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Competition and Niche-Partitioning in two Species of Walnut Aphids

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ABSTRACT

Two species of aphids colonize walnut orchards in Kashmir valley, Walnut green aphid (*Chromaphis juglandicola* Kalt.) and Dusky veined aphid (*Panaphis juglandis* Goeze). *P. juglandis* is much larger than the *C. juglandicola* and works entirely on the upper surface of leaves while *Chromaphis* feeds on lower surface of leaves. Both aphids obtain their nutrition from the phloem tissue. In walnut orchards of Kashmir valley these two aphid species are not usually found together on same trees or orchards. Walnut orchards infested with one species usually do not have other. In laboratory studies, using potted walnut seedlings, competition with *C. juglandicola* proved to be an important factor limiting population growth rate of *P. juglandis*, which survived an average of 12 days when competing for nutrients. The preference of *P. juglandis* for upper leaf surface subjects it to a constant rain of honey dew and debris from colonies of *C. juglandicola* on the lower surface of higher leaflets. Contamination of upper leaf surface with *C. juglandicola* honeydew also helps limit the population of *P.juglandis*, which survived an average of eight days when exposed to *C. juglandicola* honeydew. *P. juglandis* not exposed to honeydew or nutrient competition survived an average of 20 days.A

KEY WORDS: Competition, *Chromaphis*, *Pan aphis*, Honeydew, Walnut

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INTRODUCTION

Walnut trees are susceptible to pests and diseases such as walnut weevil *(Alcides Porrectirostris* Marsha), walnut blue beetle *(Monolepta erythrecephale)*, Sanjose scale *(Quadraspidiotus pernicious* Comst), Dusky veined aphid (*Panaphis juglandis* Goeze)[1] and walnut green aphid *(Chromaphis juglandicola* Kalt). Among the different pests prevalent in the walnut-producing areas, walnut aphids' viz. *P. juglandis* and *C. juglandicola* damage walnut orchards most seriously.[1,2] Their feeding reduces tree vigour, nut size, yield, and quality. In addition to direct feeding damage, they excrete copious amounts of honey-dew that falls onto nuts, leaves and shoots. Honey-dew supports growth of the black sooty mould fungus. This fungus reduces light penetration to the leaf surface reducing its photosynthetic capacity. Being black, it also absorbs heat to predispose nuts to sunburn and subsequent kernel quality loss due to high temperatures[2]. High populations of aphids may also cause leaf drop, exposing more nuts to sunburn. If heavy populations are allowed to develop (i.e. > 15 aphids per walnut leaflet) and remain for as little as 14 days uncontrolled, current season's nut quality is reduced along with a substantial reduction in the following season's crop[3].

The walnut aphid, *Chromaphis juglandicola* (Fig.1) is a serious pest known in different parts of the world. It is yellowish in colour and feeds on the lower surface of leaves and is a sap feeder[4]. The dusky veined aphid, *P. juglandis* (Fig.2) is another walnut pest in the valley. The life cycle of dusky veined aphid is similar to walnut aphid. It overwinters in the egg stage on twigs. Eggs hatch as soon as leaf buds begin to open where the young aphids settle on the leaflets, and they mature into larger, yellow aphids with dusky black spots, and reproduce without mating, giving birth to live nymphs. The aphids pass through many generations a year, depending upon temperature. In fall, wingless females mate with smaller, winged males and lay the overwinter eggs. In contrast to walnut aphid however, dusky veined aphids feed on the upper sides of leaves

at the midrib. If 25% of a leaflet sample contains colonies of dusky veined aphids, economic quality damaged has been measured[5]. As walnut aphids decrease the vigour of walnut trees so there is a need to study and manage these serious pests in all its respects. Natural enemies play an important role in the natural control of walnut aphids. As these two aphids feed on exposed parts (leaves), they are susceptible to a variety of natural enemies such as predators and parasitoids [4, 6].

Competition between any two insect species for a common resource base has been an important factor for microhabitat distribution and spatial dispersion patterns[7]. Competition is an important factor for niche selection in *Eriosoma* aphids on Japanese elm[8]. Habitat selection in *Pemphigus* aphids is influenced by competition and resource exploitation[9].

MATERIALS AND METHODS

Fresh colonies from Batpora and Botanical Garden, University of Kashmir were brought to Animal House and were reared on potted seedlings of walnut. Competition for food between two species was studied by allowing the two species to grow together on same leaflet. 10 Ist instar nymphs of both species were put on one walnut leaflet. Ten replicates were maintained and were compared with control having only single species (10 replicates). For studying effect of Honey dew of *C. juglandicola* on the growth of *P. juglandis*, lower surface of upper leaflets were artificially infested with the former and upper surface of the next lower leaflet were infested with later. Twigs were aligned by using clips, so as to allow continuous and desired falling of honey dew on leaflets.

RESULTS

During survey to different orchards in the Kashmir valley it was found that *C. juglandicola* and *P. juglandis* do not grow together. Orchards infested with one species have less or negligible population of other species. As both species are phloem sap

feeders they might be competing with each other. Laboratory studies revealed that competition for food between the two species is an important factor limiting the population growth rate. *P. juglandis* survived an average of 13 days when competing for nutrients with *C. juglandicola.* When not competing for food, *P. juglandis* survived an average of 20 days (Control). Effect of honey dew of C. juglandicola on the growth of *P. juglandis* proved to be another important factor affecting spatial distribution of the later (Fig. 3). Contamination of the upper leaf surface with honey dew of *C. juglandicola* limits the population of *P. juglandis*, which survived an average of 8 days when exposed to *C. juglandicola* honey dew. P. juglandis not exposed to honey dew (i.e; Control) survived an average of 20 days.

DISCUSSION

C. juglandicola is much smaller than *P. juglandis* but it is a much better competitor in phloem sap feeding. It feeds on lower side of walnut leaflets. *P. juglandis* have developed another strategy to escape from competition by feeding on upper side of leaflets. However, *C. juglandicola* in order to exclude competitor, which has the same resource base, has devised another mechanism for eliminating *P. juglandis* by exuding acidic honey dew which is poisonous to the later. Competition for food and space between two species of walnut aphids proves Gause's Competition Exclusion Principle, which says that no two species having same ecological niche can coexist together.

Fig. 1. Heavy infestation of *Chromaphis juglandicola* on underside of walnut leaf

Fig. 2. Winged *Panaphis juglandis* Females and IV instar larvae feeding along midvein on upper side of walnut leaf

Fig. 3. *P. juglandis* exposed to honey dew of *C. juglandicola*

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