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Perspective

Influence of Seed Treatment and Mixed Cropping on Garlic White Rot Management

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INTRODUCTION

Garlic (*Allium sativum*) is a widely cultivated crop with significant culinary and medicinal value. However, the persistent threat of white rot, caused by the fungus *Sclerotium cepivorum*, poses a substantial challenge to garlic production worldwide. In recent years, researchers and farmers alike have explored various strategies to manage and mitigate the impact of white rot. Garlic, a member of the *Allium* genus, has been cultivated for centuries, appreciated for its unique flavor and diverse medicinal properties. Despite its resilience, garlic is susceptible to various diseases, and white rot, caused by the soil-borne fungus *Sclerotium cepivorum*, stands out as a formidable adversary. White rot infestations can lead to devastating losses, affecting both yield and quality of garlic bulbs. In response to this challenge, researchers have investigated innovative approaches to manage white rot, with a particular focus on seed treatment and mixed cropping.

DESCRIPTION

Seed treatment techniques

Seed treatment involves the application of various agents to seeds before planting, aiming to enhance germination, protect against diseases, and improve overall plant health. In the context of garlic white rot management, several seed treatment techniques have been explored.

Chemical seed treatments: Chemical seed treatments involve the application of fungicides or biopesticides to garlic seeds. Fungicides such as thiophanate-methyl and iprodione have demonstrated efficacy against *Sclerotium cepivorum*. These chemicals act by inhibiting fungal growth and preventing the establishment of white rot in the garlic crop.

Biological seed treatments: Biological seed treatments leverage beneficial microorganisms, such as *Trichoderma* spp. and *Bacillus* spp., to suppress the growth of pathogenic fungi. These biocontrol agents establish a protective barrier around the garlic seeds, limiting the invasion of *Sclerotium cepivorum* and promoting a healthier plant-microbe balance in the soil.

Heat treatment: Heat treatment involves subjecting garlic seeds to elevated temperatures to eliminate pathogens. While this method can be effective in reducing the white rot inoculum, careful optimization of temperature and duration is crucial to avoid detrimental effects on seed viability.

Mixed cropping strategies

Mixed cropping, the cultivation of two or more crops in close proximity, is another avenue explored for managing garlic white rot. The rationale behind mixed cropping lies in disrupting the life cycle of the pathogen, reducing disease pressure, and enhancing overall crop resilience.

Companion cropping: Companion cropping involves planting garlic alongside companion plants that exhibit natural resistance to white rot or release allelopathic compounds inhibitory to the pathogen. For example, crops like marigold (*Tagetes* spp.) and French marigold (*Tagetes patula*) have shown potential in reducing the incidence of white rot when intercropped with garlic.

Crop rotation: Crop rotation involves alternating the cultivation of garlic with non-host crops for white rot during successive planting seasons. This practice helps break the disease cycle by depriving *Sclerotium cepivorum* of a continuous host, thereby reducing inoculum levels in the soil.

Polyculture systems: Polyculture systems integrate multiple crops within the same field, creating a diverse and dynamic agroecosystem. The presence of different crops can disrupt the habitat and life cycle of white rot pathogens, limiting their ability to establish and spread within the garlic crop.

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Synergistic effects of seed treatment and mixed cropping

While seed treatment and mixed cropping have been investigated individually, their combined application presents a promising avenue for integrated garlic white rot management. The synergy between these strategies can offer enhanced protection, resilience, and sustainability in garlic cultivation.

Enhanced disease suppression: Combining chemical or biological seed treatments with mixed cropping can create a multifaceted defense against white rot. Chemical seed treatments can provide immediate protection to the seeds, while mixed cropping establishes a resilient agroecosystem that impedes the pathogen's progress.

Biodiversity and ecosystem services: Mixed cropping contributes to biodiversity in agricultural systems, fostering a complex web of interactions among plants, microbes, and other organisms. This biodiversity can enhance ecosystem services, such as natural pest control and nutrient cycling, creating a more sustainable and resilient agricultural environment.

Reduced dependency on chemical inputs: Integrated approaches that combine seed treatments and mixed cropping reduce the reliance on chemical inputs, addressing concerns related to environmental impact and resistance development in pathogens. This shift towards sustainable agriculture aligns with the growing demand for environmentally friendly farming practices.

Challenges and considerations

While the combination of seed treatment and mixed cropping holds promise for garlic white rot management, several challenges and considerations must be addressed:

Resistance development: Continuous reliance on specific seed treatments or companion crops may lead to the development of resistance in white rot pathogens. To counter this, a diversified and integrated approach should be adopted, incorporating various seed treatments and mixed cropping strategies over time.

Site-specific adaptation: The efficacy of seed treatments and mixed cropping can vary depending on soil conditions, climate, and regional factors. Tailoring these strategies to specific agroecological contexts is essential for optimizing their impact on garlic white rot management.

Farmer adoption and education: Successful implementation of these strategies requires farmer awareness, education, and training. Extension services and agricultural outreach programs play a crucial role in disseminating knowledge about the benefits and proper application of seed treatments and mixed cropping for white rot management.

CONCLUSION

Garlic white rot poses a significant threat to global garlic production, prompting the exploration of innovative and sustainable management strategies. The combination of seed treatment and mixed cropping emerges as a promising approach, leveraging the strengths of both interventions for enhanced disease suppression, biodiversity promotion, and reduced environmental impact. As agricultural systems evolve towards more sustainable practices, the integration of these strategies holds the potential to revolutionize garlic cultivation, ensuring the resilience and productivity of this essential crop in the face of white rot challenges. Continued research, collaboration between researchers and farmers, and effective knowledge dissemination are critical to realizing the full potential of these integrated management approaches and securing the future of garlic production.