EFFECT OF INDUCED RESISTANCE AND HOST PHENOLOGY ON THE SUSCEPTIBILITY OF HELIOTHINES TO BACULOVIRUS

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Abstract

The effect of induced resistance and host phenology of cotton (*Gossypium hirsutum* L.), velvetleaf (*Abutilon theophrasti* Medicus), Carolina geranium (*Geranium carolinianum* L.) on the larval susceptibility of *Helicoverpa zea* (Bodd.) and *Heliothis virescens* F. to *Heliothis zea* Nuclear Polyhedrosis Virus (HNPV) was studied. Induced resistance in cotton enhanced the *H. zea* and *H. virescens* larval susceptibility to HNPV. Host phenology of cotton, velvetleaf and Carolina geranium significantly ($P<0.05$) affected the larval susceptibility of both species to HNPV. *H. virescens* larvae was more susceptible to HNPV than the *H. zea* on cotton and Carolina geranium while *H. zea* was more susceptible to HNPV than *H. virescens* on velvetleaf.

Introduction

The bollworm, *Helicoverpa zea* (Bodd.) and tobacco budworm *Heliothis virescens* (F.) are major pests of cotton in United States (Stadelbacher 1979), *H. zea* alone can cause an estimated average annual loss up to $1 billion (Knipling & Stadelbacher 1983).

The phytochemical bases of induced resistance and their effect on the biology and larval growth of *H. zea* have been demonstrated in cotton (Guerra 1981, Bi *et al*. 1997), but no reports on induced resistance to *H. virescens* are available.

Hunter and Schultz (1993) have shown that induced resistance in oaks interferes with the effectiveness of LdNPV against the gypsy moth. No reports on the effects of induced resistance in cotton on the susceptibility of *H. zea* and *H. virescens* to HNPV are available. Effect of host phenology, particularly, the effect of feeding on the vegetative and reproductive tissues of cotton on the infectivity of HNPV to these species is not known. Information regarding the inter-specific variation on the larval susceptibility of *H. zea* and *H. virescens* to HNPV is not known.

Although for managing *H. zea* and *H. virescens* populations on cotton the importance of wild/alternate hosts has been emphasized (Stadelbacher 1981, Mueller *et al*. 1984), no report on the induced resistance or host phenology of the wild hosts on the larval susceptibility of these species to HNPV is available.

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In this report, the effect of induced resistance in cotton and two wild hosts, and the effect of phenology on the susceptibility of *H. zea* and *H. virescens* to HNPV is reported.

Materials and Methods

Induced Resistance Studies

Cotton (cv Stoneville 213) and velvetleaf were grown in 2000 ml plastic pots. Forty five to 60 day old plants were induced individually by infesting with laboratory cultured 24 h starved three 4th instar *H. zea* or *H. virescens* larvae for two days contained in 30 X 30 X 60 cm screen cages. Uninduced and induced foliage were brought to the laboratory to rear the neonates of the test insects to the 2nd instar.

Disks (3.50 mm dia.) were cut from the foliage of 2nd batches of uninduced or induced plants and virus was applied with a 0.1µl HNPV solution in 1% Triton X-100 (100 and 10 occlusion bodies/0.1µl). In the case of the non HNPV treated group, only 0.1µl of 1% Triton-X-100 was applied.

A bioassay arena with 25 cells was made by embedding a plastic grid in a petridish with a layer of agar-water. Dosed disks were placed individually in those cells and the larvae were allowed to feed on them for 24 h. Larvae were transferred and reared individually on the uninduced or induced foliage. Larval survival were recorded daily.

Host Phenology

Disks were cut from the vegetative (young leaves) and reproductive tissues (young squares) of cotton, velvetleaf and Carolina geranium and dosed with HNPV. After 24 h larvae were transferred into 30 mm plastic agar-cups containing either vegetative or reproductive tissues and reared for 10 days. Larval survival were recorded daily.

Inter-Specific Variation on Larval Susceptibility

Disks were cut from young cotton leaves, dosed with serial doses of HNPV. After 24 h larvae were transferred into 30 mm agar-plastic cups and reared on vegetative tissues for 10 days. Larval survival were recorded daily.

Results and Discussion

Effect of Prior Herbivory on Larval Mortality

HNPV-treated *H. zea* larvae reared on previously wounded foliage of cotton had 93.3% HNPV-related mortality as compared with 75.4% in unwounded foliage, and this mortality in wounded foliage was significantly ($P <0.05$) higher than unwounded foliage These mortality in velvetleaf was 82.9 and 77.6% in wounded and unwounded foliage, respectively, thus, prior herbivory on velvetleaf did not affect significantly on larval susceptibility to HNPV(Fig 1). HNPV-treated *H. virescens* larvae reared on previously wounded foliage of cotton had 51.7% HNPV-related

mortality as compared with 37.1% in unwounded foliage, and these mortality in wounded foliage was significantly ($P < 0.05$) higher than unwounded foliage. Again previous herbivory on velvetleaf did not affect susceptibility (Fig 2).

Effect of Host Phenology on Larval Mortality

HPNV-treated *H. zea* larvae reared on vegetative tissues of cotton, velvetleaf and geranium had 76.3, 71.6 and 98.8% HNPV-related mortality, respectively. as compared with 91.0, 48.7 and 59.5% in reproductive tissues. In cotton, mortality on reproductive tissues was significantly ($P < 0.05$) higher vegetative tissues while in velvetleaf and geranium mortality on vegetative tissues was significantly ($P < 0.05$) higher than reproductive tissues (Fig. 3). HNPV-treated *H. virescens* larvae reared on vegetative tissues of cotton, velvetleaf and geranium had 73.9, 61.9, and 65.8% HNPV-related mortality, respectively. as compared with 59.6, 39.9 and 66.8% in reproductive tissues. These mortality on vegetative tissues of cotton and velvetleaf was significantly ($P < 0.05$) higher than reproductive tissues but not on geranium(Fig. 4).

Inter-Specific Variation on Larval Susceptibility

In cotton, the LD_{50} for *H. zea* larvae was significantly higher ($P<0.05$) (89.4 OB/larva) than for *H. virescens* larvae (35.7 OB/larva). In geranium, the LD_{50} for *H. zea* larvae was also significantly higher ($P<0.05$) (38.6 OB/larva) than for *H. virescens* larvae (4.5 OB./larva). While in velvetleaf, the LD_{50} for *H. virescens* larvae was significantly higher ($P<0.05$) (30.0 OB/larva) than for *H. zea* larvae (8.7 OB/larva) (Table 1).

Summary

Induced resistance and host phenology of cotton and wild or alternate hosts significantly affected the larval susceptibility of *H. zea* and *H. virescens* to HNPV. Relative susceptibility of these species to baculovirus on these hosts varied.

References

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Table 1. Probit Analysis of Mortality of NPV-Treated Heliothine Larvae.

Species	LD_{50} (OB/Larva)	Slope (±SE)	95% Fiducial Limit	
Cotton				
H. zea	89.36	2.27 (0.29)	70.81	111.54
H. virescens	35.70	0.93 (0.12)	18.83	56.24
Velvetleaf				
H. zea	8.70	0.98 (0.12)	5.32	12.68
H. virescens	29.96	1.23 (0.14)	23.02	40.95
C. geranium				
H. zea	38.63	2.91 (0.29)	32.92	44.67
H. virescens	4.48	1.05 (0.18)	1.85	7.34

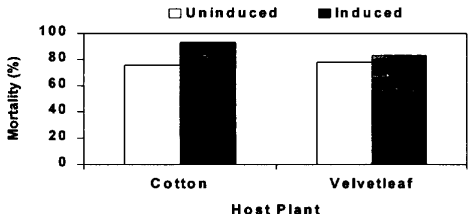

Figure 1. Prior Herbivory on Plants Affect Mortality of NPV-Treated *H. zea*

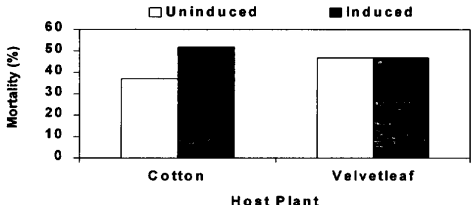

Figure 2. Prior Herbivory on Plants Affect Mortality of NPV-Treated *H. virescens*

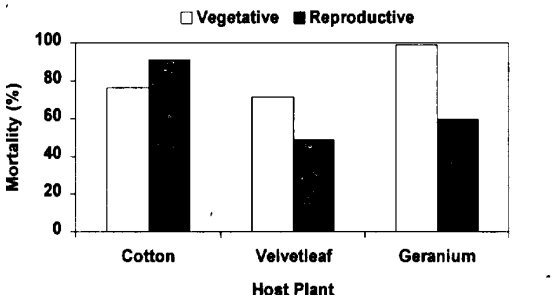

Figure 3. Host Phenology Affects Mortality of NPV-Treated *H. zea*

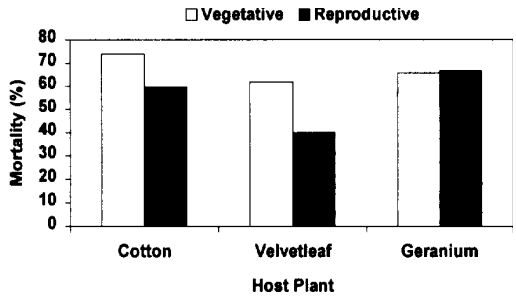

Figure 4. Host Phenology Affects Mortality of NPV-Treated *H. virescens*