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Phytophagous Mites' Infestation in Rice Plants and Defense Strategies

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Editorial

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Rice is cultivated in approximately 150 million hectares around the world, and its annual yield is close to 610 million tons [1]. However, the estimates for the potential losses caused by animal pests are around 25% worldwide [2]. One important cause of these losses is the infestation of phytophagous mites, which can cause drastic reductions in production (up to 90%), specially related with the weight of the grains [3].

Mites can cause several visual damages to plants, such as stains on leaves and forming grains, hindering the development of attacked panicles and resulting in empty grains [4]. The surface of the grain, leaf sheath and husks can acquire a brown or black color [5]. In other cases, infested seedlings become pale and stunted, and leaves exhibit chlorotic areas at both abaxial and adaxial surfaces that resemble nitrogen deficiency, acquiring a brittle texture [6,7].

Physiological damages include destruction of photosynthetic structures and storage organs of the infested plants, leading to plant growth inhibition [8]. The primary metabolism is disturbed, specifically changing the metabolism of amino acids and carbohydrates, as well as changing the hydric potential of their cells [9]. Mite infestation can also reduce soluble protein levels, as well as the concentration of sugars, which result in cellular dysfunction and impairment in plant growth [10]. The production of reactive oxygen species is increased by mite infestation and affects plant biomass production. Oxidative stress may also affect photosynthetic efficiency due to stomatic restrictions. It can also harm the cell membrane, raise degradation rates of protein and DNA and, consequently, lead to cell death. Some proteins of the photosynthetic apparatus can be inactivated due to oxidative stress and cause a dissipation of light in the form of heat, compromising energy production [11].

In order to defend themselves from mite attack, plants present two classical strategies, named chemical and physical [12]. For a comprehensive review check [13]. Their first chemical defense is to synthesize toxic metabolites followed by proteins that will, in the long term, create physical defenses [14]. The production of toxic metabolites that can reduce plant digestibility is a common chemical defense described for a wide range of potential consumers [15]. Plant defenses may also occur through the production of repelling and anti-nutritional toxins, as well as the release of volatile organic compounds that attract predators of the phytophagous mite [16]. Physical defense includes tissue rigidity, spines, hairs, latex, hardness of the leaf and the presence of waxes, thorns, and trichomes, reducing the access of the phytophagous to vegetal tissues and interfering with their feeding [17-19].

Rice culture is of great importance to worldwide nutrition, and alternatives should be sought for controlling damages caused by phytophagous mite infestations. Host plants probably present a great variability in their gene pools as found for abiotic stress

tolerance, allowing the identification of cultivars resistant to phytophagous mite infestation. Applying conventional breeding and selection techniques, cultivars with elevated resistance level may be bred into high-producing lines. The identification of molecular markers associated with resistance would be helpful in such breeding programs, and as more information on the molecular and physiological plant modifications induced by mite infestation becomes available, more resistance-related genes or proteins can be used for plant genetic manipulation [20]. Therefore, biotechnological approaches, such as the generation of transgenic plants, are possibly indispensable to enable effective and significant phytophagous mite infestation resistance.

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