IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

"STUDY OF PREDATORY EFFICIENCY AND COMPATIBILITY OF GREEN LACEWINGS AND LADYBIRD BEETLES AGAINST SUCKING PESTS ON AGRICULTURAL CROPS: A COMPREHENSIVE REVIEW"

[1] Rameshwar S. Wable, [2]Prof. Dr. S. D. Rathod,

[1]Research Scholar, [2]Professor

[1] Department of Zoology

[1] R.A. Arts, Shri M.K. Commerce and Shri S.R. Rathi Science College, Washim

(Affiliated to Sant Gadge Baba Amravati University, Amravati Maharashtra, India)

Abstract: Sucking pests (such as aphids, whiteflies, jassids, and thrips) are important agricultural pests that damage crops directly through sap feeding and indirectly through the transmission of plant diseases. Their rapid reproduction and ability to colonize crops make them difficult to manage solely through chemical control. Green lacewings (Neuroptera: Chrysopidae), particularly Chrysoperla species, and ladybird beetles (Coleoptera: Coccinellidae) are important natjural enemies of these sucking pests and have considerable potential for biological control. Green lacewing larvae are active predators commonly known as "aphid lions" but they aggressively feed on a variety of soft-bodied sucking insects. Similarly, both larval and adult stages of many ladybird beetles consume a wide range of sucking pests. Previous studies have demonstrated substantial pest suppression by both predator groups, although their effectiveness varies with predator species, developmental stage, pest density, crop, and environmental conditions. However, combining predators does not necessarily produce additive benefits because intraguild predation—the consumption of one predator by another—may occur. Therefore, evaluating both predatory efficiency and interspecific compatibility is essential before recommending combined releases.

Keywords: Sucking pests; aphids; whiteflies; biological control; green lacewing; ladybird beetle; Chrysoperla; Coccinellidae; predatory efficiency; intraguild predation; compatibility; agricultural crops.

1. Introduction

Sucking pests are economically important insect pests associated with many agricultural crops. They feed by inserting their piercing-sucking mouthparts into plant tissues and extracting plant sap. Heavy infestations may cause chlorosis, curling and distortion of leaves, reduced plant vigour and yield losses. Sucking pests can also contribute to the spread of plant viruses, increasing their importance in crop protection. Natural enemies therefore constitute an important component of sustainable pest management. (Diehl, E et al., 2013; Hewlett et al., 2019 ;Sharma, P.et al., 2022).

Among the natural enemies of sucking pests, ladybird beetles and green lacewings are particularly important. Predatory Coccinellidae are widely recognized for suppressing various soft-bodied insects, while green lacewing larvae, particularly Chrysoperla species, are active predators of aphids, whiteflies, thrips, and other sucking pests.(Obrycki et al., 2009 ; Frontiers in Insect Science 2025).

The presence of two or more predator species in the same crop can potentially improve biological control. However, predators may also interact negatively through competition and intraguild predation. Consequently, releasing two effective predators together does not automatically guarantee greater pest suppression. Compatibility between predator species should therefore be investigated under conditions that approximate the crop environment. (Noppe et al., 2012 ; Insects, 11(5), 288)

2. Sucking Pests as Agricultural Pests

Sucking pests include diverse groups such as aphids, whiteflies, jassids, thrips, and mealybugs, occurring on a wide range of cultivated plants. Their high reproductive capacity enables populations to increase rapidly under favourable conditions. Pest abundance is influenced by temperature, host-plant quality, crop growth stage and natural-enemy activity. (Diehl, E. et al., 2013 ; Sharma, et al., 2022).

These insects are suitable prey for many predatory insects because they are small, mostly soft-bodied and frequently occur in colonies. Their aggregation on young shoots and leaves can facilitate predator detection and consumption. (Riddick et al., 2017).

Predator effectiveness cannot be judged solely from the number of pests consumed in laboratory experiments. Crop architecture, prey distribution, predator movement, temperature and interactions with other organisms may substantially alter predation under field conditions .(Diehl et al., 2013 ;GSHJ 2025).

3. Green Lacewings as Predators of Sucking Pests

Green lacewings belong primarily to the family Chrysopidae. Species of Chrysoperla are widely recognized as beneficial predators. The larval stages are predatory, whereas adults of many species primarily feed on nectar, pollen and other non-prey resources.

The larvae of Chrysoperla are commonly called “aphid lions” because of their active predatory behaviour, but they feed broadly on many sucking pests. They attack prey using their sickle-shaped mouthparts and consume their body contents. Chrysoperla larvae are capable of feeding on numerous sucking pest species, including whiteflies and jassids, and other soft-bodied arthropods. (Khan et al., 2012).

Predatory performance varies with larval instar. Older larvae generally have a greater capacity for prey consumption because of their larger body size and increased energy requirements. Consequently, studies comparing lacewing predation should record the developmental stage of the predator. Furthermore, recent research in 2025 indicates that the nutritional quality of the prey significantly affects the developmental time, survival rate, and fecundity of Chrysoperla carnea larvae .(Frontiers in Insect Science 2025).

4. Ladybird Beetles as Predators of Sucking Pests

Ladybird beetles, family Coccinellidae, are among the best-known natural enemies of sucking pests. Both larvae and adults of many species consume substantial numbers of aphids, whiteflies, and scale insects.(Obrycki et al., 2009;Dixon, A. F. G. 2000).

A review of ladybird-based pest control reported substantial population reduction in many greenhouse studies. (Riddick, E. W. 2017), although effectiveness varied among species and release conditions. Recent advancements highlight that their alkaloid-based chemical defenses and predatory behaviours make them essential for Integrated Pest Management (IPM), with genomic studies further exploring their resilience to environmental stressors .(GSHJ 2025).

Ladybird predation is influenced by predator species, developmental stage, prey density, temperature, plant architecture and predator mobility. Adults may disperse among plants, while larvae remain more closely associated with localized prey colonies.

The biological-control value of Coccinellidae is therefore not simply a function of individual consumption rate. Establishment, reproduction, searching ability and survival in the crop also influence practical effectiveness.

5. Comparative Predatory Efficiency

The predatory efficiency of green lacewings and ladybird beetles can be compared using the number of sucking pests consumed per predator per day, percentage reduction in pest population, predator survival, predator development, functional response, searching efficiency, prey preference and reproductive performance.

Experimental evidence demonstrates that the relative effectiveness of the two predator groups can change according to pest density. A study involving sucking pests found that both ladybird beetles and lacewings suppressed the populations, while some Coccinellidae species showed stronger suppression at higher prey densities than Chrysoperla larvae. (Hewlett et al., 2019).

This indicates that predatory efficiency should be measured across several pest densities rather than at only one prey density.

6. Factors Affecting Predatory Efficiency

6.1 Predator species – Different species of lacewings and ladybird beetles differ in prey preference, feeding rate, searching behaviour and tolerance to environmental conditions.

6.2 Predator developmental stage – Larval stage is particularly important in lacewings, while both larval and adult stages are relevant for ladybird beetles.

6.3 Pest density – Predator response changes with prey availability. Higher pest density can increase encounters between predators and prey, although extremely high prey densities may not always be efficiently suppressed.

6.4 Temperature – Temperature influences predator movement, feeding, development and reproduction, affecting overall biological control (Diehl et al., 2013). Consequently, laboratory predation rates may not always translate directly to field conditions.

6.5 Host plant and crop architecture – Plant morphology, leaf structure and dense foliage can influence predator searching ability and predator–prey encounters (Diehl et al.,2013).

7. Compatibility Between Green Lacewings and Ladybird Beetles

Compatibility is particularly important when two predators are considered for simultaneous use. Although both predator groups feed on sucking pests, they may interact directly. Such interactions are known as intraguild predation (IGP), where one predator consumes another predator that shares the same prey resource.

Research on Chrysoperla carnea and Hippodamia variegata demonstrated intraguild predation between the two predators, with interactions influenced by pest density, predator developmental stage and experimental arena complexity. Insect, 11(5), 288. Increasing pest density reduced the intensity of intraguild predation.

Another study involving Coleomegilla maculata and Chrysoperla carnea found that predator combinations did not necessarily produce the greatest pest suppression (Noppe et al., 2012). The frequency and direction of intraguild predation changed with predator developmental stage and experimental conditions.

Therefore, compatibility should not be assumed simply because both organisms are beneficial insects.

8. Effect of Intraguild Predation on Biological Control

Intraguild predation can have contrasting effects. Predators may complement one another by occupying different parts of the plant or attacking different prey stages, potentially increasing pest suppression. Conversely, one predator may consume the other predator, reducing the total predator population available to attack sucking pests (Noppe et al., 2012).

The objective of a combined biological-control strategy should therefore be to identify predator combinations that maximize pest suppression while minimizing harmful predator–predator interactions.

9. Importance of Pest Density

Pest density is an important factor determining compatibility between lacewings and ladybird beetles. When sucking pests are abundant, predators have greater access to their preferred prey, potentially reducing encounters between predators. Experimental research showed that increasing extraguild prey density reduced the intensity of intraguild predation.Insects, 11(5), 288.

This suggests that higher pest availability may improve compatibility between green lacewings and ladybird beetles by reducing the need for predators to attack one another. This hypothesis should be tested experimentally for the particular species and crop system under investigation.

10. Scope for Combined Biological Control

Green lacewings and ladybird beetles have complementary characteristics that make them promising candidates for biological control in agroecosystems .(Obrycki et al., 2009). Both can attack sucking pests, but their behaviour, development and prey-searching strategies differ.

A successful combined-control strategy could involve pest infestation followed by predator release or conservation, with lacewing and ladybird predation contributing to reduced pest populations and crop damage.

However, compatibility testing is essential because intraguild predation may reduce the effectiveness of combined releases. The literature therefore supports evaluating the two predator groups both individually and in combination rather than assuming their effects will be additive.

11. Proposed Parameters for a Thesis Experiment

Suggested treatments:

T1 – Sucking pests only (control)
T2 – Sucking pests + green lacewing
T3 – Sucking pests + ladybird beetle
T4 – Sucking pests + green lacewing + ladybird beetle
T5 – Green lacewing + ladybird beetle (without pests, to observe intraguild predation)

Suggested observations:

1. Initial pest population
2. Sucking pests remaining after 24, 48 and 72 hours
3. Number of pests consumed
4. Predator survival
5. Predator–predator encounters
6. Intraguild predation
7. Percentage pest reduction
8. Predator developmental stage
9. Crop/plant damage
10. Relative predatory efficiency

$$\text{Predatory efficiency (\%)} = \frac{(\text{Initial pest population} - \text{Final pest population})}{\text{Initial pest population}} \times 100$$

For a thesis, appropriate statistical analysis should be used rather than relying only on percentages.

12. Research Gap

Although both ladybird beetles and green lacewings are well-established predators of sucking pests, their comparative performance and compatibility can vary substantially with species, prey density, predator developmental stage, crop and environmental conditions. Existing studies demonstrate that intraguild predation can occur between these predators, but its magnitude and consequences are not constant across experimental systems(Noppe et al., 2012),;Insects, 11(5), 288.)

This creates an opportunity for a localized study on agricultural crops in Washim District, Maharashtra, particularly if naturally occurring predator species and locally important sucking pests are investigated. Such a study could provide information relevant to conservation biological control and integrated pest management under local agricultural conditions.

13. Conclusion

Green lacewings and ladybird beetles are important natural enemies of sucking pests and have considerable potential for sustainable pest management. Both predator groups can substantially reduce pest populations, but their relative efficiency depends on predator species, developmental stage, prey density, crop characteristics and environmental conditions. (Diehl et al., 2013); Obrycki et al., 2009).

The simultaneous use of the two predators requires particular attention to compatibility and intraguild predation. Therefore, comparative studies that evaluate individual and combined predator treatments can provide valuable information for selecting effective biological-control strategies. (Noppe et al., 2012, Insects, 11(5), 288).

For a thesis based in Washim District, the study could contribute locally relevant information on the predatory efficiency, compatibility and potential biological-control value of green lacewings and ladybird beetles against sucking pests on agricultural crops. (Sharma, P., et al., 2022).

References

1. Diehl, E., Sereda, E., Wolters, V., & Birkhofer, K. (2013). Effects of predator specialization, host plant and climate on biological control of aphids by natural enemies: a meta-analysis. Journal of Applied Ecology.

2. Hewlett, J. A., Szczepaniec, A., & Eubanks, M. D. (2019). The effects of sugarcane aphid density in sorghum on predation by lady beetles and lacewings. Biological Control, 129, 171–177.

3. Noppe, C., Michaud, J. P., & De Clercq, P. (2012). Intraguild predation between lady beetles and lacewings: outcomes and consequences vary with focal prey and arena of interaction. Annals of the Entomological Society of America, 105(4), 562–571.

4. Noppe, J. J., Harwood, J. D., Kring, T. J., & O'Neil, R. J. (2009). Aphidophagy by Coccinellidae: application of biological control in agroecosystems. Biological Control, 51(2), 244–254.

5. Riddick, E. W. (2017). Identification of conditions for successful aphid control by ladybirds in greenhouses. Insects, 8(2), 38.

6. Intraguild predation between Chrysoperla carnea and Hippodamia variegata at various extraguild prey densities and arena complexities. Insect, 11(5), 288.

7. Frontiers in Insect Science (2025). Aphid wing polyphenism and conspecific egg cannibalism affect the development and reproduction of Chrysoperla carnea.

8. GSHJ (2025). Ladybird Beetles: Nature's Allies in Pest Control. 9VOM Publishing, Vol. 1 No. 1.

9. Khan, M. A., et al. (2012). Predatory potential of Chrysoperla carnea against whiteflies and jassids in field crops. Journal of Biological Control.

10. Dixon, A. F. G. (2000). Insect predator-prey dynamics: Ladybird beetles and biological control. Cambridge University Press.

11. Sharma, P., et al. (2022). Biological control of sucking insect pests in vegetable crops using predatory coccinellids and lacewings: A comprehensive review. Crop Protection, 154, 105892.