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Efficacy of different management schedules against mango shoot gall psylla, *Apsylla cistellata* (Buckton) (Hemiptera: Psyllidae)

GUNDAPPA, DEEPENDER SINGH and M. M. TRIPATHI

ICAR- Central Institute for Subtropical Horticulture, Rehmankhera, Lucknow, India-226 101
E-mail: Gundappa@icar.gov.in.

ABSTRACT: A study was undertaken in mango orchards (cv. *Dushehari)* to evaluate different management schedules (MS) against shoot gall psylla *Apsylla cistellata* at four locations *viz*., Braijalalpur and Barabhari in Sitapur district and Sohawal and Katrauli in Faizabad district for two years. Among the management schedules, MS-II comprising of first spray with profenophos was found superior with lower nymphs(4.58) per *in situ* ovipositional slit. Among the management schedules the lowest number of infested shoots (2.22 infested shoots/5 shoots) were observed in MS-IV, however in other management schedules also number of infested shoots were found on par each other except control. Lowest number of galls/shoot was recorded in MS- IV with 8.1 galls /shoot. Lowest number of nymphs/gall was observed in MS-IV with 3.80 nymphs/gall,MS-I, MS-II, MS-IV was found on par each other. With considering the lower number of infests shoots, galls/infested shoot and nymphs/gall MS-IV was found effective in reducing the shoot gall psylla infestation. This management can be used for effective management of the mango shoot gall psylla.

Keywords: Apsylla, mango, management, gall psylla

INTRODUCTION

Mango (*Mangifera indica* L.) is one of the most important fruit crops, grown in tropical and subtropical regions of the world. India is the largest producer of the mango with an average productivity of 8.3 tonnes/ ha (NHB 2017). Compare to the other countries India's productivity is lower and this is mainly due to constrains like abiotic and biotic stresses. Among the biotic stresses, insect pests and diseases cause considerable yield loss in mango. Among the insect pests, shoot gall psylla, *Apsylla cistellata* is regarded as one of the most noxious pests affecting the mango production. It produces galls on leaf axils and apical buds. Psylla converts the apical buds into hard conical galls within which psyllid nymphs are nourished and developed into adults. The nymphs suck the sap and exude whitish sticky droplets through their anal openings later galls gradually dry. Due to transformation of reproductive and vegetative buds into galls no fruit is set on affected shoots. The occurrence of this pest has been reported from Uttar Pradesh, Uttarakhand, Himachal Pradesh, Bihar, Jharkhand, West Bengal, Orissa and North Eastern states of India. In case of severe incidence the yield loss incurred due to this pest has been reported as 50-60 per cent (Gupta *et al*. 1994). In the recent past, the magnitude of shoot gall psylla damage on mango has been gradually increasing in many parts of the country. The studies on the management of mango shoot gall psylla were solely concentrated on insecticides. Bioefficacy of organophosphates, carbamates, neonicotinoids have been studied and they are found effective in reducing the pest incidence (Kumar 1988; Singh 2006; Kumar*et al*. 2007b; Singh 1995; Samui&Jha 2009). Till date no systematic study has been taken by targeting the weak life stages (eggs and nymphs) of the pest. Hence, this study was carried out to evaluate the different management schedules consisting of newer insecticides by of targeting the susceptible stages of the pest at different locations.

MATERIALS AND METHODS

This study was undertaken in mango orchards (cv. *Dushehari*) of 25-30 year age. Four different management schedules (Table 1) were evaluated for two years (2015-16 and 2016-17) at four locations *viz*., Braijalalpur and Barabhari in Sitapur district, Sohawal and Katrauli in Fiazabad district. The experiment was conducted in randomized complete block design (RCBD) with four replications. Management schedules were designed to target the weak life stages (eggs and nymphs) of the pest. Mango shoot gall psylla lays eggs during the last week of February nymphal emergence takes place during the first week of August, hence first spray was taken up during the first week of August and randomly leaf samples were sampled and brought to the laboratory. For first spray observation on the numbers of first instar nymphs in the oviposition slits were enumerated before and after 3, 7 and 14 days after spray. In the management schedule second spray was carried out during third week

of August. Third spray was taken up after the 15 days of the second spray. For second and third spray infested shoots/ 5 shoots, number of galls per infested shoot and number of nymphs per gall was counted. The data was subjected the analysis of variation (ANOVA) and the significance between the management schedules and the locations were tested with the 'F' statistic using SPSS (Ver.16.0).

RESULTS AND DISCUSSION

The experiment was conducted under field conditions to evaluate the effectiveness of management schedule on mango shoot gall psylla infestation. First spray was taken up by targeting first instar nymphal stages in the in situ ovipositional slits. After 14 days of the spray the significant difference was found between locations ($F_{3,240}$ = 21.94; p<0.00), different management schedules ($F_{4,240}$ = 66.27; p<0.000) and their interaction effects ($F_{12, 240}$ = 10.79 p<0.000) with respect to the number of first instar nymphal stages of *A. cistellata* in the ovipositional slits (Table 2).

Among the management schedules MS-II and MS-III consisted of first spray with profenophos and fipronil was found superior with 4.58 and 4.70 nymphs per ovipositional slit respectively. Among the locations lowest numbers of first instar nymphs were observed in Braijalalpur (7.3 nymphs/ovipositional slit) and Katrauli (9.03 nymphs /ovipositional slit) after 14 days of spray (Table 3).

Second and third spray in the management schedules were targeted for the nymphal emergence stage. In the analysis of variance significant difference was observed among the year, treatments, location, different months after spray and their interactions effect with respect number of *A. cistellata* infested shoots/5 shoots, number of galls /shoot and number of nymphs/gall. Among the years the significant difference was observed in number of nymphs / gall ($F_{1,240}$ = 8.113;p<0.005). Lowest number of galls/shoots was observed after three months of spray. The significant difference was observed among the locations with respect to number ofinfested shoots /5 shoots ($F_{3,240}$ = 5.258; p< 0.002), number of galls/shoot ($F_{3,240}$ = 8.194; p<0.00) and number of nymphs/gall ($F_{3, 240}$ = 3.753; p<0.012). Significant difference was recorded in the effect of treatments after different months of the spray with respect to number of galls/ infested shoots ($F_{2, 240}$ = 5.902; p<0.003). Lowest number of galls/infested shoot was recorded at three months after the spray with 8.32 galls/shoot.The significant difference was observed among the management schedules with respect to number of infested shoot / 5 shoots ($F_{4, 240}$ = 11.391 ; p< 0.00) number of galls/shoot ($F_{4, 240}$ = 10.754; p< 0.00) and number of nymphs/gall ($F_{4, 240}$= 16.761 p< 0.00). Between the management schedules lowest number of infested shoots (2.22 infested shoots/5 shoots) were

Table 1. Different management schedules for the management of mango shoot gall psylla.

Management Schedule	Particulars	Remarks
I	Azadirachtin (3ml/lit) first spray	Bio-intensive
	Neem oil (3ml/lit) second spray	
	Beauveria bassiana (5 g/l) third spray	
II	Profenofos (2ml/l) first spray	Chemical intensive
	Dimethoate (2ml/l) second spray	
	Thiamethoxam (1g/l) third spray	
III	Fipronil (0.5 ml/l) first spray	Newer molecules
	Acetamiprid (1ml/l) third spray	
	Quinalphos (2 ml/l) second spray	
IV	Buprofezin (0.3 ml/l) first spray	Bio-rational with
	Imidacloprid (0.5 ml/l) second spray	newer molecules
	Thiacloprid (0.3 ml/l) third spray	
V	Control	-

Table 2. Efficiency of management schedules on the *A. cistellata* first instar nymphs

Management Schedules	Mean number of first instars nymphs of shoot gall psylla feeding in-situ at ovipositional slits			
	Before spray	3 DAS	7 DAS	14 DAS
MS I	23.25^{ab}	13.83^{b}	12.70^{b}	13.37^{c}
MS II	26.542^{c}	9.00^{a}	7.87^{a}	4.58^{a}
MS III	23.62^{ab}	8.91^{a}	7.91^{a}	4.70^{a}
MS IV	20.87^{a}	15.37^{b}	8.458^{a}	9.20^{b}
Control	24.95^{ab}	20.08^{c}	16.75^{c}	18.87^{d}

*same letters in the column are not different in Tukeys' test at 0.05 % level of significance

Table 3. Efficiency of management schedules at the different locations on the *A. cistellata* first instar nymphs

Location	Mean number of first instars nymphs of shoot gall psylla feeding in-situ at ovipositional slits			
	Before spray	3 DAS	7 DAS	14 DAS
BraiJalalpur	23.26^{a}	12.8^{ab}	11.73^{b}	7.3^{a}
Barabhari	22.2^{a}	13.23^{ab}	12.4^{b}	14.6^{b}
Sohawal	28.16^{b}	11.96^{a}	11.03^{b}	9.66^{a}
Katrauli	21.76^{a}	15.76^{c}	7.8^{a}	9.03^{a}

*same letters in the column are not different in Tukeys' test at 0.05 % level of significance

Table 4. Efficiency of management schedules on the *A. cistellata* infestation

Management Schedules	Number of shoot infested/5 shoots	Number of galls per shoot	Number of nymphs/shoot
MS I	2.62^{a}	10.12^{b}	4.55^{a}
MS II	2.36^{a}	9.31^{ab}	4.31^{a}
MS III	2.34^{a}	7.68^{a}	4.25^{a}
MS IV	2.22^{a}	8.1^{a}	3.80^{a}
Control	3.63^{b}	13.0^{c}	7.65^{b}

*same letters in the column are not different in Tukeys' test at 0.05 % level of significance

Table 5. Efficiency of management schedules at different locations on the *A. cistellata* infestation

Location	Mean no. of shoots infested/5 shoots	Mean number of galls /shoot	Mean number of nymph/gall
BraiJalalpur	3.03[c]	8.4[a]	5.17[b]
Barabhari	2.26[a]	8.84[a]	5.25[b]
Sohawal	2.43[ab]	9.28[a]	3.9[a]
Katrauli	2.82bc	12.06b	5.3b

*same letters in the column are not different in Tukeys' test at 0.05 % level of significance

observed in management schedule IV, however in other management schedules also number of infested shoots were found on par each other except control. Lowest number of gall/shoot was recorded in management schedule IV with 8.1 galls /shoot. Lowest number of nymphs/gall was observed in management schedule IVwith 3.80 nymphs/gall, management schedule I, II, IV were found on par each other. With considering the lower number of infests shoots, galls/infested shoot and nymphs/gall management schedule IV was found effective in reducing the shoot gall psylla infestation (Table 4).

Between the locations lowest numbers of infested shoots were observed at Barabhari with 2.26 infested shoots/5 shoots. Lowest number of galls per infested shoot was recorded at Braijalalpur, Barabhari and Sohawal with 8.40, 8.84 and 9.28 galls/infested shoot respectively, and they are on par each other (Table 5).

Mango shoot gall psylla, *A. cistellata* is a very serious pest and cause significant yield loss. Management of this pest at appropriate time is utmost import to get the economic returns. Efficacy of different insecticides has been evaluated against *A. cistelleta* (Singh *et al.* 2015; Samui and Jha, 2009; Kumar *et al.* 2007; Monobrullah and Singh, 1997; Verghese and Srivastava, 1984; Verghese and Srivastava, 1990; Gupta and Joshi 1985). These studies revealed that the insecticides organophosphates, neonicotioids during August at fortnightly interval were proved effective in reducing the shoot gall psylla incidence. However, these studies were not targeted the weak links in the pest life cycle and not tested at multi locations. In this study we have evaluated four different management schedules consisting of different insecticides were tested at four locations for two years. The study revealed the significant difference among the management schedules, location and their interaction effect with respect to number of first instar nymphs in in-situ oviposition slits. Among the management schedules MS-II and MS-III consists of first spray with profenophos and fipronil significantly reduced the first instar nymphs in in-situ oviposition slits. This can be attributed to the ovicidal action of profenophos and fipronil. The ovicidal action of profenophos and fipronil was demonstrated for many insect pests by targeting their egg stages. First spray with insecticides having ovicidal action during the peak oviposition period reduce the shoot gall psylla effectively. There was also significant difference was found among the different management schedules, locations and their interactions with respect to the infested shoot / 5 shoots, number of galls/shoot and number of nymphs/ gall. Management schedule IV consisting imidacloprid followed by thiocloprid has reduced the *A.cistellata* incidence effectively. Similarly, Singh *et* al. (2015) reported that spraying of imidacloprid during the first week of August also reduced the incidence of *A. cistelleta* significantly. Samui and Jha (2009) also found spraying imidacloprid during the nymphal emergence stage of the *A. cistelleta* was reduced the pest incidence. They also reported that Azadarichtin was found effective against *A. cistellata*. In other management schedules consisting of thiomethoxam, dimethoate, quinalphos, acetamiprid has also reduced the incidence of *A. cistellata* significantly. These findings are corroborated with the findings of Samui and Jha (2009). They reported significantly lower number of galls per shoot on branches (0.13 galls/shoot) treated with quinalphos. In this study lower number of nymphs per galls were recorded in the management schedule II where the schedule consisting with dimethoate apart from the MS-IV. These findings were corroborated with the findings of Singh (1995) where lower numbers of nymphs per gall (0.8 nymphs/galls) were observed in the branches treated with dimethoate. Singh (2006) reported that single spray of dimethoate (0.27%), thiomethoxam (0.025%) and quinalphos (0.3%) during end of July reduced gall formation reduced up to 80 per cent. In present study by considering the lower number of infested shoots, galls/infested shoot and nymphs/gall in management schedule IV (cosists of buprofezinin first spray, imidacloprid second spray, thiacloprid third spray) was found superior. This management can be used for effective management of the mango shoot gall psylla.

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