INFECTION OF RED PALM WEEVIL BY MICROBIAL PATHOGENS

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The red palm weevil *(Rhynchophorus ferrugineus* F.) is a tissue borer pest of the coconut palm. The pest infestation is detectable only when palms are about to die due to damage of internal tissues. Curative chemical treatments are not very effective, particularly at later stages of infestation. Though an earwig, a predator on eggs and early instar grubs of the pest was recorded (Abraham and Kurian, 1973), it exerts only a meagre control of the pest due to its polyphagous nature and difficulty to reach the pest within the palm tissues. Recently a cytoplasmic polyhedrosis virus (Gopinadhan *et al.*, 1990) has been reported. But, applicability of the same under field conditions is not known. Natural occurrence of bacterial and efficient viral pathogens, if any, for using them for biocontrol is investigated.

Field-collected grubs, pupae and adults of red palm weevil which showed abnormality were used for isolation of different pathogens. Tissues were processed and observed under both LM and TEM.

Haemolymph of the surface-sterlised grubs was collected, diluted (10 g) serially and aliquots from 10 and 10^2 were inoculated in different microbiological media to cover the entire range of microbes. Cultural, morphological staining, physiological and biochemical characters were studied for the pure cultures of bacteria. Pathogenicity of the isolates was checked in terms of LD_{50} by inoculating 10–10^{10} bacteria (intrahaemocoelic) and 10–10^{15} bacteria (*per os*) to each of the 10 grubs for each concentration.

The major symptoms and post-mortem changes are furnished in Table 70.1. The symptoms are typical for bacterial infection known for various bacterial diseases of insects (Burges and Hussy, 1971; Steinhaus, 1963). Among different bacterial isolates (Table 70.2), the coryneform bacteria are more important pathogens because of their LD_{50} values (10^3–10^8) were minimum and were constantly associated with the disease. Any bacterium having LD_{50}

value between 10^3 and 10^8 is expected to become a pathogen (Burges and Hussy, 1971). Following the coryneform group, *Bacillus* spp. (Table 70.1) were isolated most of the time along with the former. So, it could be expected that coryneform bacteria are the primary cause of the bacterial infection and *Bacillus* spp. are opportunistic invaders accentuating death of the grubs. Though uncommon, *Corynebacterium* spp. and *Arthrobacter* spp. of coryneform group are known insect pathogens (Burges, 1981). Secondary role of *Bacillus* spp. is evident from their high LD_{50} values (Table 70.1) and non-occurrence of known pathogens like *B. thuringiensis, B. lentimorbus* and *B. popilliae*. The other bacterial isolates (Table 70.1) which are common inhabitants of the gut were occasionally obtained and their high LD_{50} values (Table 70.1) suggest that they are of non-pathogenic type.

Table 70.1: Morphological and behavioural characters of diseased grubs of red palm weevil

Characters	*Observations*
Behavioural	Sluggishness, refusal to feed.
Morphological	Rough and tough skin, accumulation of fluid in the haemocoel, yellowing of fat, diarrhoea, dilation of gut, thickening of gut wall, whitish appearance of gut.
Post-mortem	Softening, blackening and putrefaction.

Table 70.2: Bacterial isolates from diseased grubs of red palm weevil and their LD_{50} values

	LD_{50} values	
Organism	*Per os*	*Intrahaemocoelie*
Coryneform group*	10^8–10^{11}	10^3–10^8
Bacillus spp.**	$\geq 10^{12}$	$\geq 10^8$
Serratia spp., *Proteus* spp.		
Pseudomonas spp.		
Micrococcus spp.	≥ 10	$\geq 10^9$
Lactobacillus spp.		

*Based on 90 out of 158 isolates.
**Based on 30 out of 45 isolates.

The histopathological changes (Table 70.3) are evident for a nuclear viral infection of the pest. Similar symptoms of other nuclear infections by

Table 70.3: Histopathological characters of different tissues and characters of virus-like structures

Tissue	*Histopathology*	*Virus structure*
Fore, mid-gut and hind gut, fat body and nerve tissue.	Nuclear hypertrophy, fragmentation of chromatin, vacuolisation in nucleus and cytoplasm.	Two types, hexagonal isodiametric with central core and capsid, and 7.8–13.7 nm (attached to nuclear membrane) and 0.30–0.33 μ in diameter.

entomoviruses are well documented (Burges, 1981; Burges and Hussy, 1971; Steinhaus, 1963). Presence of virus-like particles (Table 70.3) within the infected cells confirms the view.

However, sequence of development of the disease, possibility of simultaneous infection by virus and bacteria like that of flachire/gattine of *Bombyx mori* and the exact role of individual organisms requires further investigation.

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