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RESEARCH ARTICLE

Biochemical and molecular studies on the resistance mechanisms in tea [*Camellia sinensis* (L.) O. Kuntze] against blister blight disease

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Abstract Tea (*Camellia sinensis*) plantations are exposed to biotic and abiotic stresses. Among the biotic factors, blister blight (BB), caused by *Exobasidium vexans*, affects the quality and quantity of the product and demands high fungicide application. A long term solution for disease resistance would require the knowledge of the basic molecular and biochemical changes occurring in plant as an attempt to resist the pathogen and limit the spread of the disease which can further help in developing resistant cultivars using biotechnological tools. Thus, gene expression studies using the cDNA based suppressive subtractive hybridization library, characterization of genes for pathogenesis related (PR) proteins [chitinase (*CsCHIT*), glucanase (*CsGLUC*), phenylalanine ammonia lyase (*CsPAL*)] and genes in flavonoid pathway were accessed in the BB resistant and susceptible cultivars, SA6 and TES34, respectively. Further, biochemical analysis of PR and antioxidant enzymes (POX, APX, SOD) involved in BB resistance have been carried out to investigate the potential molecular and biochemical changes. Various stages of pathogen development had varied impact on PR protein, flavonoid pathway and anti-oxidative enzymes and indicates the possible role of reactive oxygen species, lignins, flavonoids, anthocyanins and other synthesized compounds in acting as antimicrobial/antifungal agents in tea cultivars.

Keywords Blister blight · Flavonoid · Pathogenesis · Resistance · SSH · Tea

Introduction

Tea [*Camellia sinensis* (L.) O. Kuntze] is a perennial crop, with an economic life span of over 60 years. Extensive cultivation, improved technology, nutrition and fertility management, introduction of high yielding clones and longer pruning cycle have helped in production increase but have also encouraged productivity limit due to biotic stresses caused by insects, mite pests and various other pathogens (Senthilkumar et al. 2012; Singh et al. 2015).

As the crop is being cultivated for its young succulent leaves, diseases infecting these leaves also affect the quality and quantity of harvest (Senthilkumar et al. 2012; Singh et al. 2015). Among the foliar diseases, blister blight (BB) is caused by the obligatory biotrophic fungal pathogen, *Exobasidium vexans* (Order: *Exobasidiales*).

Indiscriminate usage of fungicides to control BB may lead to resistance development and may exceed the acceptable maximum residue limits of residue (1–2 ppm for systemic fungicides).

Various attempts have been made to correlate resistance with the chemical composition of tea leaf like changes in saccharide, increased activity of polyphenol oxidase and peroxidase, and decrease in chlorophylls and carotenoids induced by BB infection (Rajalakshmi and Ramarethinam 2000). Study of the molecular changes that take place in

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