

Damsel Bug: A smooth-looking slender predator

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Introduction

Nabidae (commonly called damsel bugs or nabids) is a small family of true bugs, comprising nearly 400 species worldwide. Nabids are generalist predators of small invertebrates mostly arthropods. The genus *Nabis*, which attacks several families of insect prey, is considered important because of their contribution to the suppression of economically important pests. They mostly feed on crop pests but will also attack other predators. Nabids kill their prey immediately and suck them dry. Nymphs begin eating almost immediately after hatching and consume many individuals to complete their development. As such, nabids can be valuable biological control agents of insect pests in agricultural environments. *Nabis* are encountered regularly in agricultural systems throughout North America where they are often strikingly abundant. Their generalist appetite allows them to feed on a variety of insects (e.g. aphids, leafhoppers, young caterpillar, insect eggs, etc.) of economic importance in field crops. However, this generalist feeding habit may make them less effective biological control agents than specialist predators that attack specific pest species.

Nabids are found more commonly in alfalfa, soybean and cotton than in other crops or orchards. In US soybean, *Nabis* spp. are among the most numerous insect predators found. In addition to agricultural systems, nabids are commonly found on low herbaceous vegetation, shrubs and grasses but a few species can be regularly found in trees. Some species are found in moist areas on the ground or at the edge of streams, ponds and marshes. Grassy fields generally have more nabids than do broadleaf weed or weed-less fields. Their predaceous behavior, together with their prevalent existence in diverse environments, particularly agricultural systems, has attracted the attention of many entomologists.

Description

Nabids are slender, soft body insects with a narrow head and small bulging eyes (**Fig. 1**). They are roughly 10 to 12 mm (1/3 to 1/2 inch) long. Nabids are mostly yellowish, gray, or dull brown to gray in appearance and resemble small, smooth-looking assassin bugs. Some species of nabids are black and antlike in appearance, but these are less common in agricultural environments. Nabids have long stilt-like legs and a pair of long, four-segmented antennae. Each foreleg is slightly thickened and has a double row of spines that act as grasping organs for the containment of prey, similar to mantids. Being a true bug, their mouth is long, needle-like, and tucked under the head and body at rest, but is flexible and can be positioned in front of the head when feeding (**Fig. 2**). Nabids undergo three developmental stages (egg, nymph, and adult).



Fig. 1. Nabid nymph with small bulging eyes. Photo by Mick Talbot, Creative Commons



Fig. 2. Nabid adult with mouthpart extended. Photo by Gbohne, Creative Commons

Eggs

Nabis eggs are white, oblong and flattened at the base. Some have described them as jar-shaped with the front end narrowed into a “collar”. Eggs are deposited singly in soft plant tissue and stems. Several eggs may be laid in close proximity. In alfalfa, most eggs were found where stem diameter measured from 0.8 to 1.9 mm (0.03 to 0.07 in) but height of oviposition site was not related to length of stem.

Nymphs

Nymphs look like small, wingless version of adults (**Fig. 3**). They are active shortly after hatching and begin feeding immediately, often on prey considerably larger than themselves. Nymphs go through five instars (juvenile stages) that range in size from 3-8 mm (1/8 to 1/3 in) in length. With each successive instar they shed their skin, develop wing pads, grow larger and look more like adults.

Adults

Adults are 8-12 mm (1/3 to 1/2 in) long with two pairs of fully functional wings (forewings and hindwings). Forewings are hardened at the base and membranous at the tip. At rest, forewings cross over their back, one over the other, creating a triangle pattern behind the pronotum (“shoulders”), pointing toward the rear. A distinguishing characteristic of adult nabid wings is the presence several small cells lining the margin of the membranous part of the wing which may be viewable with a hand lens (**Fig. 4**).

Life Cycle/History

Nabids have multiple generations per year and are present throughout the plant growing season. This varies, however, among species and within plant habitats. Most species of nabids overwinter as adults or large nymphs in protected places such as leaf litter, weedy areas, within perennial crops and shrubs, low plants or some sort of ground cover including winter crops such as grain. Nabids emerge from overwintering sites and begin to appear in fields during spring (e.g., May or June) when the weather warms up. Peak nabid activity is in mid to late summer.

Adults become active during warm months and females begin depositing eggs into soft plant tissue of low-growing plants soon after emergence. A female damsel bug can lay up to 200 eggs which hatch in 8 to 12 days depending on temperature. Nymphs emerge and develop over 3 to 4 weeks and may be found taking cover in plant debris, at the base of plant stems or in cracks at the soil surface. Some *Nabis* species have one generation per year while others have two to five generations, depending on location. Two common nabid species, *Nabis americanoferus* and *Nabis roseipennis* were reported to produce more than one generation per year as far north as southern Canada.

Temperature and development

Different laboratory studies have shown that temperature plays an important role in the development, longevity and fecundity (number of eggs produced) of different *Nabis* species. In experiments where *Nabis* species were given the same diet but were allowed to grow under different controlled temperatures, the time it took to develop from egg to adult tended to decrease with increasing temperature within a certain range. Below that temperature range, eggs did not hatch, and nymphs did not complete development and molt to the next stage. For many *Nabis* species, the temperature threshold for successful development from the egg to the adult stage in the laboratory is between 11 to 15°C (52 to 59°F). Below these temperatures, *Nabis* species may not be able to complete their development. At warmer temperatures, *Nabis* species tend to grow and develop much faster,



Fig. 3. Picture of nabid nymph. Photo by Mick Talbot, Creative Commons



Fig. 4. Picture of adult nabid on leaf. Photo by Line Sabroe, Creative Commons

and spend much less time at each nymphal stage. However, experiments show that there is a trade-off at the extreme end of the temperature range where mortality at different life stages increased with temperature as well. For example, experiments show that *Nabis* nymphs showed the fastest development times but also the lowest survival rates at temperatures near 32°C (90°F). Each *Nabis* species likely has its own specific temperature range where developmental time and survival rate are optimized to produce the most offspring that grow and develop within the shortest time period.

In addition, temperature and diet can interact to influence *Nabis* growth rate and their potential to suppress insect pests. In experiments where *N. americanoferus* were reared using different insect prey as food, those that were fed alfalfa blotch leafminer larvae developed significantly faster than those fed pea aphids. Therefore, the nutritional quality of available prey in the field can determine how quickly *Nabis* grow and develop. In another experiment where researchers fed different insect prey to *N. roseipennis* at different temperatures, *N. roseipennis* tended to consume more tarnished plant bug nymphs at higher temperatures, but consumed the same amount of tobacco budworm larvae across a range of temperatures. These findings suggest that *Nabis* species may provide better biological control of arthropod pests at higher temperatures for some but not all pest species.

Biological control potential

Nabis spp. are fast moving predators and are often the most numerous species of predators present within a crop at some point during the growing season. They feed on a diversity of arthropod prey including aphids, moth eggs, and small caterpillars (Fig. 5). However, the polyphagous (generalist) feeding habits of nabids may make them less effective than species-specific predators that target specific prey species. Important butterfly and moth pests that they are known to feed on include the corn earworm, European corn borer, imported cabbageworm and some armyworms. Other prey may include leafhoppers (including beet and potato leafhoppers), small sawfly larvae, mites, tarnished plant bug nymphs, asparagus beetle and Colorado potato beetle eggs and nymphs. Most insect prey of nabids are plant-feeding species, but nabids sometime attack predaceous insects, including members of their own species. They can survive for up to two weeks without food. However, if no other prey is available, they will turn to cannibalism which is common throughout the life cycle of nabids.

Nabids can be abundant in a wide variety of agricultural systems. They are among the most abundant predators in alfalfa, cotton, soybean and certain other crops in North America. Two of the most common species in alfalfa and soybean in eastern North America are *N. americanoferus* and *N. roseipennis*. Field experiments have demonstrated the ability of *N. roseipennis* to reduce green cloverworm populations in soybean. When present in sufficient numbers and at the appropriate time, they are capable of causing significant reductions in green cloverworm numbers even when alternative prey and other predators are present. During a study in soybean, prey items that were observed to be captured by three *Nabis* species included minute pirate bug (*Orius*) adults and nymphs, *Nabis* nymphs, potato leafhopper adults, *Lygus* adults and nymphs, aphids, green cloverworm larvae, soybean thrips, locust leafminers, miscellaneous Diptera and whitefly nymphs.

Predation by *Nabis* spp. on Mexican bean beetle (MBB) was studied in the laboratory and in field cages containing soybeans. *Nabis* spp. fed upon MBB eggs, 1st, 2nd and 3rd stage larvae, but not upon 4th stage larvae, pupae, or adults. Results from field cage tests indicated *Nabis* spp. could significantly reduce MBB numbers. Consumption of prey was especially high for reproductive females. Studies have shown that attack rates on prey were highest and handling times lowest for reproductively mature females of *N. americanoferus*.



Fig. 5. Black damsel bug feeding on caterpillar, Photo by Keith Roragen, Creative Commons

Interaction with other biological control agents

Though fast predators, nabids are sometimes victims of intraguild predation (killing and eating of potential competitors or organisms that share the similar prey) and fall prey to predators such as sphecid wasps, assassin bugs, birds, and other creatures such as predaceous stink bugs and spiders. Still, there was one recorded instance in which an attacking spider was killed by the nabid which suggest they are not easy prey. In addition to predation, nabids are vulnerable to parasitism. A variety of organisms (e.g., fungi, wasps and tachinid flies) may impose mortality upon nabids by parasitizing their egg, nymph or adult stages. At least three species of tachinid flies and several egg parasitoids have been reported to parasitize *Nabis* species. A mymarid wasp parasitized up to 70% of nabid eggs found in California alfalfa fields. Interesting enough, there are occasions when male *Nabis* are far more vulnerable to parasitism than females. One wasp in particular, *Wesmaelia pendula*, which can be found parasitizing male nabids, only rarely parasitized female nabids.

Though nabids mainly eat plant-feeding arthropods, they feed on other predators such as lacewing larvae, minute pirate bugs and big-eyed bugs (*Geocoris*). Though *Nabis* may feed on other predators, they may be capable of lowering pest populations in the presence of other predators. For example, laboratory and field studies demonstrated the ability of a *Nabis* and *Geocoris* guild to suppress Colorado potato beetle (CPB) numbers. However, *Nabis* tended to avoid CPB predation when green peach aphids were present which suggests the species studied had a stronger preference for aphids than CPB.

Do nabids bite humans?

Though nabids mainly prey on small insects, there are several records of damsel bugs biting humans. The majority of reported cases on fortuitous or accidental bites by damsel bugs that are associated with species in the genus *Nabis*. Four species of *Nabis* in the United States have been reported to bite humans: *N. alternatus*, *N. americanoferus*, *N. capsiformis* and *N. roseipennis*. The majority of these cases have the following reactions in common: pinprick-like pain when bitten, burning sensation, development of an erythema which lasts for a few days, and punctures due to the stylet of the damsel bug entering the skin. One researcher suggested that there are two possible causes for adventitious bites: 1) defense and 2) the obtaining of water and/or solutes. Attacks occurred during summer and situations with high temperatures, which suggests that they were searching for hydration resources. Additionally, in most instances, sweat was apparently involved as the attractant. Though capable of biting, *Nabis* are generally thought as medically harmless as their bites are not as dangerous as some other insect bites and theirs are mainly considered painful and annoying.

Conserving nabids

There is considerable evidence that nabids respond to habitat manipulation in the form of plant diversification in agroecosystems. For example, intercropped fields of bean and maize supported more nabids than grown alone as a monoculture. Since nabids prefer to take shelter in low growing grasses and other ground covers, maintaining such environments may encourage these predators. Grassy soybean fields had more nabids than broadleaf-weed and weed-free fields; and in soybean fields, nabids were most numerous in no-till fields previously planted with soybeans that had not received an insecticide application. Another study showed that *N. americanoferus* was more effective at reducing leafhopper abundance, and protecting alfalfa from hopperburn, when alfalfa was intercropped with orchardgrass than grown alone. It was suggested that the orchardgrass, increased leafhopper movement, and *Nabis* captured leafhoppers more efficiently when they were more mobile. Planting crops adjacent to non-agricultural land may be another strategy used to enhance beneficial arthropods such as nabids within the cropping system. Species of plants in habitats next to orchards were sampled to compare beneficial arthropods within the orchard with the neighboring plant flora. The findings indicated that some taxa of beneficial arthropods such as *N. alternatus* moved into orchards from neighboring plants. Additionally, how vegetation is managed may also impact *Nabis* movement into a crop. For example, mowing adjacent habitats may cause adults to disperse into nearby cropping systems.

Using “soft” or selective pesticides that more specifically target the pest and are less harmful to nabids may help conserve their populations in cropping systems. The use of some insecticides including insect growth regulators (IGR) may reduce nabid numbers. A study showed that the initial use of IGRs, buprofezin or pyriproxyfen, reduced the number of *N. alternatus* in comparison with the untreated control. In most instances,

reductions in natural enemy taxa were much greater with the use of conventional insecticides. Reductions in their populations following insecticide sprays were thought to be due to direct toxicity and/or indirect effects such as a response to decreases in prey number.

Plant feeding

First instars of three *Nabis* species were found to utilize some plant foods sufficiently to survive, but no development followed. Thus, prey appear to be more essential to the nymphal development of *Nabis* spp. than two other popular generalist predators (i.e., *Geocoris* and *Orius*). However, *Nabis* was able to proceed through nymphal development and occasionally to adulthood on some plant foods. It is likely that moisture is the chief objective for feeding on plants. However, some *Nabis* species may use plant material for food as well as for moisture. Moreover, similar to omnivorous insects (eat plant and insect prey), *Nabis* supplement their diet by feeding on plant tissue. Still, plant feeding by *Nabis* is minor but could help maintain them for short periods when prey are in limited supply. *Nabis* may feed on nectar also when prey and water is scarce.

Summary

Nabids (damselfly bugs) are widely distributed generalist predators that feed on a variety of small, soft-bodied arthropods. This small family of generalist predators is commonly found in many crop and garden situations; and their contribution as predators against a variety of insect pests has been acknowledged. Adult and immature stages are frequently among the most abundant predatory insects in some agricultural fields. Though nabids can provide some natural control of pest species, it was proposed that it may be difficult to utilize them as biological control agents because of their polyphagy (feeding on many type of prey), cannibalism and variability in numbers over time and space. Additionally, nabids are not commercially available for augmentation which indicates attempts to increase their numbers in agricultural systems should be via conservation practices such as manipulating the habitat to favor their population increase and avoiding chemicals that are harmful to them.