Title Enhanced proteolytic and cellulolytic activity in insecticide-resistant strains of the maize weevil, *Sitophilus zeamais*

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Abstract

Insecticide resistance is frequently associated with fitness costs in the absence of insecticides, but extended and intense past selection with these compounds may favor the evolution of fitness modifier genes that mitigate such costs. Insecticide resistance without fitness cost was associated with greater accumulation of total proteins and carbohydrates in a strain of the maize weevil (*Sitophilus zeamais* Motschulsky (Coleoptera: Curculionidae)). Increased energy reserves may be due to an accumulation of carbohydrates and proteins because of increased digestive efficiency. To test this hypothesis, proteases and enzymes (cellulase and the pectinases polygalacturonase and pectin lyase), which enable insects to access the nutrients, were used to compare digestive efficiency in insecticide-susceptible and -resistant strains of the maize weevil. A canonical variate analysis indicated significant differences among the strains in enzyme activities, and kinetic parameters were calculated. Serine- and cysteine-proteinases as well as cellulase activities were smaller in susceptible than resistant strains. In addition, the esterolytic activity of serine-proteinases was most increased in the insecticide-resistant strain exhibiting a fitness disadvantage associated with insecticide resistance. Overall, enzymes in the insecticide-resistant strains had increased serine- and cysteine-proteolytic and cellulolytic activity, and kinetic parameters suggested that cysteine-proteinase and cellulase activities were more important in mitigating the cost of insecticide resistance in maize weevil strains.