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BIOCHEMICAL INTERACTIONS IN SHOT-HOLE BORER INFESTATION OF TEA

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Shot-hole borer (SHB) beetle (*Xyleborus fornicatus*) bores galleries in tea (*Camellia sinensis*) stems and exists in symbiotic association with the ambrosia fungus (*Monacrosporium ambrosium*). SHB infestation of tea results in a loss in yield of the valuable leaf and the economic loss is felt mostly in high yielding fields planted with clonal tea. We have been studying the biochemical interactions between the SHB beetle, the tea bush and the ambrosia fungus in an attempt to develop a biochemical method for control of SHB. For this purpose a tea clone susceptible to SHB attack, TRI 2025, and a more resistant clone TRI 2023, were selected for our study.

Host plant chemistry is known to influence the susceptibility of cultivars to microbial pathogens and insect predators. Secondary metabolites such as alkaloids, sterols, saponins and phenolics, as well as primary nutrient chemicals such as carbohydrates and amino acids play an important role in plant-fungal interactions and plant–herbivore interactions. Our studies show that the accumulation of caffeine, the major alkaloid found in tea, may be a defence mechanism of the tea plant. Caffeine was shown to have an inhibitory effect on the fungus, to delay the onset of the different developmental stages in the life cycle of the beetle, and to significantly reduce the number of emerging females in laboratory culture media. Caffeine is not toxic to the adult beetle but appears to have an ovitoxic effect. Polyphenols, which are important constituents of tea, were found to reduce the inhibitory effect of caffeine on the beetle. Activation of phenolic biosynthesis was indicated by an increase in phenylalanylammonia lyase (PAL) and polyphenol peroxidase (PPO) activities in beetle infested stems of both clones. However PAL and PPO activities were higher in the more susceptible TRI 2025 clone, which also has a higher content of phenolics. Caffeine–polyphenol interactions probably reduce the inhibitory effect of caffeine, and could also account for the *in vivo* tolerance of SHB to the relatively high concentrations of caffeine found in tea stems. Studies of neutral sugars showed that the development of ambrosia fungus as well as SHB was influenced by the relative proportions of glucose and inositol in the culture medium. Glucose and inositol in the ratio 5:1 (as found in susceptible TRI 2023 clone) were found to be more favourable to the development of both the fungus and SHB.

Chitin, a linear polymer of β-2,4-linked-*N*-acetyl-**D**-glucosamine, is a constituent of fungal cell walls and the exoskeleton of arthropods. Organisms composed of chitin produce chitinases which do not occur naturally in plants. But plants may produce chitinases as a defence against microorganisms and insect predators. Chitinase activity in tea stems was found to be less in the susceptible TRI 2025 clone than in TRI 2023, and was significantly lower in beetle infested stems from both clones. Therefore either SHB beetle or the ambrosia fungus apparently has the ability to suppress the activity of this enzyme.

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