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Research Article

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Monitoring and Analysis of Population Dynamics of the Leafhoppers on Mango

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ABSTRACT

Mango is the important fruit crop in India and it is infested severely by leafhopper causing damage ranged from 60-100 per cent. In the present experiment different leafhoppers populations were monitored on the mango tree of Kesar at College of horticulture, Bidar, during 2015-17 revealed that the I. nitidulus was more (4.68 per sweep), followed by A. atkinsoni (3.65) and lastly I. nagpurensis (3.23). The populations were more in flowering season in first year and low in offseason, but in second year the population were more in the beginning of the offseason after the highest record in fruiting season. During 2015-16, weather parameters such as maximum temperature and relative humidity (RH) showed significant positive correlation (r=0.59 to 0.74). Similarly, in 2016-17, wind speed showed positive significant correlation (r=0.57 - 0.62) and no relation such relation were observed with other climatic factors.

Keywords: *Leafhoppers, Mango, Kesar, Population dynamics, Weather parameters, Monitor.*

INTRODUCTION

The mango (*Mangifera indica* Linnaeus) is the India national fruit and called as "King of fruits" because of its wide adaptability, attractive colour, brilliant taste, exotic flavour, standard nutritive value, richness in variety, appearance and admiration among the masses. The distribution of the crop is as similar to apple in the temperate region. In India there are more than 1000 mango varieties are under cultivation, each varying in shape, size and taste (Singh, 1990; & Anant, 2016). On mango nearly 250 insect and mite pests of different stages been attacked and among the pests the leafhoppers are more economically important (Gangolly et al., 1957).

The leafhoppers *viz., Amritodus atkinsoni* (Lethierry), *Idioscopus nitidulus* (Lethierry) and *I. clypealis* (Lethierry) alone can cause 20-100 per cent inflorescence loss (Tandon & Verghese, 1985; & Kaushik et al., 2014). The occurrence of the *I. nagpurensis* is also predominant along with other species on mango (Viraktamath et al., 1994).

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The species like *I. nagpurensis*, *I. nitidulus* and *A. atkinsoni* were present throughout the study period (Viraktamath et al., 1996). In these species nymphs causes more damage than the adults, where the colonisation of the both was observed at vegetative and reproductive phases of the tree. Large number of nymphs and adults of the hoppers cluster on the lower side of the puncture tender shoots, inflorescences and leaves of mango tree and suck the sap (Tandon & Verghese, 1985; Pingale & Patil, 1988; Rahman & Kuldeep, 2007; & Kaushik et al., 2014). The infestation, abundance and severity of the pest is also influenced by various environmental factors besides plant resistance or varietal characters (Dhaliwal & Singh, 2004; & Kaushik et al., 2014). With the purpose to construct the suitable management techniques, it is a basic requisite to have thorough knowledge of the distribution seasonal abundance and damage potential of the leafhoppers. Present experiment is an endeavour to display leafhopper activity on different varieties in North-Eastern region of Karnataka.

MATERIALS AND METHODS

The field trial for the evaluation of mango varieties against leafhoppers was conducted during 2015-16 and 2016-17, at the research farm of College of Horticulture, Bidar. Analyses of the seasonal incidence of mango hoppers was conducted on five selected mango trees of Kesar variety by recording the data at fortnight during on season and monthly interval during off season by taking five sweeps in each direction.

The methodology followed for sampling on inflorescence was by selecting four-inflorescence in different direction of the individual tree and adults were recorded by visual counting. Similarly for sampling on the tree trunk, done by sweeping five times on the tree trunk and leafhoppers collected with an aspirator. During off season of the crop four sweeps in different direction on the foliage with a standard net was taken and leafhoppers collected using an aspirator and counted for documentation (Viraktamth et al., 1996). Further, the data on daily weather parameters were collected from the Agricultural Research Station, Bidar.

Statistical analysis

The data were subjected to square root transformation. The transformed data were analysed by one-way and two-way ANOVA and means were separated using SAS software. The correlation of weather parameters related to the leafhopper activity was calculated using IBM-SPSS 24.0 software (IBM CROP, 2016).

RESULTS AND DISCUSSION

Results revealed that, throughout the cropping season the *I. nitidulus* was collected more and it was followed by *A. atkinsoni* and *I. nagpuriensis* (Table 1). The highest total number of leaf hoppers were collected during first fortnight of April 2017 (17.43 leafhoppers/sweep) followed by 1st fortnight of April 2015 (16.70 leafhoppers/sweep). The highest number of *I. nitidulus* was collected during first week of July 2016 (10.12 leafhoppers) followed by first fortnight of April 2016 (6.78 leafhoppers). Whereas, maximum number of *A. atkinsoni* and *I. nagpurensis* was collected during first week of July 2016 *viz.,* 6.71 leafhoppers and 5.99 leafhoppers per sweep respectively (Table 1). Similarly, maximum number of *I. nagpurensis* was observed in July- August and they declined gradually during September to October (Viraktamath et al., 1994). On the other hand, during February and March, a moderate to high population of leafhoppers were observed on the inflorescence and leaves of mango (Abbas & Sharma, 1995). The *Idioscopus* spp. was comparatively more in 8th and 9th standard weeks (Lakshmi et al., 2010).

Among the total leafhopper infested the *I. nitidulus* was more (4.68 per sweep), followed by *A. atkinsoni* (3.65) and lastly *I.*

nagpurensis (3.23). It indicates that the population of *I. nitidulus* was more prominent in the mango orchard causing maximum damage for the yield of fruits and plant growth (Table 1). Similarly, more number of *I. nitidulus* was recorded on mango followed by *I. nagpuriensis* and *A. atkinsoni* (Viraktamath et al., 1994). In contrary *I. clypealis* was observed more and caused highest damage to mango crop in Jammu mango growing area (Sharma & Sharma, 2011).

Population dynamics of leafhoppers on mango

The population dynamics was studied on the five selected tree of Kesar variety, in the begging of the study the population collected was lowest with an approximate average of 5 leafhoppers/ 5 sweeps during first week of June 2015 and continued this trend for three months. There was sudden fall in the numbers were seen in the months of September first week to November first week of 2015 (0.8-2.5 leafhoppers). Later from second fortnight of December the steady rise in the populations were observed from ~4.5 to maximum of 19 leafhoppers in first week of April 2016 to till the end of the season (Fig. 1; Table 2). Similarly, hopper peak was in March to April (Kudagamage et al., 2001) and more population densities of hoppers were seen in April-May in Siahoo and March-April in Minab area (Pezhman, 2005).

Similar, during the second year the populations were started from the highest number ~13 leafhopper per sweep and there was a maximum catch in the successive month of July first week of about 35 leafhoppers (Fig. 2). The continuous peak of hopper population was also observed in June that was coincided with the vegetative flush of mango (Kudagamage et al., 2001; & Manjunath, 2014). Unlike first year the populations of leafhopper recorded in lowest number from October 2016 to January 2017 (Table 2 and 3). Similarly, minimum population of leafhoppers were observed during December to January in Siahoo and Minab area (Pezhman, 2005). Later, the population trend started in increasing way till the end of May 2017. In this year the lowest population count was in second fortnight of November 2016 (~4 leafhopper/sweep) and highest was in first week of July 2016 (~35 leafhopper/sweep) (Table 3). Maximum numbers of leafhopper population were recorded during April to May (Saeed et al., 2013) and their population remains least during the winter season (Joshi & Kumar, 2012).

In the first year (2015-16), the favourable maximum temperature and relative humidity (RH) were the important factors responsible for enhanced infestation of leafhoppers. On all the trees the maximum temperature, maximum and minimum relative humidity (RH) had significant positive correlation with "r" ranged from 0.59 to 0.74. But all the other factors does not so any such relation with hoppers infestation. In contrary during the second year 2016-17 the wind speed showed maximum relation with leafhopper infestation (r=0.57 - 0.62) and no relation were observed with other climatic factors (Table 4). Similarly, the various meteorological factors such as minimum temperature and vapour pressure showed positive correlation (Patel et al., 1994; & Varshneya & Rana, 2008). Similarly, strong positive correlation was observed between the mean number of hoppers and temperature (Saeed et al., 2013). In supporting with second year data, the negative influence of the relative humidity and wind showed the positive correlation for hopper infestation (Lakshmi et al., 2010). Similar to second year data temperature, rainfall and relative humidity showed non-significant relation with hopper populations (Anant et al., 2019).

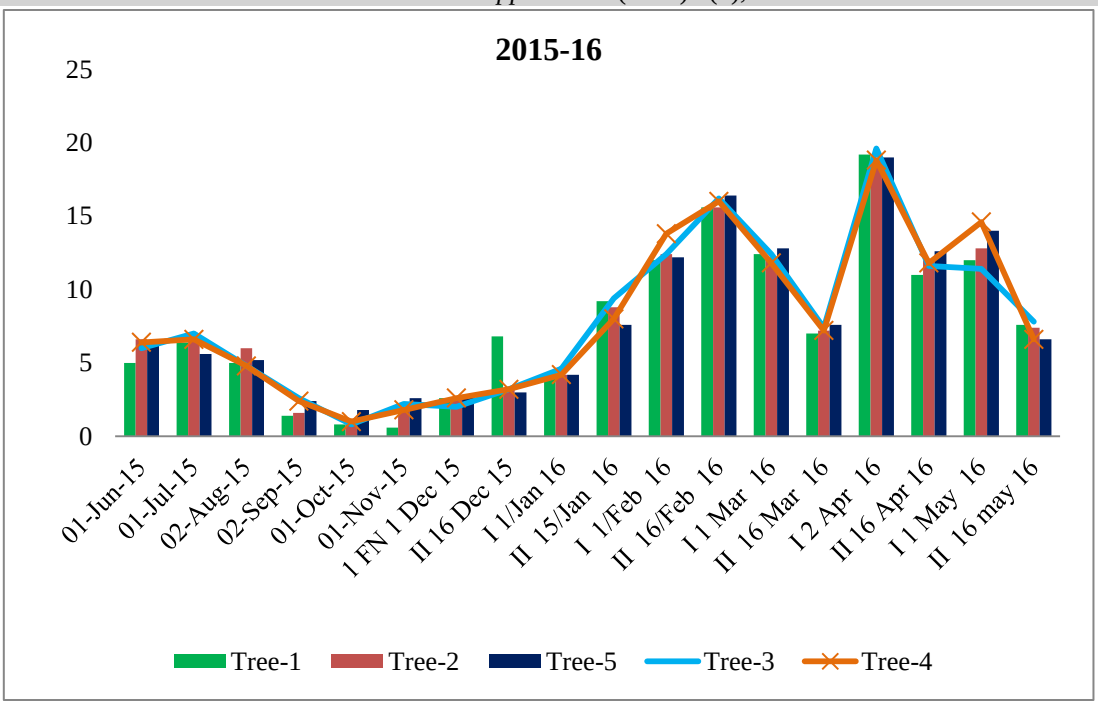

Fig. 1: Population dynamics of the leafhopper on mango variety during 2015-16 at COH, Bidar

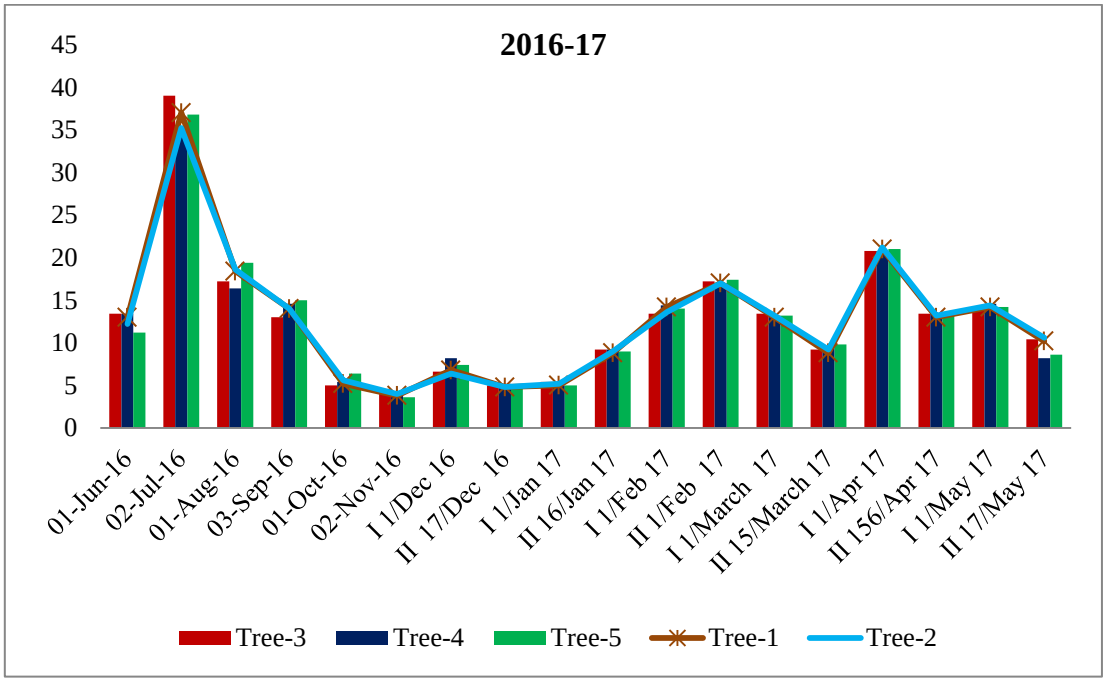

Fig. 2: Population dynamics of the leafhopper on mango variety during 2016-17 at COH, Bidar

Table 1: Seasonal incidence of the mango hoppers in the mango orchards of Halladakeri farm, COH, Bidar

Period	*Amritodus atkinsoni*	*Idioscopus nagpurensis*	*I. nitidulus*	Total leafhopper
01-Jun-15	2.97	2.63	3.82	9.41
01-Jul-15	3.03	2.66	3.97	9.67
02-Aug-15	3.16	1.99	3.41	8.55
02-Sep-15	1.58	1.54	2.31	5.43
01-Oct-15	1.23	0.88	1.59	3.71
01-Nov-15	1.64	1.19	2.15	4.99
I FN 1 Dec 15	1.60	1.88	2.51	6.00
II FN 16 Dec 15	2.35	1.98	3.12	7.45
I FN 1 Jan 16	2.64	2.27	3.00	7.91
II FN 15 Jan 16	3.74	3.14	4.36	11.24
I FN 1 Feb 16	4.29	3.57	5.56	13.42
II FN16 Feb 16	4.56	4.75	5.86	15.16
I FN 1 Mar 16	4.02	3.95	5.46	13.42
II FN 16 Mar 16	3.40	2.97	4.00	10.36
I FN 2 Apr 16	4.99	4.93	6.78	16.70
II FN 16 Apr 16	4.04	3.47	5.51	13.02
I FN 1 May 16	4.42	3.71	5.54	13.68
II FN 16 may 16	3.18	2.67	4.31	10.16
01-Jun-16	4.35	3.73	5.49	13.58
02-Jul-16	6.71	5.99	10.12	22.81
01-Aug-16	4.85	4.89	6.50	16.25
03-Sep-16	4.47	4.09	5.77	14.34
01-Oct-16	3.03	2.46	3.49	8.97
02-Nov-16	2.50	2.34	2.86	7.70
I FN 1 Dec 16	3.15	2.73	4.21	10.10
II FN 17 Dec 16	2.64	2.67	3.23	8.55
I FN 1 Jan 17	2.79	2.63	3.28	8.70
II FN 16 Jan 17	3.76	3.25	4.51	11.52
I FN 1 Feb 17	4.57	4.26	5.51	14.34
II FN 1 Feb 17	4.93	4.77	6.20	15.90
I FN 1 March 17	4.38	4.19	5.44	14.01
II FN 15 March 17	3.95	2.99	4.69	11.62
I FN 1 Apr 17	5.45	4.64	7.33	17.43
II FN 15 Apr 17	4.54	3.78	5.60	13.92
I FN 1 May 17	4.60	4.07	5.77	14.44
II FN 17 May 17	3.95	2.59	5.05	11.59
Ground Mean	**3.65**	**3.23**	**4.68**	**11.56**

The data are square root transformed values

Table 2: Seasonal Incidence of the mango leafhopper on the mango tree in Bidar 2015-16

Date of Observations	Tree-1	Tree-2	Tree-3	Tree-4	Tree-5
01-Jun-15	5 (2.19)	6.6 (2.54)	6 (2.38)	6.4 (2.50)	6.4 (2.45)
01-Jul-15	6.4 (2.51)	6.6 (2.56)	7 (2.58)	6.6 (2.48)	5.6 (2.32)
02-Aug-15	5 (2.21)	6 (2.45)	4.8 (2.15)	4.8 (2.10)	5.2 (2.24)
02-Sep-15	1.4 (1.17)	1.6 (1.23)	2.6 (1.60)	2.4 (1.38)	2.4 (1.52)
01-Oct-15	0.8 (0.68)	0.8 (0.68)	0.8 (0.68)	1 (0.88)	1.8 (1.31)
01-Nov-15	0.6 (0.60)	2 (1.26)	2.2 (1.28)	1.8 (1.18)	2.6 (1.43)
I FN 1 Dec 15	2.6 (1.58)	2.6 (1.58)	2 (1.38)	2.6 (1.55)	2.8 (1.65)
II FN 16 Dec 15	6.8 (2.56)	3.2 (1.75)	3.2 (1.56)	3.2 (1.57)	3 (1.55)
I FN 1 Jan 16	4 (1.97)	4.2 (1.98)	4.6 (2.06)	4.2 (2.01)	4.2 (1.99)
II FN 15 Jan 16	9.2 (2.99)	8.8 (2.91)	9.4 (3.02)	8 (2.81)	7.6 (2.71)
I FN 1 Feb 16	12 (3.39)	12.4 (3.38)	12.4 (3.41)	13.8 (3.62)	12.2 (3.39)
II FN16 Feb 16	15.6 (3.81)	15.6 (3.86)	16.2 (3.95)	16 (3.89)	16.4 (3.96)
I FN 1 Mar 16	12.4 (3.38)	12.2 (3.35)	12.4 (3.32)	11.8 (3.33)	12.8 (3.47)
II FN 16 Mar 16	7 (2.60)	7.2 (2.61)	7.4 (2.68)	7.2 (2.56)	7.6 (2.63)
I FN 2 Apr 16	19.2 (4.16)	18.6 (3.86)	19.6 (3.95)	18.8 (3.87)	19 (4.07)
II FN 16 Apr 16	11 (3.19)	12 (3.37)	11.6 (3.22)	11.8 (3.30)	12.6 (3.41)
I FN 1 May 16	12 (3.27)	12.8 (3.46)	11.4 (3.15)	14.6 (3.59)	14 (3.58)
II FN 16 may 16	7.6 (2.69)	7.4 (2.42)	7.8 (2.66)	6.6 (2.50)	6.6 (2.26)
Mean	7.7 (2.50)	7.81 (2.51)	7.85 (2.50)	7.86 (2.51)	7.93 (2.55)
S.EM=	0.25	0.27	0.32	0.25	0.24
SE.d=	0.36	0.38	0.45	0.35	0.35
CD	0.71	0.75	0.89	0.70	0.69

Figures in parentheses are square root transformed values

Table 3: Seasonal Incidence of the mango leafhopper on the mango tree in Bidar 2016-17

Date of Observations	Tree-1	Tree-2	Tree-3	Tree-4	Tree-5
01-Jun-16	13 (3.57)	12.2 (3.40)	13.4 (3.58)	13.4 (3.61)	11.2 (3.30)
02-Jul-16	37 (6.03)	35.2 (5.89)	39 (6.19)	35.4 (5.91)	36.8 (6.01)
01-Aug-16	18.4 (4.20)	18.6 (4.24)	17.2 (4.08)	16.4 (3.97)	19.4 (4.34)
03-Sep-16	14 (3.68)	14 (3.70)	13 (3.58)	14.6 (3.77)	15 (3.80)
01-Oct-16	5.2 (2.27)	5.6 (2.34)	5 (2.23)	5.4 (2.31)	6.4 (2.51)
02-Nov-16	3.8 (1.89)	4 (1.91)	4.6 (2.08)	4.2 (1.82)	3.6 (1.88)
I FN 1 Dec 16	6.8 (2.54)	6.4 (2.26)	6.6 (2.29)	8.2 (2.76)	7.4 (2.43)
II FN 17 Dec 16	4.8 (1.95)	4.8 (2.14)	5 (2.19)	5.2 (2.26)	5 (2.20)
I FN 1 Jan 17	5 (2.16)	5.2 (2.24)	5.4 (2.29)	5 (2.20)	5 (2.15)
II FN 16 Jan 17	8.8 (2.87)	9 (2.94)	9.2 (2.96)	9.2 (2.71)	9 (2.85)
I FN 1 Feb 17	14.2 (3.67)	13.6 (3.57)	13.4 (3.51)	14.4 (3.67)	14 (3.64)
II FN 1 Feb 17	17 (3.97)	17 (3.99)	17.2 (3.99)	17 (3.92)	17.4 (3.96)
I FN 1 March 17	13 (3.49)	13.2 (3.55)	13.4 (3.54)	13.2 (3.48)	13.2 (3.54)
II FN 15 March 17	8.8 (2.87)	9.2 (2.93)	9.2 (2.97)	9.6 (2.98)	9.8 (2.96)
I FN 1 Apr 17	21 (4.42)	21.2 (4.44)	20.8 (4.40)	20.8 (4.36)	21 (4.42)
II FN 15 Apr 17	13 (3.49)	13.2 (3.48)	13.4 (3.51)	13.4 (3.57)	13.4 (3.55)
I FN 1 May 17	14.2 (3.67)	14.4 (3.72)	14 (3.69)	14.6 (3.72)	14.2 (3.69)
II FN 17 May 17	10.2 (3.16)	10.6 (3.19)	10.4 (3.14)	8.2 (2.82)	8.6 (2.89)
Mean	12.67 (3.33)	12.63 (3.33)	12.78 (3.34)	12.67 (3.32)	12.8 (3.34)
S.EM=	0.15	0.19	0.20	0.22	0.19
SE.d=	0.22	0.27	0.29	0.31	0.26
CD (P=0.05)	0.43	0.55	0.57	0.62	0.53

Figures in parentheses are square root transformed values

Table 4: Correlation between leafhoppers and abiotic factors on different trees of mango during 2015-17

Weather Parameters	2015-16					2016-17				
	Tree-1	**Tree-2**	**Tree-3**	**Tree-4**	**Tree-5**	**Tree-1**	**Tree-2**	**Tree-3**	**Tree-4**	**Tree-5**
Rainfall	-0.29	-0.22	-0.25	-0.17	-0.18	0.28	0.27	0.26	0.30	0.29
Min Temp	0.70*	0.74*	0.73*	0.73*	0.77*	0.13	0.16	0.13	0.13	0.10
Max Temp	0.37	0.45	0.42	0.42	0.46	0.43	0.45	0.42	0.40	0.40
Max RH	-0.66*	-0.65*	-0.66*	-0.64*	-0.66*	0.07	0.04	0.06	0.06	0.08
Min RH	-0.65*	-0.59*	-0.60*	-0.59*	-0.60*	0.35	0.33	0.33	0.33	0.36
Wind speed	-0.19	-0.18	-0.17	-0.20	-0.21	0.62*	0.61*	0.62*	0.57*	0.58*

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