

Prey Seeking Behavior of Insect and Mite Predators

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Abstract:

The foundation of integrated pest management (IPM) practices is biological control, and natural enemies are a more and more appealing option. A common class of invertebrate natural enemies utilized as bio-control agents is the insect and mite predators. In recent years, traditional methods of biological control have become less important than the preservation and management of naturally occurring predators in agricultural eco-systems. However, these strategies must be supported by a fundamental understanding of the ecology and prey selection behavior of the predatory species being used. Prey Habitat Selection, Prey Finding, Prey Acceptance, and Prey Suitability—these four components of prey seeking behavior—have been covered in this study. To find and identify their prey, predators respond to both semiochemical and physical inputs. Prey sex pheromones, which work as kairomones, or Herbivore Induced Plant Volatiles (HIPV), which operate as allomones or synomones, are responsible for these reactions. Other aspects of prey seeking behaviour, such as plant architecture, patch quality, the chemical makeup of the prey cuticle, etc. are also discussed. All together affect the foraging efficiency of natural enemies.

Keywords: Agricultural, Allomones, Architecture, Biological control, Foraging efficiency, Herbivore induced plant volatiles, Kairomones, Predators, Prey acceptance, Prey finding, Prey habitat selection, Prey preference, Prey suitability, Semiochemical, Synomones.

Introduction:

In order to behave optimally, animals typically need knowledge about the state of their habitat. According to the signs they detect, a learning process through estimation is regularly updated for this behavior. Ecologists have long struggled to identify these cues, yet they continue to do so ([Tentelier and Fauvergue, 2007](#)).

Predation is the act of one animal killing and devouring another species, and the killing and devouring animal is known as the predator. However, hunger isn't always the driving force behind predatory behavior; it often is. The efficacy of prey capture often decreases with hunger in many animals, but in the case of Jumping Spiders (*Epiblemma scenicum*) and Praying Mantis (*Hierodula crassa*), the prey capturing stereotyped movements are unaffected by hunger. However, predators use either long-range or short-range cues as part of their host selection or host seeking approach. These cues may be sex pheromones (like aphids' Kairomones) or plant volatiles called Synomones that are caused by pests ([Rehman and Powell, 2010](#)). These findings will highlight a novel role of herbivore-induced plant volatiles (HIPV) in predator foraging behavior, which is vital for good biological control since it

allows predators and host availability to be time and space synchronised (Tentelier and Fauvergue, 2007).

Tri-trophic interactions, which include aggressive and defensive interactions among trophic levels, take place within a geographically diversified and dynamic physical and chemical environment. This interaction comprises both intra- and inter-specific links in morphological, behavioral, and physiological terms within a trophic level. Tri-trophic interactions are frequently intricately entwined and highly reliant (Moraes et al., 2000).

Predator Behavior:

In a variety of settings, predators travel considerable distances in quest of prey. They might come across a number of prospective prey species while searching, some of which are scattered across a wide range of plants. So, the prey finding or host seeking and the use are affected by many factors, including-

1. Volatile and tactile cues released by prey, the chemical and physical properties of the prey's host plant (Messina & Hanks 1998, De Clerq et al. 2000).
2. The Sex of the predator.
3. The prey species attacked (Parajulee et al. 1994, Donnelly & Phillips 2001).
4. The spatial distribution of prey (Ryoo 1996).
5. Predator Searching capacity and arrestment on host patches (Ives et al. 1993, Neuenschwander & Ajuonu 1995).
6. Discovery of alternative prey (Chesson 1989).
7. Prey defenses and habitat complexity (Hoddle 2003).

While most predators' immature stages and adults are able to hunt for prey, adults frequently travel great distances in their foraging. The immature stages that cannot fly must react to more regional stimuli (Hagen et al. 1976). Coccinellid larvae follow volatile odors to locate aphids, and older, more mobile larvae hunt more effectively (Jamal & Brown, 2001).

Predators react to a series of cues, beginning with those that draw them from afar to prey areas. If the habitat has the right cues, localized prey search results in prey detection, evaluation, and usage.

Prey Habitat Location:-

Mature females who are actively seeking oviposition locations are typically the ones to locate the habitat of their prey. In some species, adult predators may break diapauses or emerge from it while already in a suitable crop or forest habitat, at which point they start looking for prey. Alternatively, if the location from the previous year is no longer acceptable, predators that live in annual crops may need to relocate in order to obtain prey. To find the suitable prey habitat, 3 potential sources of cues exist-

- ❖ The Habitat (e.g. plants) itself
- ❖ The Prey itself
- ❖ Chemicals released by pest damaged plants

Chemical cues (Info-chemicals) produced by plants are typically easier to detect than info-chemicals produced by herbivores; this is because plants have a higher biomass and density, which increases their "Detectability" (Vet & Dicke, 1992). However, the unharmed plants that make up the ecosystem may produce a lot of odor, whether or not there are any prey around. Because of this, "Reliability" is quite low (Vet & Dicke 1992; Beyaert & Hilker 2014).

In contrast, odors from the bodies of prey, such as pheromones or odors from prey frass, are Reliable and this behavioral trait can be used to monitor important predators of target pest. According to

Aukema et al. (2000), the predator *Rhizophagus grandis* (Gyllenhal) (Coleoptera: Rhizophagidae) is drawn to traps by a kairomone released by the bark beetle *Dendroctonus micans* Kug (Coleoptera: Scolytidae). In order to determine the chemical components of the kairomone, which is mostly formed by the larval frass of *Dendroctonus micans* Kug, the University of Hamburg carried out an experiment in 1992. Each of the nine different Oxygenated Mono-terpenes that have been isolated has a semiochemical effect on *Rhizophagus grandis* (Gyllenhal). At a certain degree, a predator can be stimulated by a mixture of fenchol, borneol, terpinen-4-ol, verbenone, isopinocampone, pinocampone, and fenchol. The experiment demonstrates that for dosages above 15 microlitre, almost 60% of insects are drawn to the kairomone (Larval Frass Stimuli), and for doses above 30 microlitre, the attraction gradually decreases and reaches a plateau (Gregoire et al. 1992).

The herbivorous prey's aggressive destruction of plants is the third source of odors. These smells are frequent and strong. For instance, plants that have been injured by feeding spider mites are extremely attractive to phytoseiid mites (*Phytoseiulus persimilis*, *Amblyseius swirskii*, etc.), which feed on spider mites (Sabelis & Van de Baan 1983, de Boer & Dicke 2005, Shimoda et al. 2005). Similar to this, bean plants affected by *Tetranychus urticae* Koch draw *Scolothrips takahashii* Priesner, a predatory thrips that specializes in taking out Spider mites. These thrips are not attracted to healthy leaves, mechanically damaged leaves, spider mites, or any of their byproducts. However, spider mites should be employed to treat damaged plants. Methyl Salicylate (MeSa), a compound in many blends of herbivore-induced plant volatiles, attracts predators, such as *Chrysopa* spp (James 2006).

In a few cases, predators may react to odor mixes that contain volatiles from both the prey and herbivore-induced plant volatiles. The volatiles released by disturbed pests like aphids or by plants like cowpeas that aphids are feeding on attract some predators, particularly coccinellids. This demonstrates how predator attractiveness is influenced by the [E]-Beta-farnesene aphid warning pheromone (Ninkovic et al. 2001). In a manner similar to this, Hydrophilid beetles, generalist predators of Banana Weevil, *Cosmopolites sordidus* (Germar), are attracted to weevil-damaged banana pseudo stems, and this attraction is heightened in the presence of weevil aggregation pheromones (Tinzaara et al. 2005).

Research into the elements of plants that attract predators has led to the development of Methyl Salicylate (MeSA), a synthetic equivalent that has been used in the field as a lure to bring predators and increase their density in crops (James 2003; James & Price 2004). A greater variety of predators (such as Coleoptera: Coccinellidae; Diptera: Empidiidae, Syrphidae; Hemiptera: Anthocoridae, Geocoridae; Neuroptera: Chrysopidae, Hemerobiidae) are more numerous in plots with MeSA dispensers than in the control plot. However, MeSA-treated areas saw a decline in the pest Spider Mite population.

Table 1:- List of Infochemicals Released by Plant Attacked by Aphids Attracting Ladybirds

Ladybird Beetle	Prey Species	Host Plant	Infochemical	References
<i>Coccinella septempunctata</i>	<i>Aphis glycines</i>	Soybean	Methyl Salicylate	Zhu & Park (2005)
<i>C. septempunctata</i>	<i>Toxoptera aurantii</i>	Citrus	Benzaldehyde	Han & Chen (2002)
<i>C. septempunctata</i>	-	-	(Z)-jasmone	Birkett et al. (2000)
<i>C. septempunctata</i>	-	-	(E)-B-farnesene	Al Abassi et al. (2000)

<i>Hippodamia convergens</i>	<i>Myzus persicae</i>	-	(E)-B-farnesene	Acar et al. (2001)
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Plants' ability to attract predators has an impact on biological conservation management. Occasionally, non-crop plants may be a significant source of chemicals that attract predators. Ladybird beetles were attracted to weeds in barley whether or not there were aphids present; demonstrating the importance of maintaining some non-crop plant diversity in agricultural fields (Ninkovic & Pettersson 2003). Conversely, herbivores consuming novel crops may go unreported by neighborhood predators if these new plant species don't produce the necessary alluring volatiles. As a result, native pests may manage to avoid predators and harm freshly planted crops more severely (Grossman et al. 2005).

Prey Finding:

Predators must find the "Prey" after reaching an appropriate prey environment in order to feed. If the habitat is initially examined and signs of prey are found nearby, the predator is likely to use **Intensified Local Search (ILS)**. It involves turning more frequently, creating winding search pathways, and moving more slowly so that leaf surfaces may be examined in greater detail. Frass from the prey can cause these behaviors to occur (Wainhouse et al. 1991; Jones et al. 2004). Prey materials such as wax or honeydew (Van Den Meiracker et al. 1990, Heidari & Copland 1993, Jhansi et al. 2000), volatile and non volatile olfactory cues released by prey (Shonouda et al. 1998, Jamal & Brown 2001), and vibrations from prey chewing (Pfannenstiel et al. 1995), or short range visual detection of prey (Stubbs, 1980).

The efficiency of localized search can be influenced by many factors, including plant architecture, predator's hunger status, visual cues, patch quality and prey products.

Predator attack rates can be influenced by **host plant architecture**, such as plant height, leaf number, and leaf area (Messina & Hanks 1998). The more complex the morphology of the host plant, the less prey will be located in a given period of time (Hoddle 2003). For instance, *Coccinella septempunctata* larvae hunt for Pea Aphids, *Acyrtosiphon pisum*, less successfully on highly branching types of peas than on unbranched variants (Legrand and Barbosa 2003). Even the plants' surface characteristics, such as their hairiness or slipperiness, have an impact on how well predators can forage. Predators' foraging and walking speeds are slower when trichomes are present (Stavrinides and Skirvin 2003; Riddick & Simmons 2014). Similar to this, waxy plants make it harder for most predators to find prey. For example, *Hippodamia convergens* larvae find more aphids on non-waxy cabbage than on waxy varieties (Chang et al. 2006). Additionally, *Coccinella septempunctata* larvae find hunting and killing animals on leaves with more junctions less effective (Legrand and Barbosa 2000).

The ability to find prey can be impacted by the **predator's level of hunger**. In comparison to predators that are well fed, hungry predators move more slowly, stop more frequently, rest for longer periods of time, and cover less ground during their searches (Henaut et al. 2002). Age of the predator can also have an impact on the hunt; young, starving predators start intensive linear foraging earlier than older ones. This is probably due to the larger nutritional reserves of older predators. However, learning from prior encounters with and consumption of prey may also have an impact on older predators' search behavior (Lamine et al. 2005).

The primary known fact that aids in locating the prey is that of **visual cues**. It is, however, infrequently observed. According to Hattingh and Samways (1995), adults of *Chilocorus nigritus*

(Fabricius) prefer to feed close to horizons that induce tree-lines to flat horizons. Due of their ability to employ visual cues to locate prey, many predators (including ladybirds) prefer to forage during the day. However, while yellow pillars mimic stressed plants that are more likely to be plagued with aphids (Lorenzetti et al. 1997), native adults of *Harmonia axyridis* are more drawn to them than green pillars (Mondor and Warren 2000).

Patch Quality and Prey Products are also crucial factors in the predators' ability to locate prey. Victim items, such as honeydew, are frequently discovered to act as an additional cue, enhancing the predators' ability to find their victim. For example, artificial honeydew spraying can draw some ladybird beetles and improve the frequency of prey discovery. *Hippodamia convergens* larvae are more drawn to honeydew-contaminated patches than clean patches (Purandare and Tenhumberg, 2012). It also delays their search time for some predators and serves as an arrestant (Ide et al. 2007). The predator's ability to hunt and eat can be hampered by the presence of honeydew in patches of Pear Psylla, *Cacopsylla chinensis* (Yang and Li), for example, *Opius sauteri* Poppius (Hemiptera: Anthocoridae) (Zhang et al. 2019).

Prey Acceptance:

The size of the prey, the predator's age and experience, as well as the prey's defensive responses, can all affect the success of an assault once the prey has been encountered. Predator biting or sucking may result from the prey's cuticle's chemical makeup (Hagen et al. 1976; Dixon 2000). Painting suitable prey with cuticular preparations from undesirable prey has been used to illustrate the significance of surface chemistry to predators. In these studies, predators rejected painted prey because they encountered the erroneous chemical search image (Dixon 2000). In many cases, the choice to attack may depend on a quick evaluation of relative dangers in contrast to any prospective nutritional advantages of the target species.

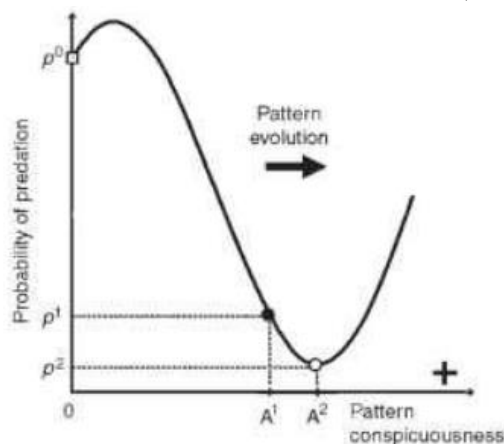
A common Jumping Spider, *Habronattus pyrrithrix* Chamberlin (Araneae: Salticidae), is prevalent in leaf litter in both natural vegetation and agricultural settings. Experimental research is done to determine how painted prey affects its ability to feed. *Oncopeltus fasciatus*, often known as the large milkweed bug, is used for this purpose. For their own defense, these red and black aposematic bugs can scavenge cardenolides from milkweed (*Asclepias* spp.). Their biology was well understood due to their long history as a model organism (Feir 1974). The toxin level and, thus, the palatability, of milkweed bugs in the wild vary greatly (Isman et al. 1977). The poison concentration of *O. fasciatus* can be easily altered through feeding in captivity, which also affects how tasty they are to jumping spiders. So, some of the prey are raised on edible sunflower seeds while others are raised on deadly milkweed seeds. And after two weeks, it was discovered that the Jumping Spider was less inclined to attack the poisonous Red Bugs (fed on Milkweed). It suggests that the Jumping Spider strongly disapproves of the intense red coloring.

The impact of prey acceptance is examined, which might vary depending on the cuticular makeup of the prey. The larva of Potato Tuber Moth, *Phthorimaea operculella* (Zeller) (Lepidoptera: Gelechiidae) is considered as important preys to two hymenopteran predators viz. the Argentine ant, *Iridomyrmex humilis* (Mayr) (Hymenoptera: Formicidae), and the paper wasp, *Mischocyuarus flavitarsus* (Sauss.) (Hymenoptera: Vespidae). On the other hand, the quinolizidine alkaloids are withheld from their leguminous hosts by the larvae of *Uresiphita reversalis* (Guenée) (Lepidoptera: Pyralidae), which principally store them in the cuticle. With the final larval moult, stored alkaloids are

lost. The variance of prey acceptance to the predators is now being tested on potato tuber moth larvae by applying extracts of late-instar larvae and pupae. In contrast to untreated prey, it was discovered that *P. operculella* larvae treated with alkaloid extracts of *U. reversalis* larval exuviae or with surface extracts of entire larvae were deterrent to both predators. However, the addition of pupal exuviae extract to *P. operculella* did not have any inhibitory effects (Montllor, Bernays, Cornelius 1990).

In addition to these, whether the prey is accepted by the predator or not depends on the cuticular warning colour of the prey's body (Aposematic colour). To escape or repel predators, prey frequently develops warning colorations (also known as mimicry). *Tyria jacobaeae*, a caterpillar of the Cinnabar Moth (Lepidoptera: Erebididae), has alternate orange and black streaks down its body that serve as an advertisement for its deadly nature (Barnett et al. 2018).

Some insects are gregariously structured in ways that the predators find rather strange. As a result, they frequently flee from or refuse their prey because they believe it will not be tasty, similar to Romaleidae (Orthoptera) grasshopper nymphs with gregarious *Chromacris lubber* (Despland et al. 2020). Black is frequently utilized as a warning color by insects, despite not being a particularly bright color, probably because it stands out more against green foliage. Additionally, a large group of Gregarious *Morpho sp.* caterpillars spend the day together. For feeding, they scatter at night. Clusters of aposematic prey frequently provide an emergent, increased pattern that the predators are likely to perceive as a supernormal stimulus and, as a result, better memorise (Sillen-Tullberg 1987).



Here, the **Peak Shift Mechanism** (PSM) is used to determine how noticeable the prey is. The curve depicts a fitness function that connects the conspicuousness of a pattern to the likelihood of being preyed upon. It is believed that predators have knowledge of prey ranging from aposematism (solid circle: high conspicuousness, A^1 ; distastefulness, low probability of predation, p^1) to crypsis (open square: zero conspicuousness, tastefulness, high chance of predation). The curve beyond the solid circle results from predators extrapolating from this knowledge the palatability of prey with more conspicuousness they have not yet encountered. In particular, slightly more conspicuous prey (open circle) elicit a stronger rejection response than the known aposematic prey (solid circle), and as a result suffer an even lower probability of predation, p^2 . As a result, selection should cause the conspicuity of the unappealing prey to gradually shift from A^1 to A^2 , which is how selection should work. Cryptic unappealing prey, on the other hand, cannot drift away from crypsis (Open Square) towards higher levels of conspicuousness since they are more likely to be preyed upon when they do so. To reach levels of conspicuousness where birds may classify the prey as warningly colored and avoid confusion with the typical staple of cryptic tasty prey, an initial phenotypic jump is required (Kazemi 2017).

Prey Suitability:-

For any predator, prey species will vary in their quality as food for survival or egg development. Potential prey species can be divided into three groups (Dixon 2000)-

- Species that support both development and reproduction.
- Species that can be eaten, but do not support reproduction and contribute to lower fitness.
- Species unpalatable or noxious that are not eaten.

Immature predators may not finish development or, if they do, the adults may be lower than predicted size, shorter lived, and lay fewer eggs if predators consume too many inferior quality prey from the second alternative. On the other hand, good quality prey causes shorter developmental durations, lower immature stage mortality, larger females, and increased fitness (Hoddle et al. 2001). To make up for a possible dietary shortage the predator may be facing, certain prey may occasionally be sought. For instance, certain vitamin shortages can make some predatory mites more sensitive to the kairomones released by their prey, which indicate the presence of vital nutrients. When the vital nutritional element that was lacking is recovered, the changed prey selection response is eliminated. Following that, predators may switch to other easier-to-capture or favoured prey (Dicke & Groenvelf 1986; Dicke et al. 1986).

A prey is typically not as suitable as prey to the predators when it is ill or parasitized by additional parasitoids. However, the specialist predators have a wider selection of suitable prey species than the generalist predators do. It is frequently seen that eating parasitized mummies interferes with the development of the predators. When fed *Schizaphis graminum* Rhondani nymphs and mummies that have been parasitized by *Lysiphlebus testaceipes* (Cresson), larvae of *H. convergens* fail to develop into viable pupae (K. Giles, pers. comm.). By feeding *Cycloneda sanguinea* larvae to *T. citricida* nymphs that were parasitized by *L. testaceipes*, similar results were obtained (J.P. Michaud).

However, the prey suitability of immature stages and adult stages may be different. But it is very much important to have a good meal for both larva and adults (in those cases where both stages are predatory) for good development, reproduction and survival. So, it is differentiated into two categories-

- ✓ Prey Suitability for Immature Stages
- ✓ Prey Suitability for Adult Stages

By evaluating larval performance on a certain monotypic prey diet, prey appropriateness for immature stages can be classified as "optimal," "adequate," or "marginal." Three empirical criteria—survival, adult weight, and developmental time—can be used to compare the suitability of different prey types for different developmental stages. Physical variables like temperature, humidity, and day length can be held relatively constant within a range of values that are known to be beneficial for the species. Survival is undoubtedly more crucial than everything else. The information provided by Cottrell (2004) includes a reference diet of conspecific eggs and serves as an effective example of its value in determining if prey is suitable for larvae. *Monelliopsis pecanis* Bissell, which yields better adult weight and faster development than the conspecific egg diet, is an ideal prey for *Olla v-nigrum* Mulsant, according to an analysis of their data for conspecific egg diets started in the first instar. This species, however, only provides *H. axyridis* with enough prey, providing adult weights and developmental times that are equal to the conspecific egg diet but not superior.

Compared to research using larvae, those determining the relative appropriateness of prey for adults have more potentially confounding factors and empirical issues. As a result, many studies only consider the growth of the larva (Michels & Behle 1991; Munyaneza & Obrycki 1998), ignoring the

reproductive performance of the prey. The identification of "essential prey" cannot be determined only on the basis of successful larval development because a species' numerical response in the context of biological control depends on both full development and effective reproduction.

Therefore, indexing the appropriateness of a complete prey is a very time-consuming task. When fed as a monotypic diet to larvae and adults, really complete prey should be able to support the growth and reproduction of multiple generations of a predatory species (i.e. two or more) without experiencing a discernible reduction in any biological performance indicator. One could want to get a rough assessment of relative appropriateness for these prey that takes into account both larval and adult performance factors. One may compute and compare r_m values obtained on meals of various prey kinds because these preys are sufficient for both larval growth and adult reproduction. Only the generation time and an estimation of fecundity and fertility over that time are necessary. The generation time can be computed as the total of the pre-oviposition period, pre-pupal and pupal periods, larval developing time, and egg incubation duration. If insects for reproductive performance trials are reared as larvae on the same prey that they get in adult feeding trials, impacts of larval diet on adult size are avoided in the r_m estimation but will still be reflected via effects of adult size on female fecundity. Then, using r_m values determined from an objective methodology that integrates distinct life history repercussions of the diet for both larval and adult life stages, species representing whole prey can be indexed according to their relative suitability for a given predatory species.

Issues Pertaining to Manipulation of Prey Seeking Behavior of Predators:-

The best way to characterize predatory seeking effectiveness that is reliant on prey density and prey consumption by predators is through a functional response (Pervez and Omkar 2003, 2005; Omkar and Pervez 2004). Most predators are believed to display a Type II functional response. According to Pervez and Omkar (2010), important predators on plants like ladybirds are visible to be distributed both spatially and temporally in the field and in the lab. As a result, their efficacy as biocontrol agents can be altered, as can the distribution patterns of specific ladybirds for a synergistic effect on the mortality of prey populations (Omkar and Pervez 2011). The simultaneous release of large and small ladybirds into aphid-infested microhabitats, however, carries some dangers (Omkar et al. 2014).

According to studies on prey preferences, specialized predators show a preference and affinity for some prey over others (Guroo et al. 2017; Pervez and Kumar 2017). Additionally, because preys retain host plant allelochemicals and employ them as a defense against predators, this prey-preference is greatly influenced by the host plant. For instance, the glycoside and lipids from the cornicles of the aphid, *Acyrtosiphon nipponicus* (Aphididae) enable it defend against *Harmonia axyridis*, which causes the ladybird to release the aphid and depart from the aphid colony (Nishida 2014). As a result, ladybirds avoid future attacks on and consumption of these aphids since they are toxic and unappealing to them. This aphid is therefore avoided when raised on poisonous hosts despite being highly favored when raised on acceptable host plants. By giving predators prey that has been reared on acceptable and nourishing hosts rather than harmful host plants; we may control their ability to select their prey.

Summary:

The integrated pest management plans incorporate biological control, a sustainable and socially acceptable approach of pest management. In biological control, diseases, parasitoids, and predators are all engaged. A predator can choose its prey by a number of methods, including prey habitat discovery,

prey discovery, prey acceptance, and host suitability. Understanding these intricate processes will improve the biological control that is sustainable. Typically, predators use those methods to find their prey -

1. **Prey Habitat Location-** The predator looks for areas where suitable plants and prey are present, especially in adult females.
2. **Prey Finding-** Once the predator has located a good prey habitat, it looks for prey on or very near the plants.
3. **Prey Acceptance-** The predator evaluates the prey colony and decides to eat to the extent of its ability.
4. **Prey Suitability-** The appropriateness of prey depends on whether the food consumed by the predator successfully aids the predator in completing full growth, development, and reproduction. For the predator, it can be extremely suitable, somewhat suitable, or unsuitable.

The role of tritrophic interaction is very much evident in any stage of prey seeking behavior of predators. The plant (producer) is affected by herbivore (1st trophic level) and releases some *de novo* (Phytoanticipens and Phytoalexins- secondary Plant Metabolites) or Herbivore Induced Plant Volatiles (HIPV) that can attract certain predators (2nd trophic level) to act on its prey. [Gómez-Cabezas et al. \(2023\)](#) has described this phenomenon of affected plants as “**CRY FOR HELP**”.

But occasionally it can be poisonous to the predators, particularly if the host plant is poisonous and the prey eats the poisonous plant sap. Additionally, intraspecific and interspecific rivalries among predators may reduce their ability to successfully hunt for prey.

Conclusion:

In the Integrated Pest Management (IPM) paradigm, biological control is the cornerstone, and the potential of using natural enemies is growing more appealing. Numerous kinds of predators, a class of invertebrate natural enemies that are frequently used as biological control agents, are employed to manage different aphid problems.

Studying plant-host-predator interactions at various field scales is crucial to comprehend the chemical exploitation techniques used by foraging predators. Experimental research on the mechanism of information chemically mediated prey searching is needed ([Pettersson et al. 2008](#)). Investigations into behavior and electrophysiology shed light on the substances used by predators ([Pettersson et al. 2008](#)).

Understanding the processes influencing the prey's foraging behavior will be crucial to the program's success when using predators for biological control. If the release is planned so that the predators, especially females, would have the greatest opportunity to locate suitable prey as rapidly as possible, the successful establishment of imported species may be substantially facilitated. The exposure of the predators to semiochemicals associated with their prey in the new environment could considerably increase their odds of success by training them to recognize and look for preys. With an emphasis on reducing reliance on insecticides, biological control releases are taken into consideration as part of a comprehensive IPM programme rather than in isolation. Poor knowledge of the natural enemy's capacity to seek hosts in certain crops after release is mostly to blame for many unsuccessful attempts at augmentative biological control ([Wright et al. 2000](#)). The tritrophic interaction that modifies the environment in such a way as to usually boost the efficiency of prey searching by the predators is another crucial element.

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