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Consumption, digestion and utilization of sunflower leaves by *Helicoverpa armigera* (Hübner) treated with nuclear polyhedrosis virus*

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ABSTRACT: Effect of three doses of nuclear polyhedrosis virus *viz.*, 5.40 x 10^8, 5.40 x 10^5 and 5.40 x 10^3 polyhedral occlusion bodies (POBs/ml) on consumption, digestion and utilisation of sunflower leaves by 8 days old larvae of *Helicoverpa armigera* (Hübner) was studied for a period of 5 days. The food intake, faecal matter production and weight gain of virus-fed larvae were significantly lower than those of healthy ones on the fourth and fifth day of inoculation and showed dose-dependent tendency. There was weight gain by both control and virus-fed larvae up to third day, after which the virus-fed larvae lost weight in contrast to gain in weight by control larvae. The approximate digestibility did not show effect due to virus infection. The growth rate, gross and net efficiency of food utilisation were altered during the virus infection.

KEY WORDS: Approximate digestibility, consumption index, gross efficiency, growth rate, *Helicoverpa armigera*, net efficiency, nuclear polyhedrosis virus

Sunflower has become popular due its photo-insensitivity, short duration and its adaptability to different agroclimatic conditions. Among the insect pests affecting sunflower, *Helicoverpa armigera* (Hübner) causes damage to developing seeds and ultimately affects the crop yield (Thontadarya and Jayaramaiah, 1973). Among the various control agents, the nuclear polyhedrosis virus is found effective in the management of this pest on various crops including sunflower (Jayaraj *et al.*, 1985; Rabindra, 1985). Most of the studies on NPV related to the control aspect, very

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scanty published information is available on the effect of different doses of nuclear polyhedrosis virus on the growth parameters of the larvae. It was, therefore, felt necessary to undertake the present investigation.

MATERIALS AND METHODS

For this study, larvae of *H. armigera* were obtained from the laboratory culture. The freshly hatched larvae transferred with the help of sterile camel hair brush on sunflower leaves and reared for 8 days. Eight day old larvae of the same size were taken for the experiment. The experiment was conducted under the laboratory conditions in the Department of Agricultural Entomology, Mahatma Phule Krishi Vidyapeeth, Rahuri during 1986-87. The larvae were kept individually in plastic containers (3 x 0.5 cm) to avoid cannibalism. The larvae were starved for 6 h before feeding treated leaves. Three concentrations of the virus *viz.*, 5.40×10^8 (V_1), 5.40×10^5 (V_2) and 5.40×10^3 (V_3) polyhedral occlusion bodies (POBs) were used. One ml of each concentration of virus was smeared with the help of sterile camel hair brush on the sunflower leaves (3 x 3 cm). For control treatment (V_0), one ml of distilled water was used for smearing the leaves. The leaves and larvae were weighed individually. The treated and untreated leaves were fed to the larvae for 24 h. Unconsumed food and faeces were removed and weighed at an interval of 24 h and at the same time weight of larvae was also taken. Each treatment was replicated thrice using 5 larvae replication.

The experiment was conducted at 27 ± 2°C. The leaves were kept in a desiccator to avoid moisture loss. During experiment the larvae, food introduced, unconsumed food and faecal matter were dried at 80°C in hot air oven and weighed at an interval of 24 h. The observations were confined to a period of 5 days after which virus-fed larvae started dying with pronounced disease symptoms.

The indices of consumption, digestion and utilisation *viz.*, consumption index (C. I), growth rate (G. R.), approximate digestibility (A. D.), gross efficiency (E. C. I.) and net efficiency (E. C. D.) were calculated on dry weight basis following the method of Waldbauer (1968).

RESULTS AND DISCUSSION

Food intake, food balance, faecal matter

The food intake was almost the same in both NPV treated and control larvae for the first 3 days (Table 1). On fourth day, however, there was reduction in food intake in larvae feeding on virus treated leaves. The reduction was directly dependent on the dose of the virus. Significant reduction of food intake was observed on fifth day in the virus-fed larvae i. e., 0.176g (V_1), 0.181g (V_2), 0.203g (V_3) and 0.261g (V_0). In the food balance, there was not much difference between control and virus-fed larvae for the first two days. The food balances were found to be more in virus-fed larvae from third day onwards. The faecal matter production was comparatively more in control than the virus-fed larvae.

Table 1. Effect of NPV on food intake, excretion and balance/larva/day (values expressed in g)

Treatment (POBs/ml)		Days					
		1	2	3	4	5	Total
V_0 (Control)	Intake	0.182	0.192	0.210	0.253	0.261	1.098
	Excretion	0.007	0.011	0.013	0.015	0.018	0.064
	Balance	0.175	0.181	0.197	0.238	0.243	1.034
Virus 1 (5.40×10^8)	Intake	0.172	0.192	0.220	0.196	0.176	0.956
	Excretion	0.006	0.010	0.014	0.012	0.011	0.053
	Balance	0.166	0.182	0.206	0.184	0.165	0.9 03
Virus 2 (5.40×10^5)	Intake	0.172	0.189	0.220	0.212	0.181	0.974
	Excretion	0.007	0.010	0.014	0.013	0.011	0.055
	Balance	0.165	0.179	0.206	0.199	0.170	0.919
Virus 3 (5.40×10^3)	Intake	0.172	0.189	0.229	0.219	0.203	1.012
	Excretion	0.007	0.011	0.013	0.013	0.012	0.056
	Balance	0.165	0.178	0.216	0.206	0.191	0.956

Consumption index

Data presented in Table 2a revealed that the differences in mean C. I. values due to virus doses and days were statistically significant. The highest dose of virus was found to reduce the C. I. The lowest mean of C. I. (1.77) was noticed in the highest virus dose which was significantly lower than the other doses. As regards the effect of days, the mean C. I. of 1.22 was recorded on the fifth day which was significantly lower than that in the remaining days even at one per cent level of significance.

Growth rate

The differences in mean growth rate (G. R.) due to virus doses and days were statistically significant. The virus doses found to reduce the G. R. and this reduction indicated dose dependent tendency. The lowest mean G. R. of 0.18 was observed in the highest dose of virus which was significantly lower than other doses of virus. When effect of period on G. R. was considered, decline in mean G. R. on the subsequent days was observed. The mean G. R. of 0.87 was noticed on fifth day which was significantly lower than in the rest of the days.

The interaction of virus dose x days was statistically significant. On fourth and fifth day highest dose of virus recorded significantly lower G. R. than that in the remaining doses.

Approximate digestibility

The differences in mean A. D. due to virus doses and period were statistically significant (Table 2b). In respect of period, it was noticed that the mean A. D. declined on the subsequent days. The minimum A. D. (93.33%) was recorded on fifth day

which was significantly lower than that in the remaining days.

The interaction of virus doses x days though was statistically significant no definite trend was observed.

Efficiency of conversion of ingested food

It was observed that the differences in mean E. C. I. due to virus doses and period were statistically significant (Table 2b). E. C. I. was recorded signifianctly lower (9.16%) when larvae were fed with highest virus dose. The highest E. C. I. of 12.76 per cent was recorded in the control. As regards period, there was drastic reduction in mean E. C. I. on fourth and fifth days. The interaction of virus dose x period was statistically significant.

Efficiency of conversion of digested food

The data presented in Table 2c revealed the significant differences in mean E. C. D. due to virus doses and period. The virus doses were found to reduce the E. C. D. and this reduction was dose dependent. The lowest E. C. D. of 9.81 per cent was noticed

Table 2a. Effect of NPV on *H. armigera* larval consumption index and growth rate on sunflower leaves

Day	V_0	V_1	V_2	V_3	Mean	
Consumption index (C. I.)						
1	2.58	2.54	2.57	2.67	2.56	SE for D = ± 0.011
2	1.92	2.03	2.07	2.16	2.05	CD (P=0.05) = 0.032
						CD (P=0.01) = 0.043
3	1.79	1.85	2.05	1.82	1.88	SE for V = ± 0.010
						CD (P=0.05) = 0.029
						CD (P=0.01) = 0.039
4	1.68	1.33	1.53	1.49	1.51	SE for V x D = ± 0.022
						CD (P=0.05) = 0.065
5	1.46	1.10	1.12	1.20	1.22	CD (P=0.01) = 0.087
Mean	1.88	1.77	1.86	1.86		
Growth rate (G. R.)						
1	0.35	0.33	0.30	0.32	0.32	SE for D = ± 0.039
2	0.19	0.25	0.26	0.30	0.25	CD (P=0.05) = 0.011
						CD (P=0.01) = 0.015
3	0.29	0.23	0.26	0.20	0.24	SE for V = ± 0.003
						CD (P=0.05) = 0.010
						CD (P=0.01) = 0.013
4	0.14	0.06	0.15	0.14	0.12	SE for V x D = ± 0.007
						CD (P=0.05) = 0.022
5	0.13	0.01	0.10	0.11	0.087	CD (P=0.01) = 0.030
Mean	0.22	0.18	0.21	0.21		

in highest dose of virus as against 13. 55 per cent in control. The period had significant effect on E. C. D. There was drastic reduction in E. C. D. on fourth and fifth day. The interaction of virus dose x days was statistically significant.

The food balance as well as faecal production are directly related to the amount of food intake and decrease in amount of these in NPV treated larvae may attributed to the reduction of feeding activity. In case of A. D., no effect was shown by virus disease.The highest weight gain in larvae was observed in control but the virus infected larvae in last two days showed negative weight gain.

The gross efficiency (E. C. I.) and net efficiency (E. C. D.) were found to be lower on fourth and fifth days in virus-fed larvae. The reduction in the efficiency of food utilisation to body matter was relatively more in virus-fed larvae than in control ones. In general, all the virus doses reduced the different indices and these reductions showed dose dependence except in case of approximate digestibility.

Table 2b. Effect of NPV on *H. armigera* larval approximate digestibility and gross efficiency on sunflower leaves

Day	V_0	V_1	V_2	V_3	Mean	
Approximate digestibility (A. D.)						
1	95.72	96.50	95.68	96.13	96.00	SE for D = ± 0.044
2	94.09	94.47	94.02	94.46	94.26	CD (P=0.05) = 0.182
						CD (P=0.01) = 0.244
3	93.58	93.42	93.49	94.03	93.63	SE for V = ± 0.057
						CD (P=0.05) = 0.163
						CD (P=0.01) = 0.218
4	93.84	93.56	93.69	93.84	93.73	SE for V x D = ± 0.128
						CD (P=0.05) = 0.363
5	93.03	93.17	93.79	93.76	93.33	CD (P=0.01) = 0.489
Mean	94.05	94.22	94.13	94.44		
Gross efficiency (E. C. I.)						
1	14.04	12.89	11.78	12.52	12.80	SE for D = ± 0.174
2	10.37	11.77	12.42	13.85	12.10	CD (P=0.05) = 0.496
						CD (P=0.01) = 0.632
3	17.06	12.06	13.62	10.88	13.40	SE for V = ± 0.155
						CD (P=0.05) = 0.444
						CD (P=0.01) = 0.593
4	12.29	7.64	10.05	10.00	9.99	SE for V x D = ± 0.348
						CD (P=0.05) = 0.993
5	10.04	1.47	8.41	9.81	7.43	CD (P=0.01) = 1.328
Mean	12.76	9.16	11.25	11.41		

Table 2c. Effect of NPV on efficiency of conversion of digested sunflower leaves by *H. armigera* larvae

Days	V_0	V_1	V_2	V_3	Mean		
Net efficiency (E. C. D.)							
1	14.75	13.35	12.31	13.02	13.36	SE for D = ±	0.161
2	10.84	13.02	13.21	14.65	12.93	CD (P=0.05) =	0.459
						CD (P=0.01) =	0.613
3	18.18	12.91	14.58	11.58	14.31	SE for V = ±	0.144
						CD (P=0.05) =	0.410
						CD (P=0.01) =	0.548
4	13.22	8.17	10.77	10.66	10.70	SE for V x D = ±	0.322
						CD (P=0.05) =	0.918
5	10.78	1.60	8.96	10.11	7.86	CD (P=0.01) =	1.227
Mean	13.55	9.81	11.96	12.00			

Narayanan (1979) reported similar results in case of *H. armigera* . The growth parameters i.e., consumption index, growth rate, approximate digestibility, gross efficiency, and net efficiency were lower in NPV-fed larvae.

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