

8. Cockroaches

8.1 Resistance in Danish field populations

An investigation of insecticide resistance in *B. germanica* was undertaken involving four field strains, a laboratory susceptible strain and a laboratory resistant strain. All strains were bioassayed against insecticides commonly used in cockroach field control and assayed *in vitro* for enzyme systems commonly associated with resistance.

In Table 8a the different strains are arranged in each row in order of magnitude. It is clearly demonstrated that there is a nearly perfect correlation between chlorpyrifos resistance and general esterase activity. This is shown not only by the mean activities, but also by the Duncan groupings. It is therefore likely that esterases play a significant role in the resistance detected.

On the other hand, there appears to be no such correlation in respect to AChE activity; although, as mentioned, insensitivity may play a role in resistance in strains C and D. Based on the data collected, there appears to be no correlation between pyrethroid resistance and the activities measured. Although resistance to pyrethroids remains high in Danish *B. germanica*, it is of far less significance than resistance to chlorpyrifos, since chlorpyrifos has for many years remained Denmark's only guarantee against control failure. The existence of individuals with high esterase activity and/or AChE insensitivity in field populations showing a degree of resistance is cause for concern and worthy of further investigation. It is our intention to collect cockroaches from a greater number of sites in future and to look in greater depth at the mechanisms responsible for any resistance detected. We also intend to confirm the apparent close link between esterase activity and chlorpyrifos resistance, and to establish which mechanism or combination of mechanisms is responsible for the high pyrethroid resistance.

This work is detailed in: Spencer A. G., Kristensen M. & Vagn Jensen K.-M. (1998) The biochemical detection of insecticide resistance in Danish field populations of the German cockroach *Blattella germanica* (Blattellidae). *Pesticide Science* 52, 196-198.

Table 8a.

Insecticide resistance and biochemical properties in field and laboratory strains of *Blattella germanica*. Each strain is represented by different letter and the strains arranged in order of magnitude for each of the properties shown (i.e. the strain at the left of each row is that with the highest insecticide resistance enzyme activity or insensitivity to AChE inhibition, while the strain to the right is that with the lowest). Duncan groupings, determined by SAS, are shown in superscript and distinguish significant difference between population means. Strains which share a Duncan group are not significantly different at population mean. This table shows clearly the correlation between chlorpyrifos resistance and esterase activity.

	Highest Lowest					
<i>R/S LD₅₀</i>						
Permethrin	C	D	E	B	A	S
Chlorpyrifos	A	B	C	D	E	S
<i>Mean GST Activity</i>						
CDNB	C ^a	B ^{ab}	A ^{ab}	D ^{bc}	E ^c	S ^d
DCNB	C ^a	B ^a	E ^a	D ^b	A ^c	S ^d
<i>Mean Esterase Activity</i>						
αNA	A ^a	B ^a	C ^a	D ^{ab}	E ^b	S ^b
βNA	B ^a	A ^{ab}	C ^{bc}	D ^{bc}	E ^c	S ^d
ρNPB	B ^a	A ^a	C ^{ab}	D ^{bc}	E ^c	S ^d
<i>Mean AChE Insensitivity</i>						
Methomyl	C ^a	A ^{ab}	D ^b	E ^c	S ^{cd}	B ^d
Azamethiphos	D ^a	C ^{ab}	B ^b	S ^c	E ^c	A ^c

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8.2 Entomopathogenic fungi for control of *Blattella germanica*

This project was initiated in 1996 and will end in 1998. An initial survey showed that entomopathogenic fungi could be isolated from field-collected German cockroaches along with other entomopathogenic organisms, although the prevalence was low. Most isolates of a range of entomopathogenic hyphomycetes proved to be infective to cockroaches, and based on low lethal time estimates two isolates were selected for further studies.

The relative pathogenicity of the fungi *Metarhizium anisopliae* and *Paecilomyces fumosoroseus* was compared in bioassays, where insects were immersed briefly in aqueous spore suspensions and incubated separately in plastic vials with access to water and food. *M. anisopliae* was the most pathogenic species even though it was originally isolated from a heterologous host in contrast to the strain of *P. fumosoroseus* that originated from a German cockroach. For both fungi females proved to be more susceptible than males to fungal infection. Further tests including more strains of each fungus will show whether this is common for the two species of fungi. Likewise, the spore production capacity of *P. fumosoroseus*, which seems to be much higher than that of *M. anisopliae*, is also investigated for several strains. Further experiments will focus on the spread of the fungus disease in cockroach populations and on the possibility of applying the fungus as a bait.

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