

Efficacy of Naturally Occurring Feeding Deterrents Endogenous to Rosaceous Trees on Japanese Beetle

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Nature of Work: The Rosaceae family contains many trees that are commercially important and commonly used in the landscape. It has been observed that different genera and species within this family vary considerably in their natural resistance to Japanese beetle attack (Hawley and Metzger, 1940). Recent studies have shown there to be a wide range of resistance among crabapple and cherry taxa to feeding of adult Japanese beetle (Ranney and Walgenbach, 1992). The nature of these mechanisms of resistance has not been determined. Natural resistance can be the result of many plant characteristics but defense chemicals or allelochemicals have been shown to be an integral part of natural control of many insect pests (Waiss et al., 1977; Reese, 1977). Identification of allelochemicals active in conferring resistance to insect attack in rosaceous trees would aid in the development of a base of knowledge concerning the biology of resistance.

Twenty three compounds known to be endogenous to rosaceous trees and having potential antifeedant qualities were evaluated for effects on the feeding of adult Japanese beetles during July 1994. Each compound was added to a standard artificial diet containing agar, cellulose and sucrose to yield molal concentrations of .001, .01 and .1. Each treatment (diet) concentration contained ten replications. Each replication consisted of a single female beetle placed into contact with a 1.5 x 1 cm plug of test media in a plastic petri dish. Beetles were starved for twenty four hours prior to the study and allowed to feed for twenty four hours during the study. A control media containing .1M sucrose was included during each test. Data was collected in the form of fecal dry weight.

Results and Discussion: Dose:feeding response curves were evaluated for each compound using linear and nonlinear regression analyses. The effective dose of a compound that reduced feeding by 25% (ED_{25}) was estimated from regression equations. Eight of the original twenty three compounds exhibited no antifeeding effects and in some cases imparted stimulatory effects on the feeding of adult Japanese beetles. These compounds include benzaldehyde, calcium oxylate, catechin, gallic acid, prunasin, quercetin, rutin and tannic acid. The remaining fifteen compounds all exhibited some degree of inhibitory influence on the feeding of adult Japanese beetle (Table 1). ED_{25} values for p-coumaric acid, eugenol and amygdalin were 1.8, 1.9 and 1.9 millimolar respectively. These values indicate that these three compounds were the most efficient at imparting antifeedant qualities when found at very low concentrations. Arbutin (ED_{25} =5.9 mM), phloretin (ED_{25} =6.8 mM), geraniol (ED_{25} =7.1 mM), phloridzin (ED_{25} =8.7 mM), naringenin (ED_{25} =9.8 mM), and o-coumaric acid (ED_{25} =14.6 mM) were effective in reducing feeding by twenty five percent at moderately low concentrations. The remaining six compounds had ED_{25} values that ranged from medium to medium high. Arginine had an ED_{25} of 41.2, benzoic acid 43.9, asparagine 53.1, chlorogenic acid 60.1, oxalic acid 62.8, and caffeic acid 77.9. These results indicate that a variety of compounds known to exist in rosaceous trees are effective feeding deterrents and may play an important role in host plant resistance.

Significance to Industry: As public concerns and limitations on the use of pesticides increase, plants with natural insect resistance will become an important tool in planning more sustainable landscapes. Long-term IPM programs which will guide the industry in the future dictate the use of pest resistant plants. The identification of effective endogenous allelochemicals is a step toward rapid screening methods for identification of resistant plants.

Literature Cited

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Table 1. The effective dosage that reduced feeding of adult female Japanese beetle by twenty five percent (ED_{25}).

