Evaluation of newer insecticide molecules against leaf hopper, *Amritodesatkinsoni*Leth. infesting mango ecosystem

ABSTRACT

The study was carried out to the evaluation of newer insecticidesmolucules against mango leaf hopper, *Amritodesatkinsoni*Leth.infesting in mango cv. Dasheri. The treatments Thiomethoxam 25 WG (0.3 gm/L) and Imidacloprid 17.8 SL (0.3 ml/L) were found most effective against mango leaf hopper. Moreover, Clothianidin 50 WDG (0.25 gm/L), Difentheuron 50 WPand Acetamiprid 20 SP (0.5 gm/L) were next effective treatments against mango leaf hopper. The other treatments *viz*, Cypermethrin 10 EC (1.5 ml/L), Buprofezin 25 EC (1.0ml/L) and Azadirachatin 3000 PPM (3ml/L) were found leasteffective against mango leaf hopper.

Key words: Evaluation, insecticide, mango leaf hopper and mango

1. Introduction:

Mango, *Mangiferaindica*isconsidered as one of the most important fruit crop of tropical and subtropical region of India and is known as "king of fruits" for wide adaptability, attractive colour, delicious taste, exotic flavour, high nutritive value, richness in variety, attractive appearance and popularity among the people. In India the production of mango fruits is 20946.3 thousand metric tonnes with area of 2370.8 thousand hectare in 2021-22 (Indiastat, 2021). Both fresh fruits and processed products made from mangoes are in high demand. As a result, there is now a need to boost both mango fruit productivity andquality. The insets are one of the limiting factors for higher production of good quality fruits. Among different insect-pests, mangoleaf hoppers are recorded as major, most serious and wide-spread sucking pests throughout the year in mango ecosystem. Three species of mango leaf hoppers, *Amritodesatkinsoni, Idioscopusclypealis and Idioscopusnitidulus*remain active throughout the year and damage each crop stage from emergence of new flush to fruiting stages (Kumar*etal.*, 2005, Gundappa*etal.*, 2014, Turkhade *etal.*, 2015 and Bana*etal.*, 2016) and cause upto 100 percent yield losses. The leaf hoppers cause a loss of 20-100 percent of inflorescencesBoth nymphs and adults of leaf hoppers

suck the sap from the young leaves, tender shoots, inflorescences, panicles; branches and rachis of the young fruits which causes non-setting of flowers and dropping of the immature fruits. Leaf hoppers also excrete huge quantitiesof honey dew resulting in growth of sooty mould formation, thus affecting the photosynthetic activity of the plant, ultimately in poor fruit set and leads to reduction in yield. Dalvi*etal.*(2010) considered it as major pest of mango, and is directly responsible in reducing the yield qualitatively and quantitatively. Considering the importance and the damage potential of the pest. The presentstudy was carried out to know the efficacy of some newerinsecticide molecules against the mango leaf hoppers.

2. Materials and Methods

The investigation was conducted in the mango orchard (cv. Dasheri) of the different farmers villages in Siwan district of Bihar during 2020 and 2021.The experiment was carried out in Randomized Block Design with ten treatments including control. Uniformly flowering 10 to 12 years old trees was selected for imposing the treatments and the observations were taken on them considering one tree as one replication. Ten panicles were randomly selected / tree from all directions of lower part of the tree canopy during panicle initiation stage and tagged for recording observations. In each treatment except control, the need based applications of insecticides were given when the hopper population reached to five orexcluding five (nymphs and adults) on each randomly selected panicles of experimental tree. Spray fluid was preparedby mixing measured quantity of water and insecticides. Twenty litters of spray solution were used per tree. The respective insecticides were applied as a foliarspray on the tree with the help of tractor mounted power sprayer. An untreated check was also maintained for comparison. Population of mango leaf hoppers (nymphs and adults) were recorded visually on ten tagged panicles/tree. Leaf hopper population were counted one daybeforespraying and 7^{th}, 10^{th} and 15^{th} days after insecticidal application of each treatment and with the 1^{st} and 2^{nd} spray, respectively.

3. Results and Discussion

Different new insecticide molecules were tried to check their comparative efficacy against mango hopper during 2020 and 2021, and the results obtained are presented (Table-1Pooled). Analysis of data on mango hopper population recorded before treatments indicated non-significant results suggested that the hopper population was homogeneous. The hopper population

was recorded after 7 days of spraying showed that the superiority of treatment Thiomtehoxam by registering least number of hoppers/panicle (1.15) and it was at par with Imidacloprid,Acetamiprid, Difentheuron and Clothianidinnoted hopper population of 1.23, 1.58, 1.72 and 1.78/panicle, respectively. Cypermethrinexhibited 2.87 hoppers/panicle and it was statistically equally effective as letter Buprofezin (2.94/panicle).On the other hand, the highest number of hopper population per panicle was recorded in the treatment of Azadirachtin (3.38) but it was at par with Dimethoate (farmer's practice). After 10 days of insecticidal application, Thiomethoxam, Difentheuron,Clothianidin and Imidacloprid were statistically equally effective against mango hoppers and exhibited hopper population of 2.24 to 3.13/panicle, respectively. Acetamiprid, Cypermethrin, Buprofezin and Azadirachatin were also statistically equally effective (Table-1). At 10 DAS the maximum number of hopper population per panicle was recorded in Dimethoate (6.86) but significantly superior over the untreated check (10.48). Among all the tested insecticides, Thiomethoxam found statistically superior against mango hoppes after 15 days of insecticidal application by recording 3.06 hoppers/panicle. All the insecticidal treatments were significantly at par with them.Azadirachtin and Dimethoate treated trees exhibited 8.47 and 9.14 hoppers/panicles, respectively. The mean result of first spray showed that the treatment with Thiomethoxamregistered lower incidence of hopper/panicle (2.15) and it was at par with Imidacloprid, Clothianidin, Difentheuron and Acetamiprid exhibited 2.79, 3.34, 3.50 and 3.98 hoppers/panicle and they were at par with each other (Table-1).

The efficacy of insecticidal treatments on second spray against hopper population pooled data was given in Table-1. All the insecticidal treatments showed an increasing trend of hopper population at 15 DAS. The data recorded on seventh days after the second spray revealed that Thiomethoxamtreated tree recorded minimum hopper population (1.17), which was significantly at par with Imidacloprid (1.47) and followed by Clothianidin (1.73),Cypermethrin (1.84),Difentheuron (1.93), respectively.Buprofezin and Azadirachtin were found next effective treatment against mango hopper.The maximum hopper population was recorded in treatment of Dimethoateasfarmers practice (3.53). In contract to above 15.37 hoppers/panicle recorded in

untreated trees. After ten days of insecticidal application of treatments, the results showed that the treatment comprises of Thiomethoxam was found statistically superior in controlling the pest and the recorded 1.23 hoppers/panicle. Nexteffective treatments the Clothianidin, Difentheuron, Imidacloprid and Acetamipridand Cypermethrin, which were found statistically at par with each other and showing average surviving population of 1.82, 2.03, 2.10, 2.16 and 2.38 panicle, respectively. On 15th DAS, it was found that Thiamethoxam was the superior treatment (1:26 hoppers/panicle). Similarly Kapadia, *etal.* (2009) and Patel, *etal.* (2021) reported similar result. Next promising treatments were Clothianidin, Difentheuron, Imidacloprid and Acetamiprid recorded 1.86, 2.10, 2.19 and 2.24 hopper/panicle, respectively. Whereas,Buprofezin, Cypermethrin, Dimethoate recorded 2.33, 2.89 and 3.74 hopper/panicle, respectively. The maximum hoppers/panicle (3.83) recorded in the treatment of Azadirachatin, but significantly superior with respectto untreated trees(19.23 hoppers/panicle). The mean analysis of second spray, presented in Table- 1, showed higher effectiveness of Thiomethoxam by resisting lower hopper population (1.22) and it was at par with Imidacloprid, Clothianidin and Difentheuron, whichrecorded 1.69, 1.84 and 2.02 hoppers/panicle,respectively. These four treatments were significantly more effective than rest of the treatments. Acetamiprid, Cypermethrin and Buprofezin registered 2.16, 2.37and 2.58 hoppers per panicle, respectively and significantly more effective then Azadirachatin and Dimethoate (Farmer'spractice). Similar results were observed by Singh *etal.* (2011).

The overall mean values computed for two sprays, clearly indicated that the treatment of Thiomethaxom (1.69 hoppers/panicle and 87.74%. reduction over control) and Imidacloprid (1.92 hoppers/panicle and 86.08% reduction over control) were found statistically superior against mango hopper in comparison to rest of the insecticides tested. Difentheuron, Clothianidin and Acetamiprid werenext best effective treatments andexhibited 2.76, 2.59 and 3.07hoppers/panicle and 79.98%, 81.22% and 77.73% reduction over control, respectively. Cypermethrin noted 3.56 hoppers/panicleand 77.73% reduction over control and it was at par with Buprofezin (3.73 hoppers/panicle and 72.95.%. reduction over control. The highest population of hoppers (4.39)

was noticed in trees treated with Azadirachtin (68.16% reduction over control) and it was statically equally effective with Dimethoate as farmer's practice(5.06 hoppers/panicle and 63.31% reduction overcontrol). These two treatments were found poor in their effectiveness against mango hopper. In past, among evaluated different insecticides wereevaluated against hopper complex on mango, Thiomethoxam (0.0084%) was found most effective treatment noted by Kumar*etal.*(2009) and Patel*etal*.(2021). Tumbada*etal.* (2018) also observed Thiomethoxam 25 WG (0.0075%) and Acetamiprid 20 SP (0.005%) as the most effective treatments in checking the population of mango hopper.Munj and Rana (2016) reported that Thiomethoxam 25 WG and Acetamiprid 20 SP were equally effective. Azadirachtin as least effective against mango hopper and Acetamiprid 20 SP were at par with each other whereas, Buprofezin25 SC was found in next to order of toxicity against mango hoppers. Chaudhari*et.al* (2017) Concluded that Thiomethoxam 0.0025% showed superior effectiveness against mango hopper. Shawan*etal.* (2018) found Acetamiprid20 SP as on effective insecticide by controlling 93.33 percent hopper population when these were applied at 0.0025% concentration.Karar*etal.,* (2020) found Thiomethoxam@ 10 g/100 litre of water as the most effective for management of mango hopper. Kadavkar*etal.,* (2021) and Patel (2021) in a study reported that Thiomethoxam 25 WG effective insecticide followed by Buprofezin 25% SC and Azadirachtin against mango hopper. All these earlier findings are more or less in contrast with the present finding and fully support the present result.

The yield data (Table 2) revealed significantly higher marketable mango fruit yield of 232.67 kg/tree inThiomethoxam treated tree followed by Imidacloprid(228.24 kg/tree), Clothianidin (225.53kg/tree) and Difentheuron (224.31 kg/tree), all being at par with each other. Dimethoate (Farmer'spractice) treatedtree produced lower marketable fruit yield (192.43 kg/tree), but significantly more than untreated check (124.69 kg/tree) The Cost-benefit analysis of different sate of treatmentsrevealed that the maximum monitory benefit of Rs. 4319.20/tree accrued from Thiomethoxam treated tree.The most effective treatment in redacting the hopper incidence as well as fruit yield realised as per tree basis. Yet the highest benefit: cost ratio (4.33:1) was obtain in Thiomethoxam treated tree. This was followed by Imidacloprid (3.92:1), Difentheuron (3.89:1)

Clothianidin (3.31:1) Acetamiprid (3.30:1) and rather moderately efficiently by Cypermethrin (2.94:1), Buprofezin (2.58:1) and Azadirachtin(2.49:1). In comparison the benefit cost ratio of 2.16:1 were lowest recorded in farmer practices (Dimethoate). Similar results were recorded by Dalvi*etal.* (2010).

4. CONCLUSION

The conclude that thiomethoxam25 WG (0.3 gm/L) and Imidacloprid 17.8 SL (0.3 ml/L) were found most effective against mango leaf hopper management and Clothianidin 50 WDG (0.25 gm/L), Difentheuron 50 WP and Acetamiprid 20 SP (0.5 gm/L) were gave also encouraging response in themanagement of the pest.

References

Bana, J. K., Singh, P.and Makwana, A.2016. Influence of abiotic factors and crop stages on population dynamics of hoppers, *Idioscopus*spp. in mango ecosystem. *Ann. pl. protec. Sci.***24**(2): 286-289**.**

Chaudhari, A. V. Sridharan, S.and Sundar Singh, S. D. 2017.Management of mangohopper with newer molecules and bio-pesticides under ultra-high density planting system. *Entomol. andZool Stud.***5**(6): 454-458.

Dalvi, M.B., Pushpa, D. Patil and Raut, S.P. 2010.Pre-harvest fungicidal application for control of *Colletotrichumgloeosporioides* in alphonso mango fruit.*Ann. pl. protec. Sci.***18**(1): 361-362.

Gundappa, P. D. Jayanthi, K.and Veirghese A.2014. Migratory behaviour of mango hopper, *I dioscopus*spp. in relation to host plant flowering *phenology*; a synchronous shift.*Bioscan.***9**(2): 639–641.

Haseeb, M. 2006. Occurrence of fruit sucking bug on mango.*Ann. pl. protec. Sci.***14:** 218-219

Kapadia.M.N. Bhutani, P.G.Jeuthava, D.M. Varani, V.R. and Beria,N.N. 2009. Integrated management of mealy bugs in custard appl. *Ann. Pl. Protec. Sci*. **17**(2): 372-375**.**

Karar, H. Khan, A. H. Kiran, S. Iqbal, A.and Vlah, H.2020 Efficacy of various insecticidal modules against mango hopper, *Idioscopusclypealis*Lethierry (Hemiptera: Cicadellidae**)** "Samar BahishtChaunsa and their impact on yield. *Pure Appl. Biol*. **9**(3):1791-1759.

Kumar, S.B. Raghvani,R.andBhatt, R. I. 2005. Bio-efficacy of newer insecticide against hopper complex on alphonso mango in humid tropics of south Gujarat. *J. Appl. Zool. Res.***16**(1):64-66.

Munj, A.Y. and Rana, B.S. 2016.Population dynamics and management of mango hopper *Idioscopusniveasparsus* Lith.Under Konkan region of Maharashtra. Thesis Ph.D. (Agri).MaharanaPratapUniumnity of Agriculture and Tuchnology, Udaipur (Raj.).

Patel T. Shukla, A. and Patel,S. R. 2021. Bio-efficacy of chemical and bio-rational insecticides against hopper, *Idioscopusuitidulus* infesting mango. *Ann. Pl. Protec. Sci.*2**9**(2) : 88-92.

Samanta, A. Gosh, A. Hembran, T.K. Patra, S. and Somchowdhury, A.K. 2009.Efficacy of insecticides against mango hoppers and fruit yield.*Ann. Pl. Protec Sci.* **17**(1) : 225-274.

Shawan, S.I. Rashed, B.U. Mitra, A.S. and Jahan 2018.Efficacy of different chemical and botanical insecticides in Controlling mango hopper (*Amritodusatkinsoni* L.) *Adv. Plants Agric. Res.***8**(2) : 127-131**.**

Singh, Rajmdra; Prasad, C.S. and Tiwari, G. N. 2011.Efficacy of botanicals, bio pesticides and insecticides on mango mealy bug.*Ann. Pl. Protec. Sci.***18**(2) : 311–314.

Tumbada, R.D.Pokhrkar, D. S. and Datkhile, R.V. 2018.Efficacy of entomopathogenic fungi against mongo hoppers.*J.Pharmacogn and Phytochem.***7**(2) : 3198-3202.

Turkhade, P.D.Godase, S.K. Narangalkar, A. I. Dhekale, J.S. and Haldankar, P. M.2015.In-vitro efficacy of Entomo-pathogenic fungi against mangohopper," *Idioscopusniveosparus* (L).*Ann. Pl. Protec. Sci.* **23:**390-417**.**

Table -1 : Efficacy of newer insecticides against mango leaf hoppers during 2020 and 2021 (pooled)

Treatment	Dose g/ml/L	Mean number of mango hoppers/panicle										% reduction over control
		First Spray					Second Spray					
		1DBS	7 DAS	10 DAS	15 DAS	Mean	1 DBS	7 DAS	10 DAS	15 DAS	Mean	Over all mean	
Clothianidin 50 WDG	0.25 ml	5.28 (2.40)	1.78 (1.51)	3.13 (1.90)	5.11 (2.37)	3.34 (1.96)	6.36 (2.62)	1.73 (1.49)	1.82 (1.52)	1.86 (1.54)	1.84 (1.53)	2.59 (1.76)	81.22
Imidacloprid 17.8 SL	0.30 ml	5.67 (2.48)	1.23 (1.32)	3.02 (1.88)	4.12 (2.15)	2.79 (1.81)	6.03 (2.56)	1.47 (1.40)	2.10 (1.61)	2.19 (1.64)	1.69 (1.48)	1.92 (1.56)	86.08
Difentheuron 50 WP	0.50gm	6.35 (2.62)	1.72 (1.49)	2.91 (1.85)	5.87 (2.52)	3.50 (2.00)	6.63 (2.67)	1.93 (1.56)	2.03 (1.59)	2.10 (1.61)	2.02 (1.59)	2.76 (1.81)	79.98
Thiomethoxam 25 WDG	0.30gm	5.28 (2.40)	1.15 (1.28)	2.24 (1.67)	3.06 (1.89)	2.15 (1.63)	5.57 (2.46)	1.17 (1.29)	1.23 (1.32)	1.26 (1.33)	1.22 (1.31)	1.69 (1.48)	87.74
Acetamiprid 20 SP	0.50gm	4.96 (2.34)	1.58 (1.44)	3.94 (2.11)	6.41 (2.63)	3.98 (2.12)	6.01 (2.55)	2.08 (1.61)	2.16 (1.63)	2.24 (1.66)	2.16 (1.63)	3.07 (1.89)	77.73
Cypermethrin 10 EC	1.50 ml	6.14 (2.58)	2.87 (1.84)	4.18 (2.16)	7.24 (2.78)	4.76 (2.29)	7.23 (2.78)	1.84 (1.53)	2.38 (1.70)	2.89 (1.84)	2.37 (1.69)	3.56 (2.01)	74.18
Buprofezin 25 EC	1.00 ml	5.82 (2.51)	2.94 (1.85)	4.35 (2.20)	7.36 (2.80)	4.88 (2.32)	7.36 (2.80)	2.18 (1.64)	3.24 (1.93)	2.33 (1.68)	2.58 (1.75)	3.73 (2.06)	72.95
Azadirachitin 3000 PPM	3.00 ml	5.76 (2.50)	3.38 (1.97)	3.64 (2.03)	8.47 (2.99)	5.16 (2.38)	8.42 (2.99)	3.46 (1.99)	3.60 (2.02)	3.83 (2.08)	3.63 (2.03)	4.39 (2.21)	68.16
Dimethoate 30 EC (Former'sPractice)	2.00 ml	6.45 (2.64)	3.24 (1.93)	6.86 (2.71)	9.14 (3.10)	6.41 (2.63)	9.13 (3.10)	3.53 (2.01)	3.87 (2.09)	3.74 (2.06)	3.71 (2.05)	5.06 (2.36)	63.31
Untreated Check (Control)	-	6.59 (2.66)	8.26 (2.96)	10.48 (3.31)	11.65 (3.49)	10.13 (3.26)	12.63 (3.62)	15.37 (3.98)	17.73 (4.27)	19.23 (4.44)	17.44 (4.23)	13.79 (3.78)	0
SEm (±)	-	0.132	0.114	0.137	0.105	0.052	0.106	0.082	0.072	0.081	0.073	0.060	-
CD (P= 0.05)	-	NS	0.342	0.412	0.318	0.153	0.318	0.241	0.216	0.236	0.211	0.182	-

Figures in parentheses are $\sqrt{X + 0.5}$ transformation values.
DBS = Days before spraying, DAS = Days after spraying

Table – 2 : Economics of newer insecticides against mango leaf hopper during 2020 and 2021 (pooled)

Treatments	Dose g/ml/L	Yield (kg/tree)	Increased Yield over control	Value of additional yield over control (Rs./tree)	Cost of treatment (Rs/tree)	Incremental benefit (Rs/tree)	BC ratio
Clothianidin 50 WDG	**0.25 ml**	225.53	**100.84**	**4043.60**	**935.24**	**3098.36**	**3.31 : 1**
Imidacloprid 17.8 SL	**0.30 ml**	**228.24**	**103.55**	**4142.00**	**842.57**	**3299.43**	**3.92 : 1**
Difentheuron 50 WP	**0.50gm**	**224.31**	**99.62**	**3984.80**	**814.38**	**3170.42**	**3.89 : 1**
Thiomethoxam 25 WDG	**0.30gm**	**232.67**	**107.98**	**4319.20**	**810.65**	**3508.55**	**4.33 : 1**
Acetamiprid 20 SP	**0.50gm**	**2.18.45**	**93.76**	**3750.40**	**872.40**	**2878.00**	**3.30 : 1**
Cypermethrin 10 EC	**1.50 ml**	**210.18**	**85.49**	**3419.60**	**867.84**	**2551.76**	**2.94 : 1**
Buprofezin 25 EC	**1.00 ml**	**203.26**	**78.57**	**3142.80**	**875.52**	**2267.28**	**2.58 : 1**
Azadirachitin 3000 PPM	**3.00 ml**	**198.31**	**73.62**	**2944.80**	**843.37**	**2101.43**	**2.49 : 1**
Dimethoate 30 EC (Former's Practice)	**2.00 ml**	**192.43**	**67.74**	**2709.60**	**854.85**	**1854.75**	**2.16 : 1**
Untreated Check (Control)	**-**	**124.69**	**-**	**-**	**-**	**-**	**-**
SEm (±)	**-**	**5.653**	**-**	**-**	**-**	**-**	**-**
CD (P= 0.05)	**-**	**16.962**	**-**	**-**	**-**	**-**	**-**

Market price of mango fruits @ Rs. 40.00 / kg.