AgriCos e-Newsletter
ISSN: 2582-7049
Volume : 02 Issue : 02 February 2021 Article No: 22

Leafhoppers (Cicadellidae; Hemiptera): An Emerging Agricultural Sucking Pest

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SUMMARY

Leafhoppers are found across the globe. Ecological and geographical differences are the cause of diversity in leafhoppers fauna. Keeping in view of the importance of leafhoppers in our ecosystem, people must have an adequate knowledge and information about their species, biology, nature of damage and control strategies. New species of leafhoppers and their importance in agriculture and integrated pest management needs to be discovered further and well understand.

INTRODUCTION

Beautiful small creatures of god in the animal kingdom which belongs to family Cicadellidae are commonly known as leafhoppers. Family Cicadellidae is considered as one of the largest families of plant-feeding insects that possess more than 22000 described species (Derlink *et al*., 2016). They are widely distributed in various ecosystems of this planet and associated with wide range of host. These hoppers have piercing-sucking type of mouthparts causing damage to plant directly by sucking sap and indirectly as transmitting several plant viruses. Both adults and nymphs are very active and agile due to presence of modified jumping leg. Tibia of modified hind leg covered with enlarged setae that helps to spread a secretion over their bodies which act as a pheromones carrier and water repellent. This facilitates them most versatile in different plant ecosystem. Leafhoppers belongs to hemimetabolous sub division are having an incomplete metamorphosis in their life cycle defined by three stages of life cycle *i.e.* egg, nymph and adult. Nymphal stage having several instars which are recognized by size of body and its parts. Due to sucking nature of leafhopper, it can be controlled by using many contact and systemic insecticides. Population buildup of hoppers are usually large with in short period of time due to short duration of life cycle. To control leafhopper effectively it is very important to understand its population dynamics and respective crop ecosystem. Proper timing of insecticides application plays crucial role in insect pest management.

Morphology of Leafhopper

Leafhoppers (Auchenorrhynca: Cicadellidae) are small wedge-shaped insects that ranges from 2 to 30 mm in length. Species of leafhoppers may be dorsoventrally flattened, depressed, globular or elongated in appearance. Leafhoppers are very active insects. Wings and legs are used for locomotion. Adult leafhoppers can fly as they have two pairs of wings in which the front pair is mostly colored and thickened while immature leafhoppers do not have wings so they mostly jump or run sideways. Many leafhoppers are green or brown in color but some species are marked with a variety of patterns. The hind tibia of leafhoppers possesses four rows of enlarged spine like setae. Tymbals are present at the base of leafhoppers' abdomen that vibrates and produces sounds. Leafhoppers are blunt headed and their head sometimes possess spines or some other ornamental mark. One of the main distinguishing characteristics of leafhoppers subfamilies is the position of two lateral ocelli which is sensitive to light and colour. Other major morphological features that differentiate species of leafhoppers include the setae arrangement on legs, venation in their wings and most of species identification done by dissection of male genitalia (Dietrich, 2004).

Behavior and Biology

Leafhoppers can communicate with in species by several means like chemical communication, sound communication, colour diffraction communication etc. The male leafhoppers have special tymbals that vibrate. These vibrating signals are transmitted through the substrate mostly in bending waves. Females lack tymbal organs but often able to make sounds through various stridulatory mechanisms. Many Auchenorrhynca possess a diverse range of vibrational or acoustic signals that are associated with various behaviors. It is usually present in pair form and are produced sound known as "calling signals" which attracts mates from same species for copulation. Generally a vibratory or auditory response is received by the calling male from the responding females, and male

usually continue duetting during their search for a stationary female. This behavior is in contrast with various acoustical insects in which the female finds the calling signals produced by stationary males.

Seasonal breeding, sexual reproduction and internal fertilization are the main reproductive characteristics of leafhoppers. In the late spring season, female leafhoppers after mating probably deposits eggs inside the stem or larger veins of the leaves of damaged plants either singly or in batches. To protect themselves and their eggs from pathogens and predation, some leafhoppers' species produce brochosomes. The eggs hatch in 6-9 days, and to become a fully grown adult, the emerged nymph usually needs to molt several time which varies from species to species. The white shed skin during the molting stage can easily be found attached on the lower side/underside of the leaves can also used as diagnostic sign for the presence of hopper. In many species adult leafhoppers overwinter in non-cultivated fields/areas and crop debris near to main crop. The total expected life duration of leafhoppers from eggs to the fully grown adults varies from specie to specie. Usually many overlapping generations may occurs during summer seasons due to increase in daily temperature (Dietrich, 2004).

Leafhoppers and Ecology

Leafhoppers are present worldwide from tropical regions to temperate grasslands, forests to high elevated latitudes. Leafhoppers are herbivores in nature which feeds on diverse array of host crop by sucking sap through their piercing-sucking mouthparts. Some leafhoppers species are polyphagus where as many species are host specific. As far as predation of leafhoppers is concerned, they are fast movers and can easily dodge their predators. Some leafhoppers emit a distress call that causes their predators to drop them off from host. Some of them have bright coloration which is suggested to be toxic but this information has not been reported yet (Hammond, 2018). Many insects like Hymenoptera, Tyrannidae and some small birds are known predators of leafhopper. Adults and nymphs are parasitized by pipunculid flies, dryinid wasp and epipyropid moths while mymarid and trichogrammatid wasp is the egg parasitoids of leafhoppers. The oldest Cicadellidae fossils are traced back to lower Cretaceous period. Leafhoppers have many associations like some species of genus Anteon, Aphelopus and Gonatopus are larval parasitoids of Cicadellidae. Their major role in the ecosystem is that they are the carrier of many plant diseases. Leafhoppers transmit bacteria, viruses and phytoplasmas. They sometimes directly injured the plants by feeding while sometimes indirectly by transmitting plant pathogens. For protection against various predators, some leafhoppers like Australian, *Kahaono montana* Evans usually build silk nests on underside of leaves of the same trees they live in.

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