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INVESTIGATIONS ON A NUCLEAR POLYHEDROSIS OF *Spodoptera mauritia* (BOISDUVAL) (NOCTUIDAE, LEPIDOPTERA)

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Bianchi (1957) reported for the first time the occurrence of a nuclear polyhedrosis on the larvae of S. *mauritia* in Hawaii. Jacob *et al.* (1973) reported widespread incidence of a nuclear polyhedrosis in populations of S. *mauritia,* a serious pest of paddy in Kerala. Detailed studies were undertaken on the symptomatology, larval susceptibility, cross-infectivity and nature of the causative agent of this disease, the results of which are reported in this paper.

Materials and Methods

The larvae used in these studies were reared in the laboratory on the common grass, *Ischemum aristatum* H. A purified suspension of the polyhedra in distilled water was used as the infective material. The larvae of different instars (see Table 1) were infected by feeding them on tender grass terminals with two leaves smeared with the polyhedral suspension containing (5×10^8 polyhedra/ml and 0.1 per cent teepol as wetting agent. Two larvae were released on each grass terminal. Control larvae were fed with grass leaves smeared with 0.1 per cent teepol only. After feeding for 24 hours, the larvae were transferred to fresh grass and reared individually. All experiments were conducted at room temperature and humidity.

Susceptibility determinations were based on incubation period and larval mortality due to the virus infection. Fifty larvae of each instar were used on the infection studies and control. Cross-transmission studies were made using 6 species of lepidoterous larvae as shown in Table 2. The larvae were fed on leaves of their respective host plants contaminated with the suspension of polyhedra infecting S. *mauritia* For the studies on the dissolution of polyhedra in alkali solutions a drop of the polyhedral suspension was put on a clean microscopic slide and dried in the air. The slides were then dipped in the alkali solutions of different concentration for varying periods (see Table 3 for details) and were then examined under a binocular research microscope at a magnification of 450x for the presence or absence of polyhedra.

Results and Discussion

Signs and symptoms: Initial signs of infection were visible 2 to 3 days after the ingestion of the virus, the larvae infected in the early instars assuming a greenish yellow colour and those in the later instars a pinkish colouration. The pink colour was more prominent on the lateral and ventral aspects of the body. Similar colour changes were observed in *Prodenia praefica* by Steinhaus (1960) and *Spodoptera litura* by Jacob and Subramaniam (1972). Steinhaus (*loc cit.)* suspected such colour changes to be due to accumulation of pink granules in the clear areas of the integument.

The infected larvae of S, *mauritia* gradually lost their appetite and stopped feeding 2 to 3 days prior to death. At death the cuticle was very fragile and easily broken liberating the liquefied body contents. Death occurred in 2 to 8 days. The dead larvae were found either hanging head downwards or lying over the leaves or other surfaces. Dissection of the infected larvae showed that the fat body was opaque - white in appearance. The body fluid was clear in the initial stages, turning turbid as the infection advanced.

Larval Susceptibility: The incubation period and percentage mortality of larvae of different instars are presented in Table 1. It will be seen that the susceptibility decreased with age, the second, third and fourth instars being highly susceptible. Variations in susceptibility to virus infection due to age of the host larvae have been reported earlier also. (Morris 1962; Tanada 1956; Jacob and Subramaniam 1972 b). Though such increase in resistance to the infection corresponding with the growth of larva is regarded by some authors (Tanada 1956) as a maturation immunity, Ignoffo (1966) has attributed this partly to the normal increase in body weight which in turn dilutes a constant virus dose.

Table 1

Incubation period and mortality of different larva! instars of *S mauritia* fed with nuclear polyhedrosis virus

Stage of larvae at treatment	Incubation period in days		Percent mortality due to virus
	Range	Mean	
Second instar	2—4	3.0	100
Third instar	2—5	3.1	100
Fourth instar	5—7	5,8	92
Fifth instar	5—7	6.2	76
Sixth instar	7—9	7.7	14

Note: There was no mortality in control

Table 2

Cross-infectivity of NPV of S. *mauntia* to alternate host larvae

Alternate host larvae	Stage of larvae at inoculation	No. of larvae inoculated	Mortality due to NPV	Mortality due to Others	Infectivity
Spodoptera litura	Fourth instar	50	Nil	4	— ve
Achoea janata	Third ,,	40	,,	—	— ve
Plusia signata	Third ,,	50	,,	—	— ve
Pericallia ricini	Second ,,	50	,,	2	— ve
Diachisia obliqua	Third ,,	50	,,	10	— ve
Papilio demoleus	Third ,,	30	,,	4	— ve

Cross-infectivity of the virus Results presented in Table 2 show that the NPV of S. *mauntia* was not infective to the 6 species of larvae under test. A high degree of host specificity is a characteristic of many insect viruses. However successful cross transmission of nuclear polyhedrosis viruses have been reported in a few instances (Steinhaus 1953; Smirnoff 1962; Aizawa 1962). The host specificity of NPV of S. *mauntia* could be established only after testing further its infectivity on a large number of species.

The Causative agent: Examination of the virus under electron microscope showed that the polyhedra (Fig 1) were irregular in shape and varied considerably in size. The diameter ranged from 440 to 1760 $m\mu$ with an average of 1130 ± 5.7 $m\mu$. Tanada (1960) had recorded larger polyhedra from *S. mauritia* which varied in diameter from 1.7 to 3.22 μ. Polyhedra recorded from S. *litura* were also larger in size being 1.2 to 2.8 μ in diameter (Jacob and Subramoniam 1972 a). The polyhedra of the present studies showed no surface patterns and the virus rods occurred singly and in bundles within the polyhedra (Fig. 2).

Alkali resistance of the polyhedra: The extent to which different alkali solutions bring about dissolution of polyhedra in different periods of immersion is given in Table 3. It shows that 0.1 per cent KOH and NaOH dissolved the polyhedra in 3 minutes while 0.2 per cent solutions of both did it in one minute. With 5 and 10 per cent Na_2CO_3 dissolution of polyhedra was achieved after immersion for 10 and 2 minutes respectively. It is known that polyhedra from different insects differ in their resistance to various alkalies. Brown and Swaine (1965) reported that 2 per cent Na_2CO_3 was ineffective in dissolving the polyhedra of *Spodoptera exempta.* Pawar and Ramakrishnan (1971) observed that 5 and 10

Table 3

Effect of alkali on polyhedra of S. *mauritia*

Time (Minute)	KOH (%) 0.1	KOH (%) 0.2	NaOH (%) 0.1	NaOH (%) 0.2	Na2 CO3 (%) 5.0	Na2 CO3 (%) 10.0
1	+	—	+	—	+	+
2	+	—	+	—	+	—
3	—	—	—	—	+	—
5	—	—	—	—	+	—
10	—	—	—	—	—	—

+ Polyhedra present - Polyhedra absent

per cent Na_2CO_3 required 30 and 20 minutes respectively to dissolve the polyhedra of *Prodenia litura*. The present observations show that polyhedra of S. *mauritia* are less resistant to Na_2CO_3 treatment than those of S. *exempta* and P. *litura.* These results also point out that glasswares and other utensils can be effectively sterilized against the virus by treatment with 0.2 per cent KOH or NaOH for a few minutes.

Summary

The symtomatology, larval susceptibility, cross - infectivity and nature of the causative agent of a nuclear polyhedrosis of the rice swarming caterpillar, *Spodoptera mauritia* (Boisduval) were studied. The infected larvae showed the typical symptoms of nuclear polyhedrosis. The second, third and fourth instar larvae were highly susceptible to the infection while the fifth instar larvae showed slight resistance; the sixth instar larvae were highly resistant. The virus was not infective to the larvae of *Spodoptera litura* , *Achoea Janata, Plusia signata, Diacrisia obliqua* (Walker), *Pericallia ricini* F. and *Papilio demoleus.* Examination of the virus under electron microscope showed that the polyhedra were irregular in shape and measured on an average 1130 ± 5.7 m μ in diameter. Virus rods occurred singly and in bundles. The inculsion bodies dissolved completely when treated with 0.2 per cent KOH or NaOH for one minute and with 0.1 per cent solution for 3 minutes. In 5 and 10 per cent Na_2CO_3 the polyhedra required 10 and 2 minutes respectively for dissolution.

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സംഗ്രഹം

നെല്ലിലെ കരിങ്കററിപ്പുഴുവിനെ (സ്പോഡോപ്റ്ററാ മൊറിഷ്യ) ബാധിക്കുന്ന ന്യൂക്ലിയാർ പോളിഹെഡ്രോസിസ് എന്ന വൈറസ് രോഗത്തെപ്പററി വിശദമായ ഒരു പഠനം നടത്തി. രോഗബാധയേററ പുഴു രോഗത്തിന്റെ എല്ലാ മാതൃകാലക്ഷണങ്ങളും പ്രദർശിപ്പിക്കുകയുണ്ടായി. ഈ രോഗബാധ ഏററവും രൂക്ഷമായി കണ്ടത് പുഴുവിന്റെ rosn^^imroi നാലുവരെ ഇൻസ്റ്റാറുകളിലാണ്. അഞ്ചാം ഇൻftc^ooT ലാകട്ടെ രോഗബാധയുടെ രൂക്ഷതതന്നെ കുറയുകയും ആറാം ഇൻസ്റ്റാർ ആയപ്പോഴേയ്ക്കും പുഴു വളരെ കൂടുതൽ രോഗപ്രതിരോധശക്തി പ്രദർശിപ്പിക്കുകയും ചെയ്തു. ലപ്പിഡോപ്റ്ററാ ഗോത്രത്തിൽ പെട്ട മററു ചില പുഴുക്കളിൽ ഈ വൈറസ് ഉപയോഗിച്ച് കൃത്രിമമായി രോഗം ഉണ്ടാക്കുവാൻ നടത്തിയ ശ്രമങ്ങൾ വിജയിച്ചില്ല. വൈറസ് ദണ്ഡുകൾ ഉൾക്കൊള്ളുന്ന പോളിഹെഡ്ര 0.2 ശതമാനം പൊട്ടാസിയം ഹൈഡ്രോക്സയിഡ്, സോഡിയം ഹൈഡ്രോക്സയിഡ് എന്നീ ലായിനികളിൽ ഒരു മിനിററിനുള്ളിൽ പൂർണ്ണമായും അലിയുമെന്നു കണ്ടു. കൂടാതെ 5 ശതമാനവും 10 ശതമാനവും സോഡിയം കാർബണേററ് ലായിനി ഉപയോഗിച്ചാൽ യഥാക്രമം 10 മിനിററിലും *2* ffilrrfloolejo പോളിഹെഡ്രാ അലിഞ്ഞുനശിക്കുകയുണ്ടായി. ഇലക്ട്രോൺ മൈക്രോസ്കോപ്പ് ഉപയോഗിച്ചു നടത്തിയ പഠനത്തിൽ ഈ വൈറസിന്റെ സ്വഭാവ വിശേഷങ്ങൾ മനസ്സിലാക്കി. പോളിഹെഡ്രാ ക്രമരഹിതമായ ആകൃതിയോടുകൂടിയതും ശരാശരി 1130 $\pm$ 5.7 $m\mu$ വ്യാസം ഉള്ളതുമാണ്. വൈറസ് ദണ്ഡുകൾ ഒററയായും കൂട്ടത്തോടെയും കാണുകയുണ്ടായി.

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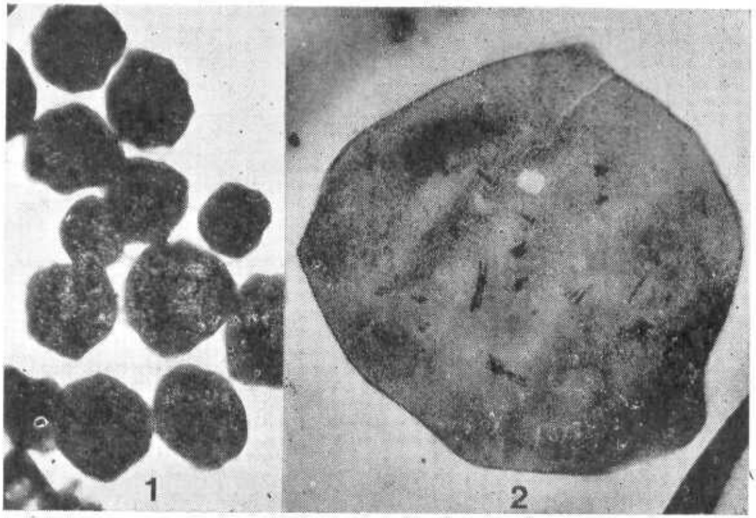

Fig. I. Electron micrograph of polyhedra from *Spodoptera mauritia.* x 11325

Fig. 2. Electron micrograph of section of a polyhedron showing occluded virus rods. x 29675

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