

MANGO HOPPER: BIOECOLOGY AND MANAGEMENT- A REVIEW

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ABSTRACT

The mango leafhoppers, *Amritodus atkinsoni* (Leth.), *Idioscopus clypealis* (Leth.) and *I. niveosparus* (*nitidulus*) (Leth.) are serious pests of mango at the flowering and fruiting stages. Biology, seasonal abundance, sex ratio and population dynamics of mango hoppers has been studied by various workers. The concept of sampling, economic threshold, cultural practices and insecticidal sprays must be adapted to workout the need-based and judicious use of insecticides that will facilitate the IPM programme on mango.

In mango, very less work has been done on the integrated management of leafhoppers and the major portion of that has been done under the ICAR Coordinated Research Project on subtropical fruits. The work done earlier has been reviewed by Pruthi and Batra (1960), Naryanan and Batra (1960), Singh (1993) etc. In this review, an attempt has been made to compile and collate the information on bioecology and control of mango hoppers under the following headings:

Bioecology

All the three species of mango leaf hoppers, viz., *Amritodus atkinsoni* Leth., *Idioscopus clypealis* Leth. and *Idioscopus niveosparus* (*nitidulus*) Leth. are serious pests of mango all over India. These were first reported from Saharanpur in Uttarpradesh and described by Lethierry (1889) under the genus *Idiocerus*. Later, Baker (1915) put *clypealis* under genus *Idiocerus*. Maldonada Capriles (1964) transferred *atkinsoni* and *niveosparus* also to *Idioscopus*. Anufriev (1970), however, shifted *atkinsoni* to genus *Amritodus*. This species is more common in North India, although other species are equally or sometimes more abundant in certain years and certain pockets. Mango hoppers, especially *I. clypealis*, apart from India, have also been reported from Pakistan, Bangladesh, Taiwan, Burma, Sri Lanka, Philippines, Indonesia and Formosa (Baker, 1915; Kayashima, 1934; Ghauri, 1967). Within India, wide distribution of *A.*

atkinsoni and *I. clypealis* has been reported by Sen and Prasad (1954) and in North West India by Pruthi and Batra (1960). Tandon and Lal (1976) reported *I. clypealis* in severe form in Punjab, Haryana, U.P., Himachal Pradesh, Bihar, West Bengal, Rajasthan, Orissa, Gujarat, Maharashtra, Karnataka, Andhra Pradesh and Tamil Nadu. Das *et al.* (1969) recorded a new hopper, *Amrasca splendens* Ghauri from Kerala causing severe damage to mango plantation. Prasad and Bagle (1979) reported widespread attack of all the three species of hoppers, especially of *I. Clypealis*, in southern India. Viraktamath and Murphy (1980) found two more species *Idioscopus nigroclypealis* and *I. clarosignatus* on mango in Singapore. Viraktamath and Viraktamath (1985) reported three new species of mango hoppers namely *Busoniominus manjunathi*, *Idioscopus anasnyal* and *Idioscopus jayshriae* on mango in Karnataka. All the three species of hoppers are monophagous on mango (Uppal and Wagle, 1944; Pruthi and Batra, 1960). However, these were also reported feeding on the leaves of fig and cesiman (Bhatnagar, 1974) and sapota (Nayar *et al.*, 1979). All the three species of hoppers have a wedge-shaped body with a broad head and narrow abdomen towards the back. The hind pair of legs is well adopted for quick hops. *A. atkinsoni* is dark gray in colour, has spots on the abdomen and scutellum and measures 4.2-5.0 mm. *I. nitidulus* is slightly smaller with three spots on

the scutellum and a prominent white band across its light brown wings and measures 4.0-4.8 mm. *I. clypealis* is the smallest with two spots on the scutellum, dark spots on the vertex, light brown in colour and measures 3-5 mm (Singh and Mandal, 1969; Sohi and Sohi, 1990). Nymphs and adults suck sap from the inflorescence and leaves. The affected florets turn brown and dry up and the fruit setting is adversely affected (Lefroy, 1906). According to Niceville (1903), Hussain and Pruthi (1921) and Khan (1939) they caused 20-100 per cent yield loss. Cheema *et al.* (1954) and Gangolly *et al.* (1957) reported that the yield loss ranged from 25 to 30 per cent. While Wadhi and Batra (1964) reported 25 to 60 per cent yield loss in general.

Lefroy (1906) reported that leaf hoppers were found in large numbers on the mango trees throughout the hot weather, especially at the flowering season and their increase appeared to be assisted by damp winds during February and March. Hartless (1914) also supported Lefroy's viewpoint that their increase appeared to be assisted by damp winds such as the eastern winds. It is a common saying amongst the cultivators that if eastern winds prevail about the time of flowering, look out for "Chappee". Hussain and Pruthi (1921) described the nature of damage of *I. atkinsoni* and *I. clypealis*. The extent of damage is proportionate to the population of various species. Leaf hoppers excrete massive quantities of honeydew which imparts sugary shine to leaves and fruits and other plant parts and encourages growth of fungi *Capnodium mangiferum* and *Meliola mangiferae*, giving rise to growth of sooty mould that reduces photosynthetic efficiency of leaves and market quality of fruits. Physical injury is also caused to leaves, panicles and shoots while egg laying in their tissues. They also reported that thick vegetative growth and moist climate are favourable for the multiplication of leaf hoppers.

The biology and life history of *Idiocerus* spp. in Punjab were studied by Hussain and Pruthi (1924) and they reported that the females laid about 200 eggs inside the new leaves and inflorescence that hatched in 4-7 days. This was followed by 4 to 5 nymphal instars of about 18-20 days duration. *I. clypealis* began breeding a little later than *I. atkinsoni*. There is only one brood in Punjab but, in Mysore a second brood was reported during July to October in case of *I. atkinsoni* and *I. nieveosparsus*.

Uppal and Wagle (1944), Patel and Hadi (1953), Sen and Prasad (1954) reported that nymphs and adults inhabited the blossoms and cause flower fall that affects fruit setting. The nymphs cause maximum damage by draining more sap and honeydew secretion thus interfering with fertilization of flowers. Uppal and Wagle (1944) recorded egg laying of hoppers singly in tender tissues usually in the midrib of the leaves or in the axis of the flower buds. The translucent eggs later turn yellow. The young nymphs are white with two small red eyes that become yellow later. The nymphs moult four times at an interval of 2-4 days. The total life cycle takes 15-19 days. While Gangolly *et al.* (1957) reported that total life cycle of *A. atkinsoni* ranged from 22-26 days under laboratory conditions. They also stated that puncturing of tissues by hoppers on tender shoots and flowers caused yield losses. Morphological studies on *I. clypealis* were conducted by Pruthi and Batra (1960) who observed that female hoppers laid 100-200 eggs singly on the floral tissues and tender leaves. The eggs hatched in 7-10 days. The nymphal period ranged from 2-4 weeks. They reported that *I. clypealis* confined to the foliage while other species viz., *A. atkinsoni* and *I. nitidulus* inhabited the trunk of the tree. These insects overwintered as adults. Sen and Choudhury (1961) reported that infestation by hoppers gave a burnt appearance to the trees

and sooty mould interfered with the photosynthetic activity of infested trees. Similarly, Ramkrishna Ayyar (1963) observed that severely infested orchards presented a sickly sight. The trees are deprived of buds, the leaves appeared shiny, covered with sooty moulds and thousand of exuvae were found on shoots and leaves.

The damage caused by hoppers is known as "honey dew disease" (Theni Manzu) in many parts of Andhra Pradesh. Singh and Mandal (1969), Chari *et al.* (1969) and Bindra *et al.* (1971) have found reduction in fruit setting and premature fruit drop. Sathiyandam *et al.* (1972) noticed withering of flowers buds and flowers due to the hopper attack and even wilting in serious cases. In the Navsari area of southern Gujarat, Patel *et al.* (1975) studied the biology and seasonal incidence of *A. atkinsoni*. The adult population increased when the mango trees were in flowering, being maximum during June. The adult life span was longest (upto 3-4 days) on mango leaves and inflorescence. They also observed these hoppers rested in the cracks and crevices of the bark of mango tree during hot noon and rainy days. The females outnumbered males throughout the year except February, June and November. Tandon *et al.* (1983) reported the effect of environmental factors on the population of *I. Clypealis* and found that the population reached a peak during March-April and was least during December-January. A quadratic equation of maximum and minimum temperature and relative humidity was worked out that explained 89 per cent variations in hopper population. Patel *et al.* (1990) reported that males of *A. atkinsoni* preferred the lower portion while females preferred upper portion of the mango tree. The population started increasing with beginning of flowering season in January and adult count increased from March onwards but decreased gradually after July. Patel *et al.* (1989) reported that females usually preferred the upper part of the mango

tree in the month of February to April and September to November. However, both, male and female appeared to show a sort of migration to the lower part during April, May, June and July.

Corey *et al.* (1989) determined the economic injury levels of the *I. clypealis* on two cropping seasons of mango and observed an average of 4.21, 4.30, 4.45 and 4.55 adults/panicle at 2, 10, 18 and 26 days respectively after flower bud break. Tandon *et al.* (1989) worked out the spatial distribution, sampling plan and appropriate transformation for *I. niveosparsus* and reported that sampling can be conducted from any point on the tree as there was no significant difference in the distribution of nymphs between the north, south, east or west portions of the tree or between the upper and lower canopies.

The biology of three species of leafhoppers was studied under laboratory condition by Hiremath and Thontadarya (1991). They reported that all three species, *A. atkinsoni*, *I. niveosparsus* and *I. clypealis* have incubation period of 5-6 days and first larval instar occupied 2-3 days. The second, third and fourth instars of *A. atkinsoni* occupied 3-4, 2-3 and 3-4 days. While, in case of *I. niveosparsus* the respective nymphal instars occupied 2-3, 2-3 and 3-4 days and for *I. Clypealis*, these were 3-4, 3-4 and 3-4 days respectively. Adult longevity was 4-8, 4-7 and 3-6 days in all three species respectively. *A. atkinsoni* and *I. niveosparsus* could be reared on leaves or inflorescence while *I. clypealis* required inflorescence for rearing. According to Sheikh *et al.* (1993), minimum temperature less than 20°C kept the population of *A. atkinsoni* under control and outbreak of the pest could occur when the minimum temperature ranged between 20-25°C. Dalvi and Dumbre (1994) studied the seasonal incidence of mango hoppers in Dapoli, Maharashtra and reported that *A. atkinsoni* and *I. niveosparsus* bred three

times a year. The population gradually decreased from April to May, increased slightly during June-July as the pest bred on vegetative flush but, declined in August-September as breeding ceased. The population again increased in October-November but declined later. The populations again increased from mid December onwards as the pest multiplied profusely on flower panicles and reached a peak in the third week of March and second week of February, respectively followed by gradual decline until the end of March or early April. Hiremath and Hiremath (1994) reported that multiplication of hoppers was noticed during June-July, September-November and January-April. While *A. atkinsoni* and *I. niveosparus* bred on tender leaves and flowers, *I. clypealis* bred only on flowers and thus caused maximum injury to flowers. Khuhro *et al.* (1996) reported maximum range of 22.16 to 23.62 insects of mango hopper per shoot during March and 10.44 to 14.57 per shoot during September to first fortnight of November. Mild temperature between 28.86 to 32.68°C, with 69 to 80.5 per cent relative humidity and onset of inflorescence with new flush of leaves during January - March and September to October favoured pest multiplication. Haseeb *et al.* (1998) studied the biology, life history, seasonal abundance and natural enemy complex of *I. nitidulus*. According to them, the adults were dull brown in colour with forewings having two white bands. Nymphs were dull yellowish-brown to dark brown in colour. Life cycle was completed in 18-20 days. The pest was active from March to July. The population started building up from the second week of March and attained peak during April-May depending upon weather conditions. Moderate temperature during March-April may lead to building up of high population of this species. Khangura *et al.* (1998) studied the seasonal abundance of *A. atkinsoni* and *I. clypealis* on Dasheri and reported that pest was active throughout the

year except in January but the population was quite low during November-December. The population started building up in February and reached a peak by end April. High population was maintained during March to May and moderate during June to October. Thus the period from March to May was found to be quite favourable for multiplication of these pests as it coincided with the emergence of inflorescence.

Management

Shah *et al.* (1979) studied on comparative efficacy of a schedule-based versus need-based application of insecticides against the mango hopper and showed that a schedule in which application of insecticides was combined with fungicides resulted in greater yield and kept the population of *A. atkinsoni* below the threshold level.

Cultural measures There seems a lack in systematic work on the effect of pruning, clean cultivation, proper spacing, high-density orcharding and other cultivation practices on hopper populations in mango. As darkness and dampness are associated with increased population and rapid multiplication of this pest, therefore, keeping the orchard clean by regular ploughing, removal of weeds, of dead, diseased and excess branches to increase supply of light to various sides of the trees are considered advantageous in reducing the pest damage (Singh, 1993). Nachiappan and Baskaran (1983) reported that resistance in certain varieties of mango could be influenced by the presence of higher potassium in the inflorescence.

Use of botanicals Neem tree (*Azadirachta indica*) possess diverse biological effects like antifeedant, repellent and juvenile hormone activity. (Pradhan and Jotwani, 1971; Girish and Jain, 1974). Certain neem products and formulations have, therefore, been exploited for the control of these insects. Srivastava *et al.* (1993) tested two neem formulations, against

the nymphs of *I. Nitidulus*, an oil based concentrate that caused 100 per cent mortality under laboratory and field conditions at 1.5 % concentration and a kernel based concentration that caused 66.6 and 73.1 per cent mortality under laboratory and field conditions, respectively at 0.5 per cent concentration. He later found that both treatments were very effective against *I. nitidulus* (Srivastava, 1995). Verghese (2000) opined that efficacy of azadirachtin against *I. niveosparsus* was dependent on the level of hopper density as it was as effective as the synthetic chemicals only at low hopper (<4 per panicle) density. Singh (2000) compared efficacy of a neem formulation, Nimbicidine (0.2 %) with freshly prepared 4 per cent neem seed kernel extract (NSK) and reported significant reduction in hopper population (16 and 15.5 hoppers/5 panicles) as compared to control (47.6 hoppers/5 panicles) without adversely affecting the population of pollinators. These were at par with cypermethrin (0.0025%), imidacloprid (0.002%) and monocrotophos (0.05%).

Chemical control Chari *et al.* (1969) reported 0.1 per cent endosulfan and carbaryl to be more effective than dimethoate (0.1%), phosphamidon (0.1%) and DDT -sulphur dust in north India. Singh *et al.* (1974) reported 0.1 per cent carbaryl, 0.1 per cent fenitrothion and 0.03 per cent dimethoate to be better. Gandhali *et al.* (1975) found 0.03 per cent dimethoate, 0.03 per cent fenitrothion, 0.1 per cent mixture of carbaryl and sulphur (1:1), 0.2 per cent mixture of DDT and sulphur as effective control when applied four times at an interval of 21 days starting from pre flowering. Thontadarya *et al.* (1978) tried stem injection of dimethoate @ 0.5 ml a.i. per cm girth of the main trunk of the mango trees that caused reduction in hopper population as compared to check trees in Karnataka. Tandon and Lal (1979) screened nineteen insecticides against *I. clypealis* in Uttarpradesh and found 0.15 per cent carbaryl, 0.04 per cent monocrotophos, 0.05 per cent

phosphamidon and 0.05 per cent methyl parathion to be highly effective. Shah *et al.* (1979) recommended 0.03 per cent monocrotophos, 0.075 per cent endosulfan and 0.2 per cent carbaryl for controlling hopper population. Yazdani and Mehto (1980) tested eight insecticides against *A. atkinsoni* and found that the percentage of kill ranged between 39.85 and 66.86 per cent. They also found that dimethoate at 0.5 kg/ha was the best and 1.67 times more efficacious than methyl parathion. Kumar *et al.* (1985) found 0.05 per cent demeton-o-methyl causing rapid knock down in *A. atkinsoni* followed by 0.05 per cent monocrotophos and 0.05 per cent carbaryl both under laboratory and field condition. Datar (1985) found 0.01 per cent fenvalerate effective against *A. atkinsoni* followed by bromophos-ethyl, carbaryl and deltamethrin while phasolin, cypermethrin and permethrin were less effective. Keeping in view the problems associated with spraying of tall trees, Srivastava and Verghese (1985) recommended fogging of malathion and diesel in 1.5: 8.5 ratio. Pingle and Patil (1988) reported that 0.1 per cent carbaryl, 0.01 per cent permethrin and 0.03 per cent dimethoate reduced the population of *A. atkinsoni* and *I. niveosparsus*, but carbaryl was more effective against *A. atkinsoni* and permethrin against *I. niveosparsus*. Singh (1989) reported 0.005 per cent fenvalerate and cypermethrin and 0.002 per cent decamethrin to be very effective against *A. atkinsoni*. Shah *et al.* (1989) carried out experiment in a mango orchard in Gujarat and showed that one spray of one of the three pyrethroids namely permethrin, fenvalerate and cypermethrin maintained the nymphal population of the cicadellid at 5 nymphs/inflorescence over a period of 50 days and the adult population at 5 adults/sweep over a period of 105 days after spraying.

Khangura *et al.* (1993) found that endosulfan at 250 and 350 g a.i./acre and monocrotophos at 150, 250 and 350 g a.i./

acre were highly effective against *A. atkinsoni* and *I. clypealis* on mango in Punjab. Rajesh and Patil (1995) released nymphs of *A. atkinsoni* and *I. niveosparsus* on seedlings of mango treated with 0.008 per cent fluvalenat, 0.04 per cent monocrotophos and 0.1 per cent carbaryl and found this treatment as highly effective and persistent. Mishra and Choudhry (1996) recommended monocrotophos 0.03 per cent, endosulfan 0.05 per cent and carbaryl 0.2 per cent for the control of *A. atkinsoni*. Verghese (2000) found imidacloprid and lamdacyhalothrin @ 0.2 ml/lit effective against *I. niveosparsus* and comparable with monocrotophos.

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