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Influence of Nuclear Polyhedrosis on Larval Growth, Moulting and Food Consumption of *Spodoptera litura* F

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ABSTRACT

Results of investigations on the influence of a nuclear polyhedrosis on growth, moulting and food consumption of the tobacco caterpillar, *Spodoptera litura*, are presented. Assessment of the length and weight of larvae revealed that virus infection caused a retardation of growth after three days following infection. Moulting in the later stages of the disease was inhibited The virus infection appeared first to increase and later to decrease food intake leading to complete cessation of feeding. The absolute quantity of food consumed by the infected larvae after the ingestion of the virus was markedly lower.

INTRODUCTION

Insect viruses generally require comparatively long periods to cause mortality of affected larvae and in some cases the target insects cause considerable damage to the crop during this interval. However, in many instances the virus diseased larvae exhibit loss of appetite and retardation of growth and on this account considerable reduction in crop losses are often possible. Hence quantitative information on the food consumption and growth rate of infected larvae is essential in the evaluation of a viral pathogen for biological control purposes. The present investigations were carried out to gather information on the food consumption and growth of the larvae of *Spodoptera litura* infected with nuclear polyhedrosis.

MATERIALS AND METHODS

Early fourth-instar larvae reared in the laboratory on castor (*Ricinus communis* L.) foliage were used in all the experiments. The larvae were inoculated with 10^5 polyhedra each by spot feeding technique. In studies on moulting, two dosages viz., 10^3 and 10^5 were administered to 50 larvae each. Control larvae were fed on uncontaminated leaf discs but otherwise treated in the same way. Observations were taken at intervals of 1, 2, 3, 4 and 5 days after inoculation.

Twenty five larvae each in control and treated group were kept individually in labelled plastic containers. The length of larvae at various intervals was measured with a plastic scale. The statistical 't' analysis was used to com-

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pare the differences between means. Thirty larvae each were selected at random from control and treated group at each interval. The larvae were weighed after dividing them into groups of 10 each in weighing bottles. Each group was then dried separately to constant weight in a hot air oven maintained at 100°C and the moisture percentage worked out. The data were subjected to analysis of variance technique.

Food consumption was ascertained by measuring the area of castor leaf consumed by individual larva. Twenty five larvae each from control and treated group were kept individually in wide mouthed glass battery jars. Each larva was provided with a single whole leaf of castor, the original contour of which had been previously marked on a metric graph paper. After feeding for 24 hr, the larvae were transferred to fresh leaves. The area of leaf consumed was measured with the aid of the graph paper on which the outlines had been marked earlier. Statistical 't' analysis was used to compare the differences between means.

RESULTS AND DISCUSSION

During the first and second days following inoculation the virus-infected and the healthy larvae did not show any difference in length. But on the third day the infected larvae were significantly longer than healthy ones. However, on the fourth and fifth days, they were markedly shorter than the healthy ones (Table 1). The data further revealed that diseased larvae did not increase in length after three days following infection. The weight of virus-infected

TABLE 1. Mean larval length, weight and moisture content of healthy and virus-infected tobacco caterpillars

Post-inoculation period (days)	Mean larval length (mm) ± S. E.		Mean larval weight (mg)		Moisture content (%)	
	Healthy	Virus-infected	Healthy	Virus-infected	Healthy	Virus-infected
1	14.56 ± 0.63	14.12 ± 0.14	49.46	43.39	87.86	86.80
2	18.60 ± 0.33	17.92 ± 0.28	127.45	123.83	86.70	86.30
3	24.04 ± 0.30	25.72 ± 0.33	234.77	254.51	87.67	86.10
4	30.48 ± 0.60	25.76 ± 0.54	584.83	360.70	86.97	86.30
5	37.48 ± 1.18	25.66 ± 0.59	997.69	326.77	84.80	84.33
CD (P = 0.05)			55.63			

larvae was significantly lower than the healthy ones on the fourth and fifth days following infection. The moisture content of healthy and infected larvae did not show any marked difference though it had always been slightly higher in the former. It is also interesting to note that the weight gain in infected larvae after three days of infection was conspicuously less than that in healthy larvae of the same age. These observations reveal that the growth of larvae was evidently retarded or prevented after 3 days following infection. The external signs of infection also were clearly visible during that period. Histopathological observations by the authors (unpublished) revealed that almost all the susceptible tissues were infected by three days. This resulted in the breakdown of normal physiological mechanisms and consequent retardation of growth. Drake and McEwen (1959) also observed that the weight gain was less in virus-infected cabbage loopers than in healthy larvae.

Table 2 shows that the virus infection did not influence the moulting that normally occurred within two days after the initiation of the test. But the subsequent moulting which generally occurred within the next two days was interferred by the infection. Only some larvae, which escaped the infection, moulted to the sixth instar. The remaining larvae failed to moult and died of polyhedrosis after being alive for over two days beyond the normal period of this moult.

The results thus show that the virus infection caused a disturbance in

TABLE 2. Effect of virus infection on the moulting of tobacco caterpillars infected in the fourth instar

Dose of Polyhedra/larva	No. of larvae	No. of larvae moulted to		No. of larvae died of virus infection
		fifth instar	sixth instar	
10^5	50	50	21	29
10^4	50	50	1	49
Control	50	50	50	—

the moulting process towards the later stages of the disease. It it now known that moulting and metamorphosis in insects are under hormonal control. Histopathological studies of *S. litura* nuclear polyhedrosis by the authors (unpublished) revealed that hypodermis was fully infected and the brain, nerve ganglia and neurilemma of nerves were moderately infected within 3 days following inoculation. Infection of these nerve structures would likely affect the hormonal balance because these are the tissues which regulate the activity of corpora allata through the neurosecretary system (Scharrer and Scharrer, 1963). Observations by Morris (1970) also indicated that the virus infections may affect the hormonal balance and timing of hormone activity. Moreover the hypodermis which had been inactivated by the virus infection would not respond to activation by the prothoracic glands for the deposition of a new cuticle. Vago (1950, 1956) also observed that nuclear polyhedrosis virus

at the incipient stages of pathogenesis caused moulting disturbances.

The present observations suggest that the virus infection brought about moulting disturbances in insect larvae possibly through an interference in the hormonal balance and / or inactivation of the hypodermis.

Table 3 gives the rate of food consumption by the test insects. During the second day following inoculation virus-infected larvae appeared to eat more than the non-infected insects. It could be that, to counteract the heavy demands forced upon the larvae by the

TABLE 3. Area of castor leaf consumed by healthy and virus-infected tobacco caterpillars

Post-inoculation period (days)	Leaf area consumed (mm^2) ± S. E.	
	Healthy	Virus-infected
1	294.20 ± 15.47	297.00 ± 21.89
2	344.00 ± 25.95	705.50 ± 83.01
3	1118.10 ± 438.02	1122.75 ± 254.2[illegible]
4	2055.10 ± 32.58	885.50 ± 401.74
5	5314.75 ± 313.52	

active viral synthesis, they were attempting to consume more food. Drake and McEwen (1959) observed that cabbage loopers infected with a nuclear-polyhedrosis virus consumed more food than the healthy ones during the first and second days following infection. On the fourth day the diseased larvae consumed significantly less food than the healthy ones and ceased to feed on the fifth day. The retardation in feeding from the third day onwards may be due to the disturbance in the normal physiological functions caused by the viral infection. It is also seen that the infected larvae consumed only one third the quantity of leaf fed to the healthy larvae during the period of five days. These observations indicate that though it takes five to six days for infected caterpillars to die, the level of damage caused to the crop by them will be considerably lower than that by the healthy larvae. This is an important consideration in utilizing this pathogen in the biological control of tobacco caterpillar.

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