

ACUTE TOXICITY AND TIME-DEPENDENT MORTALITY OF CHLORFLUAZURON AND TRIFLUMURON AGAINST SECOND-INSTAR PIERIS BRASSICAE (LEPIDOPTERA: PIERIDAE)

Samiya Sarwar Khan

Department of Entomology, University of Poonch, Rawalakot, Azad Jammu and Kashmir, Pakistan

DOI: <https://doi.org/10.5281/zenodo.23009509>

Keywords

insect growth regulator, cabbage butterfly, larval mortality, chitin synthesis inhibitor, laboratory bioassay

Article History

Received: 01 June 2026

Accepted: 23 August 2026

Published: 08 September 2026

Copyright @Author

Corresponding Author: *

Samiya Sarwar Khan

Abstract

The cabbage butterfly, *Pieris brassicae* (Linnaeus, 1758) (Lepidoptera: Pieridae), is an important defoliating pest of cruciferous vegetables. Laboratory bioassays were conducted during 2012–2013 to evaluate the acute toxicity of two insect growth regulators, chlorfluazuron and triflumuron, against second-instar larvae. A leaf-dip method was used with concentrations of 1, 3, 5 and 7%, and water-treated leaves served as the control. Forty larvae were exposed to each concentration, and mortality was recorded after 24, 48, 72, 96 and 120 h. Both compounds produced concentration- and time-dependent mortality. Chlorfluazuron mortality after 120 h was 73, 95, 98 and 100% at 1, 3, 5 and 7%, respectively. Triflumuron mortality after 120 h was 63, 93, 98 and 100% at the same concentrations. No mortality occurred in the control. The results show that both insect growth regulators were highly active against second-instar *P. brassicae* under the laboratory conditions used in this study, with mortality increasing as exposure duration and concentration increased..

1. INTRODUCTION

Pieris brassicae is a major lepidopteran pest associated with cabbage and other cruciferous crops. Larvae consume foliage and can cause substantial loss of photosynthetic tissue. Developmental biology of *P. brassicae* varies with host plant and environmental conditions, and laboratory studies have demonstrated substantial variation in developmental duration among cole crops (Ali and Rizvi 2007).

Insect growth regulators (IGRs) act on physiological processes involved in insect growth and development. Chitin synthesis inhibitors are particularly relevant to immature insects because successful molting requires formation of a functional new cuticle. Chlorfluazuron and triflumuron belong to the benzoylurea group of insect growth regulators. The biological consequences of chitin-synthesis inhibition

include abnormal development and mortality during or following molting (Cohen 2001; Tunaz and Uygun 2004).

The objective of this study was to quantify the time- and concentration-dependent mortality of second-instar *P. brassicae* exposed to chlorfluazuron and triflumuron under laboratory conditions.

2. Materials and Methods

2.1 Insect rearing and experimental design

The study was conducted in the Entomology Laboratory of the University of Poonch, Rawalakot, during 2012–2013. *P. brassicae* larvae were collected from cruciferous hosts and maintained on fresh cabbage and kale leaves. Second-instar larvae were used for the bioassays.

Fresh cabbage leaves were dipped in the respective treatment solutions for approximately 10 s and

allowed to dry for about 1–1.5 h. Ten larvae were placed in each Petri dish and four replicate dishes were used per concentration, giving 40 exposed larvae per concentration. Water-treated leaves were used as the control. Mortality was recorded at 24, 48, 72, 96 and 120 h. The thesis reports replacement of treated leaves after 72 h.

2.2 Mortality assessment

Larvae were considered dead when they showed no normal movement in response to gentle stimulation. Mortality percentages were calculated from the number of dead larvae divided by the number exposed. The thesis also analyzed concentration–mortality relationships by probit analysis; those results are presented in Manuscript 2.

3. Results

Mortality increased with both concentration and exposure duration for both compounds. The complete mortality dataset from the thesis is summarized below.

Treatment	Concentration	24 h	48 h	72 h	96 h	120 h
Chlorfluazuron	1%	30%	50%	63%	65%	73%
Chlorfluazuron	3%	53%	63%	75%	90%	95%
Chlorfluazuron	5%	73%	75%	80%	95%	98%
Chlorfluazuron	7%	75%	83%	90%	100%	100%
Triflumuron	1%	38%	50%	50%	55%	63%
Triflumuron	3%	73%	83%	83%	88%	93%
Triflumuron	5%	75%	88%	88%	95%	98%
Triflumuron	7%	88%	98%	98%	100%	100%

The control mortality was 0% at every observation period. At 24 h, triflumuron produced higher mortality than chlorfluazuron at every tested concentration. With longer exposure, the difference between compounds narrowed, and both compounds produced complete mortality at 7% by 96–120 h. At 120 h, chlorfluazuron produced 73–100% mortality across 1–7%, while triflumuron produced 63–100%.

4. Discussion

The laboratory bioassays demonstrate that both IGRs were strongly active against second-instar *P. brassicae*. The concentration- and time-dependent response is consistent with the delayed physiological effects expected from growth-regulating insecticides. Rather than interpreting mortality at a single observation time, the present results show that exposure duration materially influenced the observed response.

Triflumuron produced greater mortality during the earliest observation period at all four concentrations. By 120 h, however, chlorfluazuron produced slightly higher mortality at 1 and 3%,

while the two compounds produced almost identical mortality at 5 and 7%. This changing pattern illustrates why compound comparisons should be made at defined exposure times rather than from a single endpoint.

The results should be interpreted as laboratory toxicity data rather than as field-rate recommendations. Field efficacy depends on formulation, application rate, plant surface, temperature, humidity, larval age, and natural enemies.

5. Conclusion

Chlorfluazuron and triflumuron produced substantial mortality of second-instar *P. brassicae*. Mortality increased with concentration and exposure duration, and both compounds reached 100% mortality at the highest concentration after prolonged exposure. The findings support further evaluation of these IGRs under field conditions and within integrated pest-management programs.

REFERENCES

Abbott WS. 1925. A method of computing the effectiveness of an insecticide. *Journal of Economic Entomology* 18:265–267.

Ali A, Rizvi PQ. 2007. Developmental response of cabbage butterfly, *Pieris brassicae* L. (Lepidoptera: Pieridae) on different cole crops under laboratory and field condition. *Asian Journal of Plant Sciences* 6:1241–1245. doi:10.3923/ajps.2007.1241.1245.

Cohen E. 2001. Chitin synthesis and inhibition: a revisit. *Pest Management Science* 57:946–950. doi:10.1002/ps.363.

Finney DJ. 1971. *Probit Analysis*. 3rd ed. Cambridge University Press, Cambridge.

Tunaz H, Uygun N. 2004. Insect growth regulators for insect pest control. *Turkish Journal of Agriculture and Forestry* 28:377–387.

