simple sequence repeat interval (SSR) and designed primers based on the genomic data of Fusarium emerging, screened out multiple SSR molecular markers with good repeatability and high polymorphism to reveal the genetic diversity and population genetic structure of Fusarium emerging [21].

2.2. Fluorescence Quantitative Molecular Detection Technology

Quantitative fluorescence method can increase the sensitivity of molecular detection of pathogenic bacteria. Huang Huaidong et al. adopted quantitative real-time PCR detection method to detect Fusarium oxysporum contained in soil with a minimum threshold of 4×102 spores/soil, which is characterized by high automation, sensitivity and accuracy compared with ordinary PCR [22]. According to ITS region of Fusarium Solanum, Shi Yanxia et al. [23] established SYBR Green I fluorescence quantitative PCR method for Fusarium solanum. Zhao

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Yongpo et al. [24] established the detection system of Fusarium oxystellariae by qRT-PCR. Li Xin et al. designed qRT-PCR primers based on the amino adipatic reductase (Lys2) gene of Fusarium solanum and Fusarium oxysporum fatty acid ω-hydroxylase gene of Fusarium Fusarium notobacter. The combination of qRT-PCR and LAMP technology showed that the minimum detection concentration of the template was 0.2pg /μL. It is specific to 8 kinds of pathogens [25, 26]. At present, the molecular detection technology of Fusarium is mainly focused on Fusarium oxysporum, and there are relatively few studies on other fusarium species.

2.2.1. Chemical Control

At present, the main control methods of Fusarium include cultivating disease-resistant varieties, chemical control, physical control, biological control and crop rotation. However, chemical control is commonly used at present, which has the characteristics of quick effect, wide range of action and good effect [27]. In the early stage of the disease, carbendazim, Luhang I, methyl tobuzine and 75% chloroonil WP can be used for spraying or root irrigation to achieve certain effects [9, 28]. Zhu Yafeng et al. showed that the control effect on Fusarium root rot of Fusarium was 46.4%, 45.3% and 45.1%, respectively, by using benzoate · formaidi, carbendazim and oxametrin in the plot experiment [29]. Chen Changqing et al. used two chemical fungicides, Jingjia, oxametrin and corzendan, to achieve more than 60% of the control effect on root rot, and the control effect was close to or higher than the reported fungicides [1]. However, with the continuous use of drugs, the control effect of a single agent has been declining year by year, even failing to reach the control effect [30]. The control effect of Linlanwen and other mixed agents Lvhang 1 + carbendazim, PTC + carbendazim, carbendazim + Puke can reach 100%[31]. At present, chemical pesticides are the most common method to control Fusarium root rot of tobacco, but it is difficult to control. With the use of chemicals, there will be increased drug resistance of pathogenic bacteria and greater environmental pollution and other problems [1].

2.2.2. Physical Prevention

At present, there is no report on the use of physical control in tobacco, and the main physical control methods used in the control of tomato neck rot and root rot include heating disinfection method and circulating irrigation disinfection method [32]. Rowe et al. can prevent tomato neck rot and root rot in greenhouse by using high-temperature steam disinfection, but the control effect is not stable [33]. Chellemi et al. covered the soil with polyethylene film and used solar heat disinfection to reduce the number of progenicbacteria of tomato neck rot and effectively control tomato neck rot [34].

2.2.3. Biological Control

When plants are infected by pathogens, they will recruit some beneficial microorganisms to regulate their rhizosphere microflora, especially those that induce disease resistance and promote growth, so as to maximize the survival chances of their offspring growing in the same soil, and these beneficial microorganisms can be used to prevent and control the re-infection of pathogens [35]. Biological control is the use of bio-control bacteria or bio-control fungus interact to pathogen, competition, such as nutrition space to achieve the purpose of prevention and cure of disease occurs, is one of the more popular method of prevention and cure, although in the soil, the inhibitory action will be because of factors such as environment, biology, nutrition in soil to colonization, but the problem is slowly improving, In addition, some biological control agents have been applied to the control of related plants, which have a good application prospect [36]. For example, Bacillus, Trichoderma, Paecilomyces, Pseudomonas, Aspergillus, arbuscular fungi, etc. [37, 38]. The experiments of Tahir.H. A. et al. showed that the secretions of Bacillus amylum FZB42 and Bacillus artemisinin LSSC22 had good control effect on tobacco bacterial wilt [39]. Pseudomonas has a variety of strains that can prevent and control root diseases, and the control mechanism is also different. There are relatively few biological control strains of Bacillus, among which Bacillus cereus and Bacillus subtilis can

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effectively inhibit root diseases caused by various fungi and bacteria of Fusarium [36]. Yao Xiaoyuan proved through experiments that the bacteriostasis rates of Bacillus subtilis and Bacillus polymyxides isolated against Fusarium tobacco root rot reached 43.75% and 48.78%[40]. Chen Qianqian isolated Streptomyces aureoverticillatus from the rhizosphere soil of tobacco, and the inhibition rates of Fusarium oxysporum, Phytophthora nicotiana, and melon and fruit suds reached 52.31%, 73.68% and 92.06%[41]. Wang Mingzu et al. isolated Paecilomyces lilacinus, and the experiment showed that it had certain inhibitory effect on Fusarium oxysporum, and even had antagonistic effect on bacteria, viruses, nematodes, etc., which was widely distributed and had a good application scenario [42-44]. Trichoderma harzianum is an antagonistic fungus with good economic benefits, widely existing in soil and plant residues [45]. El-mohamedy et al. reported that Trichoderma Harzianum can accumulate phenol and chitinase to achieve the control of tomato neck rot root rot, with the control effect reaching 28%[46]. Trichoderma viride, Trichoderma asperellum and Trichoderma lignorum have certain control effects against a variety of pathogens such as Fusarium Trichoderma, Trichoderma Asperellum and Trichoderma Trichoderma Lignorum [38, 47-49]. You Shengbo et al. used the solid fermentation product of Penicillium oxalate to induce tobacco resistance to tobacco Mosaic virus [50], and Pu Yong et al. used Penicillium inactivated silk as organic fertilizer to reduce the incidence and disease index of tobacco black shank disease [51]. Bacteriophages have been proposed as a substitute for insecticides to inhibit pathogens of crops. Wang XiaoFang et al. used the combination of different bacteriophages to control tomato bacterial wilt, and the incidence of tomato bacterial wilt could be reduced by 80%. Bacteriophages could reduce the density of pathogenic bacteria, and the bacterial species with antagonistic effect on bacterial wilt increased. Moreover, phage treatment did not affect the existing rhizosphere microbiota [52]. By 2020, the National Tobacco Administration will achieve a green control coverage rate of no less than 80% in tobacco fields. The use of biological control is environmentally friendly, promotes plant growth, advocates the application of biological agents, reduces chemical pesticide pollution, and has a good development prospect [53].

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