

POPULATION TREND AND VARIETAL PREFERENCE OF MANGO MEALY BUG, *DROSICHA MANGIFERAE* (GREEN)

Abdul Waheed Solangi* Abdul Ghani Lanjar *Maqsood Anwar Rustamani * Sajjad Ali Khuhro* and Mehar ul Nissa Rais**

*Department of Entomology, Sindh Agriculture University, Tandojam.

**Department of Agriculture economics, Sindh Agriculture University, Tandojam.

Corresponding author: Abdul Waheed Solangi

Email: solangiwaheed@gmail.com Ph. #. +92-3063587142

ABSTRACT: The experiment on population trend and varietal preference of mango mealy bug, *Drosicha mangiferae* (Green) was carried out in a 40 acre mango orchard at Jeelani Farm, Kamaro Sharif near Tando Allahyar from December 2011- March 2012. The orchard has 20-30 years old mango trees of Sindhri, Saroli, Sonaro, Chaunsa, Fajri, Began pali and Langra varieties. Five randomly selected trees of each variety were examined for mealy bug population on their trunk, shoots, branches and fruits. Results revealed that the population of 1st instar mealy bug nymphs emerged from soil in 1st week of December and started crawling on tree trunk till 1st week of February 2012. Maximum up ward movement was recorded in the last week of January. Sindhri variety had significantly maximum over all seasonal population (73.60 ± 9.49) per 10 cm² on the trunks compared with Saroli (66.74 ± 12.26), Chaunsa (63.57 ± 9.07), Langra (59.74 ± 9.19), Fajri (45.22 ± 8.47), Sonaro (35.13 ± 7.43) and Began pali (30.37 ± 7.37), respectively. After trunk, the majority of 1st climbers moved to bottom shoots and the following to the middle and the end climbers to top shoots. Maximum upwards movement on shoots was recorded from 1st to 3rd week of January. Saroli, Sindhri, and Sonaro had more population on bottom shoots i.e. (34.6 ± 13.17), (34.3 ± 11.26), and (17.42 ± 6.39) per 10 cm², respectively. However, over all mean of all varieties showed that the maximum population (21.32 ± 2.40) of nymphs was recorded on top shoots compared with middle (21.30 ± 2.27) and bottom shoots (21.26 ± 3.78), respectively. Similarly, top branches had significantly ($P < 0.01$) maximum nymphal population (19.04 ± 3.48) followed by middle (16.88 ± 4.05) and bottom shoot (14.54 ± 2.59) branches. Mealy bug behaved differently in case of fruits, its maximum activities on fruits were recorded from last week of February to 1st week of March on fruits. The overall maximum mean population (5.10 ± 0.56) was recorded on middle fruits followed by bottom (4.89 ± 1.10) and top fruits (3.69 ± 0.40). On overall population base, it is concluded that sindhri had significantly maximum nymphal population ($P < 0.01$) followed by Saroli, Chuansa, Langra, Fajri, Sonaro and Began pali.

KEY WORDS: Mango mealy bug, mango varieties, Population trend

INTRODUCTION

Mango (*Mangifera indica* L.) a member of family Anacardiaceae is known as the king of fruits for its sweetness, excellent flavor, delicious taste and high nutritive value [1] and [2]. This important tropical fruit is being grown in more than 100 countries [3]. Pakistan is standing at 5th place by contributing 916.4 MT mangos, which is 3.9% in the total world production [4] [5]. A number of insect pests are known to attack the mango trees that influence yield of mango with respect to quantity and quality. Among mango insect pests mango mealy bugs, *Drosicha mangiferae* is one of the most important pests and serious threat to mango orchards [6] and [7]. The host range of *D. mangiferae* included 62 host plants under 51 genera and 28 families, which included fruit crops, forest trees, ornamental plants and weeds [8]. The nymphs and adult of mango mealy bug suck sap from inflorescence, tender leaves, shoots and fruits. As a result, the affected inflorescences are shriveled and get dried. In case of severe attack, fruit setting is severally affected. They also secrete honey dew on leaves, fruits and shoots [8], consequently, photosynthetic activity is reduced [9]. Mealy bug infestation caused significant losses in size and weight mango fruits [10], which can rise up to 80 percent [11] and [12]. Variation in population density of phytophagous insects among conspecific trees is known to be very high [13]. This

variation in susceptibility may be genetic, or phenotypic due to differences in environmental factors such as the nutritional status of the soil [14] or air pollution [15], or variation in plant age or seasonal phenology [16] as well. In tropical forests, for instance, a strong correlation was observed between renewal of foliage (flushing) and abundance of herbivores, especially Homoptera [17]. Population trend of mango mealy bug varies from orchard to orchard and varieties to variety. Temperature and relative humidity have been reported to play an important role in the development of *D. stebbingi* [18] and [19]. However, [20] reported that fluctuations in populations of mango mealybug on mango are linked to the physiological and phenological characteristics of the host plant than to climatic factors. Seasonal changes play an important role on population fluctuations of mango mealy bug. [21] mentioned that the population of mango mealy bug decreased during the rainy season and peaked during dry season. There are 1,000 different cultivars of mango throughout the world, but Pakistan offers a wide choice of ca 3500 mango cultivars [22]. The most famous and large scale grown commercial cultivars of mango are 'Sindhri', 'Dusehri', 'Chaunsa' ('Summer Bahist'), 'Black Chaunsa', 'Sufaid Chaunsa', 'Fajri', 'Malda', 'Sensation', 'Anwar Ratul', 'Ratul-12' and 'Langra'. All these cultivars differ in taste, flavor, and canopy height and leaf size. Antibiosis, Antixenosis and

tolerance are three modalities of host plant resistance [23], [24], [25]. Like other insect pests, mango mealy bug also has a varietal preference to mango cultivars, and its population varies from variety to variety [26]. Since, Sindh has the most favorable environment for mango cultivation and the most of the mango varieties are being cultivated in Sindh province particularly in southern Sindh. Therefore, the present studies were conducted on population trend of mango mealy bug to some common varieties of mangoes in Sindh.

MATERIALS AND METHODS

The experiment was carried out in the mango orchard of 40 acre area at Kamaro Sharif near Tando Allahyar district of Sindh province during December 2011- March 2012. The orchard has 20-30 years old mango trees of Sindhri, Saroli, Sonaro, Chaunsa, Fajri, Began pali and Langra varieties. Five trees from each variety were selected randomly to examine mealy bug population. Trunk, Shoots, branches and fruits of the selected plants were kept under observation. Observation on mealy bug population on the trunk of mango plant was taken by selecting three spot of 10 cm². For this purpose a metal frame was made and randomly kept at different heights/sides of the trunk; mealy bug instars confined with in a metal frame were counted. Similarly, counting of the mealy bug on various shoots was made. The counting on mango branches was also made by selecting branches at various heights of mango tree.

About 30-cm branch was examined for mealy bug population. An iron ladder was used to approach the upper branches of mango tree. The same procedure was adopted to count mealy bug population on mango panicles and fruits. Observation was taken at weekly interval. All selected tree were tagged to keep them under observation till the end of the experiment. The meteorological record was maintained during course of study. The average population of mealy bugs per trunk, branches, shoots, panicle as well as fruits was ascertained. The data thus obtained were statistically analyzed by using statistix 0.8 package.

RESULTS

Population on trunk

Table 01 reveals that the population of 1st instar mealy bug nymphs emerged from soil in 1st week of December and started crawling on tree trunk. Initially maximum average population per 10 cm² area was recorded as 76.93±13.12 on langra variety while minimum 31.93±6.97 on fajri on 10th December 2011. The maximum upward movement was recorded in the following week i.e. on 18th December. The data collected on 18th December indicated that the highest mean population (124.73±11.73 crawlers per 10 cm²) was recorded on Sindhri, followed by Saroli (103.46±17.13), Chaunsa (97.33±13.15), Langra (84.13±10.58), Fajri, (76.2±11.89) Sonaro (46.8±7.95), and Began pali (33.2±8.56), respectively. This upward movement remained more or less constant up to 1st week on January. Afterwards the population declined; however, the maximum mean population was recorded (39.0±7.39) on the trunks of Sindhri variety and minimum (29.2±7.58) on Fajri. No

upward movement on tree trunk was recorded on 10th Feb. 2011. Over all seasonal populations on the trunks of various varieties. The Sindhri variety had (73.60±9.49) mealy bugs per 10 cm² on trunk compared with Saroli (66.74±12.26), Chaunsa (63.57±9.07), Langra (59.74±9.19), Fajri (45.22±8.47), Sonaro (35.13±7.43) and Began pali (30.37±7.37), respectively. Analysis showed that Sindhri had a significantly highest population (F= 25.17, DF= 6, P< 0.01) followed by Saroli, Chaunsa, Langra, Fajri, Sonaro and Began pali while LSD showed non-significant population on Chaunsa and Langra and between Sonaro and Began pali.

Population on shoots

After tree trunk the nymphal population than moved to mango plant shoots. They were scattered moved to various positioned shoots i.e. bottom, mid and top shoots. In initial stage, i.e. during 1st week of January, Maximum movement was recorded towards bottom shoots on all varieties. Data in Table 02 indicate that during 1st week of January the populations on bottom shoots of different varieties were recorded as (82.8±26.04), (67.0±12.41), (23.0±6.31), (27.6±8.91), (17.0±3.61), (37.4±13.97) and (29.4±8.64) on Saroli, Sindhri, Fajri, Langra, Began pali, Chaunsa and Sonaro varieties, respectively. Afterwards, the majority of the nymphs were seen moving to middle and top shoots. The maximum overall mean population was recorded as (34.6±13.17) and (34.3±11.26) on bottom shoots of Saroli, Sindhri and Sonaro varieties. Whereas Fajri, Langra Began pali varieties had maximum population on their middle shoots compared with Sonaro which had more population on top shoots. Analysis of variance shows significant difference (F= 25.17, DF= 6, P< 0.01) in the population of mealy bug nymphs moving up ward on mango plant shoots at various heights. However, LSD showed non-significant difference in the nymphal population moving on middle and top shoots of all varieties of mango plants at P<0.05.

Mango mealy bug on branches

The data in Table 3 showed the population of mealy bug nymphs on branches of different varieties of mango plants. Like, the population recorded on shoots of different varieties, the branches had the same trend of mealy bug population. Maximum activities of mealy bug nymphs were recorded on Sindhri (32.72) per 30-cm followed by Saroli (22.74), Chaunsa (19.46), Fajri (13.50), Began pali (12.97), Sonaro (9.49) and Langra (6.86). The results also depicted that middle branches of Sindhri variety had more population (36.72±4.59) compared with top (34.82±4.66) and bottom (26.62±4.80) during 2011-2012. The overall mean population of all varieties showed that top branches had a significantly maximum population of mango mealybug i.e. 19.04 per 30-cm branch followed by middle branches had (16.88) individuals per 30cm branch. The bottom branches had significantly the lowest population of mealy bugs i.e., 14.54 per 30-cm branch. Analysis of variance showed that there was highly significantly different in population of mealy bug on bottom middle and top

Table 01. Mean population of mango mealy bug on trunk of different varieties of mango during 2011-2012.

Dtae	Saroli	Sindhri	Fajri	Langra	Began Pali	Chaunsa	Sonaro
10/12/2011	44.46±9.55	50.0±9.05	31.93±6.97	76.93±13.12	33.33±8.54	71.66±6.96	38.4±9.51
18-12-2011	103.46±17.13	124.73±11.73	76.2±11.89	84.13±10.58	33.2±8.56	97.33±13.15	46.8±7.95
26-12-2011	102.86±16.80	117.93±11.03	69.53±12.53	80.33±10.75	32.53±8.51	88.0±10.72	46.8±7.95
3/1/2012	90.06±15.50	113.4±12.63	72.46±11.10	77.13±11.36	33.8±8.48	89.86±12.75	46.66±7.99
10/1/2012	89.4±15.73	92.86±11.96	58.93±10.51	63.93±9.01	29.06±7.04	87.93±12.20	39.86±6.62
18-01-2012	65.2±11.69	75.8±13.06	41.53±10.13	75.0±11.15	37.4±9.34	59.26±12.58	39.42±10.52
26-01-2012	70.46±15.38	48.73±8.56	27.2±5.48	45.73±9.04	39.86±8.03	43.26±6.97	35.66±9.89
2/2/2012	34.8±8.56	39.0±7.39	29.2±7.58	34.46±7.66	34.2±7.85	34.8±6.35	23.26±6.62
10/2/2012	0±0	0±0	0±0	0±0	0±0	0±0	0±0
Mean & S.E	66.74±12.26	73.60±9.49	45.22±8.47	59.74±9.19	30.37±7.37	63.57±9.07	35.13±7.43

Table 2. Mean population of mango mealy bug on shoots of different varieties of mango during 2011-2012.

Date	Plant level	Variety						
		saroli	sindhri	Fajri	langra	Began pali	Chaunsa	Sonaro
18/12/2011	Bottom	11.2±6.09	9.0±2.16	5.2±1.85	3±1.41	4.8±2.59	11±3.40	11±3.24
	Middle	7.4±1.88	7.2±2.81	4±1.58	3.6±1.56	4±1.58	11±1.94	4.6±1.80
	Top	6.4±2.83	8.4±3.37	4.8±1.65	2.8±1.06	4.8±1.65	11.2±1.88	4.2±3.03
26-12-2011	Bottom	23.4±14.6	41.8±21.51	15.6±8.10	17.2±11.26	7.8±3.29	23.0±12.38	7.8±3.29
	Middle	10.8±4.35	8.2±1.06	4.4±1.36	5.2±1.77	4.8±1.46	13.0±5.74	7.4±2.01
	Top	6.0±1.51	9.6±3.17	3.2±0.96	6.0±1.22	3.2±1.15	4.4±1.80	7.0±1.81
3/1/2012	Bottom	47.8±21.72	38.4±16.29	18.2±7.54	17.2±11.26	13.0±1.44	23.0±12.38	21.18±8.59
	Middle	24.4±14.0	21.6±13.99	27.2±17.46	28.2±10.62	7.8±3.29	47.2±10.86	13.4±1.53
	Top	13.8±4.31	9.4±1.02	5.4±1.56	9.0±3.53	5.8±1.15	8.4±1.74	19.8±6.59
10/1/2012	Bottom	82.8±26.04	67.0±12.41	23.0±6.31	27.6±8.91	17.0±3.61	37.4±13.97	29.4±8.64
	Middle	39.6±9.93	53.0±17.62	35.2±15.78	32.2±17.37	15.6±2.87	53.2±9.55	31.4±18.21
	Top	64.0±15.00	59.0±15.15	40.6±14.01	49.4±18.84	21.8±5.70	37.8±16.21	35.4±15.01
18-01-2012	Bottom	66.8±21.80	59.8±19.84	18.4±7.46	22.8±14.79	15.0±1.67	29.0±15.95	22.6±8.44
	Middle	24.4±14.00	41.8±21.51	28.8±17.14	34.2±14.04	32.4±17.95	45.2±11.05	13.4±1.53
	Top	69.2±15.87	54.0±17.66	34.8±11.80	26.2±13.56	19.8±6.11	37.8±16.21	35.4±15.01
26-01-2012	Bottom	29.2±11.42	51.8±15.49	11.0±4.39	20.8±12.83	16.8±2.45	44.6±18.67	26.4±8.65
	Middle	21.8±8.66	30.4±11.88	23.6±13.37	25.8±12.23	32.4±17.95	48.6±11.6	15.2±3.33
	Top	52.6±11.71	43.0±15.19	23.4±13.36	28.8±12.65	17.8±4.25	34.8±15.70	23.4±6.47
2/2/2012	Bottom	55.4±19.56	60.2±19.33	17.2±8.03	22.8±14.79	17.0±0.89	44.6±18.67	22.6±8.44
	Middle	26.6±13.33	52.2±18.80	28.8±17.14	40.2±18.12	32.4±17.95	54.8±11.97	13.4±1.53
	Top	66.6±16.88	45.0±14.52	20.4±5.85	48.6±19.13	23.8±7.46	41.4±14.6	39.4±14.02
10/2/2012	Bottom	29.4±10.44	15.0±5.59	17.4±7.92	16.8±8.95	14.8±1.62	32.6±14.63	32.6±14.63
	Middle	24.6±11.37	32.0±13.84	28.8±17.14	28.2±12.97	25.4±10.99	46.8±8.40	46.8±8.40
	Top	50.8±11.65	45.0±14.52	52.0±17.46	26±5.90	23.8±7.46	26.0±5.90	26.0±5.90
Mean & S.E	Bottom	34.6±13.17	34.3±11.26	12.6±5.16	14.82±8.42	10.62±1.76	24.52±11.00	17.42±6.39
	Middle	17.96±7.75	24.65±10.15	22.6±12.62	21.93±9.75	15.48±7.40	31.98±7.11	14.56±3.83
	Top	32.94±7.98	24.85±13.42	20.51±7.49	19.68±7.59	12.08±3.49	20.18±7.40	19.06±6.79

Table 3. Mean population of mango mealy bug on branches of different varieties of mango during 2011-2012.

Date	Plant level	Variety						
		Saroli	Sindhri	Fajri	Began pali	Langra	Chaunsa	Sonaro
18-12-2011	Bottom	7.06±1.21	8.73±1.55	3.33±0.77	5.8±0.92	3.73±0.38	6.8±0.86	1.73±0.37
	Middle	2.6±0.53	4.13±0.66	2.46±0.43	5.53±0.60	6.26±0.81	6.2±0.96	1.46±0.36
	Top	5.73±1.19	3.66±0.73	3.4±0.83	6±1.24	7.4±1.11	8.33±1.34	1.73±0.49
26-12-2011	Bottom	6.6±0.71	25.2±4.06	11.8±1.83	5.13±0.78	7.73±2.23	22.66±1.53	6.8±0.96

	Middle	4.93±0.61	9.46±1.00	9.4±2.02	7.4±1.01	6.13±1.41	16.62±2.32	10.66±1.72
	Top	6.2±0.86	8±1.94	8.86±2.17	2.4±0.75	10.13±2.25	13.06±1.94	6.53±0.98
3/1/2012	Bottom	33.26±5.09	41.86±4.44	19.8±3.71	16.06±3.75	6.46±1.37	19±3.08	10.66±1.72
	Middle	34.6±6.15	50.53±5.27	13.93±2.81	17.33±3.97	8.86±2.42	38.66±6.32	5.86±1.18
	Top	35.93±6.04	45.66±6.18	18.46±3.04	18.13±4.13	5.8±1.42	23.66±3.72	10.66±1.72
10/1/2012	Bottom	35.93±6.04	47.2±5.73	19.8±3.71	19.4±4.01	5.6±1.44	19.0±3.08	12.66±1.70
	Middle	34.6±6.15	56.53±6.00	12.6±2.88	17.33±3.97	3.53±0.93	17.86±3.25	6.53±0.98
	Top	35.93±6.04	52.13±5.88	18.46±3.04	20.53±4.20	8.93±1.65	36.46±5.60	12.0±1.68
18-01-2012	Bottom	24.0±3.98	35.73±6.09	17.13±3.80	20.93±3.86	5.6±1.44	20.33±2.90	10.66±1.72
	Middle	28.66±4.64	57.06±5.47	18.4±3.37	18.53±3.88	3.53±0.93	25.26±3.30	8.86±1.33
	Top	33.4±5.31	52.13±5.88	17.13±2.61	23.2±3.81	12.53±2.20	35.8±5.56	13.33±1.60
26-01-2012	Bottom	24.0±3.98	27.73±5.74	15.8±3.30	19.4±4.01	6.06±1.41	18.13±3.02	10.66±1.72
	Middle	34.6±6.15	48.33±6.12	18.4±3.37	18.53±3.88	4.8±0.97	25.26±3.30	8.86±1.33
	Top	33.93±5.41	46.8±5.54	14.46±2.42	24.53±3.65	10.93±1.76	26.13±3.65	13.33±1.60
2/2/2012	Bottom	24.0±3.98	10.66±1.72	17.13±3.38	19.4±4.01	5.6±1.44	10.93±1.64	11.93±1.58
	Middle	34.6±6.15	8.86±1.33	18.4±3.37	18.53±3.88	3.53±0.93	24.4±3.57	11.26±1.85
	Top	34.6±5.58	13.33±1.60	14.46±2.42	24.53±3.65	10.33±1.87	28.13±3.71	14.0±1.55
10/2/2012	Bottom	15.0±3.83	27.73±5.74	13.33±3.33	3.26±0.90	6.0±1.39	12.26±1.60	10.66±1.72
	Middle	31.93±6.45	48.33±6.12	14.8±3.38	6.46±1.03	3.8±0.91	24.4±3.57	8.86±1.33
	Top	32.06±6.42	46.8±5.54	13.46±2.53	10.6±2.46	10.86±1.76	27.46±3.59	13.6±1.52
18-02-2012	Bottom	13.66±3.05	20.4±3.60	8.66±1.29	3.33±0.95	6.0±1.39	12.0±1.63	8.66±1.01
	Middle	18.46±3.15	35.8±4.23	13.46±2.93	6.46±1.03	3.8±0.91	21.2±2.89	8.86±1.33
	Top	28.06±5.01	40.8±4.94	12.13±2.43	10.73±2.44	10.2±1.72	26.73±3.69	11.6±0.93
26/2/2012	Bottom	11.86±2.49	3.86±0.58	12.06±2.33	5.26±0.43	7.0±0.92	7.53±2.26	6.26±1.03
	Middle	9.06±1.87	8.66±0.92	9.53±1.86	5.6±0.68	9.93±2.50	15.13±4.57	8.4±1.39
	Top	6.66±2.14	5.4±0.54	14.06±4.48	8.86±1.92	8.6±2.39	14.0±3.73	15.46±4.45
2/3/2012	Bottom	7.2±0.97	3.66±0.62	12.06±2.33	5.26±0.43	6.53±0.92	6.73±1.83	6.26±1.03
	Middle	4.4±0.77	7.4±0.68	6.2±0.63	5.6±0.68	9.93±2.50	10.53±3.12	7.46±1.17
	Top	3.66±0.49	4.93±0.53	5.53±1.05	8.86±1.92	8.6±2.39	8.0±1.47	11.46±2.05
Mean & S.E	Bottom	19.59±3.60	26.62±4.80	13.88±2.93	11.8±2.79	5.98±1.39	14.86±2.22	9.07±1.44
	Middle	23.40±4.61	36.72±4.59	13.14±2.70	12.17±2.78	5.03±0.98	19.55±2.89	8.2±1.27
	Top	25.25±4.61	34.82±4.66	13.49±2.38	14.95±2.98	9.57±1.76	23.98±3.64	11.22±1.39

branches (F: 13.66, DF =2, P<0.01). LSD test showed the same different in the population on bottom and top branches. Table 4 indicated that the maximum population of mealy bug nymphs on panicles and fruits of mango plant, which was recorded from 26-2-2011 to 11-3-2011. However, significantly maximum mean population was recorded on Saroli (6.98) bugs per panicle followed by Sindhri (7.00), Chaunsa (4.51), Langra (3.71), Sonaro (3.55), Began pali (3.11) and Fajri (3.01). Analysis of variance showed significant difference (F= 16.75, DF= 6, P< 0.01) in mealy bug population on panicles and fruits of different varieties. Unlike the nymphal population of mango mealy bug recorded on trunks, shoots and branches, the panicles/fruit of

middle branches had maximum population (5.10) compared with (4.89) and (3.67) bottom and top branch panicles/fruits. Analysis of variance showed significant difference (F= 7.44, DF= 2, P< 0.01) in mealy bug population on different branch panicles and fruits. LSD test also showed significant difference in the nymphal population recorded on bottom, middle and top branch panicles/fruits at (P< 0.05). The maximum population of mealy bug was recorded on middle branch panicles/fruits of all varieties except Saroli and Sindhri, which had maximum population on top branch panicles/fruits, i.e- (9.3±1.95) and (8.7±2.01), respectively.

Population on mango panicles/fruits :

Table 4. Mean population of mango mealy bug on Panicles/fruits of different varieties of mango during 2011-2012.								
Date	Plant level	Variety						
		Saroli	Sindhri	Fajri	Langra	Began pali	Chaunsa	Sonaro
18-02-2012	Bottom	6.6±1.74	5±1.87	2.4±0.92	2.8±0.96	2.6±0.67	4.4±1.56	1.6±0.6
	Middle	4.6±1.36	6.2±1.88	7.4±1.50	3.8±1.77	2±1.04	7.4±1.50	4.8±1.11
	Top	4±1.89	4.2±1.56	1±0.77	1.6±0.67	1.4±0.67	1±0.77	2.4±1.16
26/2/2012	Bottom	8.8±2.49	10.8±1.06	2±0.77	4.8±0.37	3.2±0.8	4.2±1.46	3±0.89
	Middle	4.8±0.73	7.6±2.01	4.8±1.93	2.8±1.46	3.4±1.50	3.6±1.80	4.8±0.86
	Top	6.4±1.07	6.2±1.74	3.6±2.01	5.4±1.28	3.8±1.59	3.6±1.07	5.8±1.71
2/3/2012	Bottom	12.4±1.86	6.6±2.82	2.4±1.12	4±0.44	1.6±0.67	4.4±1.32	5.2±2.57
	Middle	9.6±0.67	5.8±1.31	2.6±1.36	2.6±0.67	6±1.48	5.2±1.74	2.6±0.81
	Top	7±2.07	6.2±2.03	1.4±0.59	5.6±1.63	2.4±1.20	4.2±1.15	1.8±0.86
10/3/2012	Bottom	9.4±1.72	12.4±2.31	1.8±0.86	4.4±1.20	3.6±0.92	4.6±1.32	2±0.89
	Middle	7.4±1.12	9.4±2.11	2.4±0.92	3.6±1.20	5.4±1.63	7.6±0.50	4.6±1.20
	Top	2.8±0.91	4±0.54	4.4±1.20	3.2±1.06	2±0.89	4±1.09	4±1.61
Mean & S.E	Bottom	9.3±1.95	8.7±2.01	2.15±0.92	4±0.74	2.75±0.77	4.4±1.42	2.95±1.24
	Middle	6.6±0.97	7.25±1.83	4.3±1.43	3.2±1.28	4.2±1.41	5.95±1.39	4.2±0.99
	Top	5.05±1.49	5.05±1.49	2.6±1.12	3.95±1.16	2.4±1.09	3.2±1.02	3.5±1.33

DISCUSSION

The present investigations revealed that the population of 1st instar mealy bug nymphs emerged from soil in 1st week of December and started crawling on tree trunk to feed on mango inflorescences. The results are in agreement with those of [27] they reported the occurrence of mealy bug on mango plants from 1st week of December till May. [19] recorded the highest population of mango mealy bug on 5th April 2000 and the lowest population of mango mealy bug was recorded on 24th March 2000. The bug population on the tree trunk came to nil on 17 May 2000 onwards. However, the results are in a little contrast with those of [28] they mentioned that the nymphs emerge with the rise in temperature during January and travel up the trees via stem to feed on cell sap, adjacent to the fruiting parts. During May, the flying males emerge to mate with the flightless mature females while crawling down to the ground for egg laying. The present investigations also revealed that mealy bug attacked all mango varieties. However, initially maximum average population was recorded on Langra variety and minimum on Fajri on 10th December 2011. Thereafter the highest mean population was recorded on Sindhri followed by Saroli, Chaunsa, Langra, Fajri, Sonaro, and Began pali. The findings are in agreement with those of [29] they reported that mango mealy bug has the tendency to attack a variety of other fruit trees. [30] mentioned that though this insect is mainly a pest of mango tree, however, in the areas of heavy populations, it has the tendency to attack a variety of other fruit trees like peach (*Prunus persica*), plum (*P. domestica*), papaya (*Carica papaya*) and all citrus species. [31] concluded from the grower's survey that mealy bug variously preferred mango varieties. Survey carried out in Punjab revealed that Chaunsa cultivar was the

most susceptible to mango mealybug followed by 'Fajri', 'Langra' and 'Black Chaunsa, whereas 'Dusehri' was resistant. In another report, [31] screened twelve cultivars against mealy bug attack. He again found the 'Chaunsa' cultivar of mango showed maximum population of mango mealybug during 2005-2006 and during 2006-2007, respectively. Result further indicated that after trunk the nymphs moved to the shoots then branches and finally reached to panicles and fruits to be settled for feeding the sap. More movement was observed towards bottom shoots as compared to non-significant movement towards middle and top shoots. Similar pattern of movement was observed towards branches; however, fruits of middle branches had more population compared with the fruits of bottom and top branches. The results are in agreement with those of [27] who recorded that the number of nymphs of insect present on the tree trunk, terminal twigs or on inflorescences at an interval of a week. From the visual observations, it reveals that nymphs of mealy bug seen on trunks in the beginning were identified as first instar till mid February. [31] observed peak population of mango mealy bug to be 26.63 per 30-cm branch. Whereas [32] mentioned that significant differences were observed among quadrants, but not between old and young leaves, nor between top and bottom of the trees.

CONCLUSION

It is concluded from the results that after emerging from the soil, the 1st instar nymphs immediately started up ward movement to mango plant through trunks of the trees. After trunk, they first moved to bottom shoots then middle and top shoots than to the branches. Finally they approached to the panicles and fruits. Panicles and fruits of middle branches were found more infected compared with bottom and top

panicles of all varieties except Saroli and sindhri. No mango variety was found uninfected by mango mealy bug. However, the varieties of Saroli, Sindhri and Chaunsa were severely attacked.

REFERENCES:

- Jedele, S., Hau, A. M. and von Oppen, M., Analysis of the world market for mangoes and its importance for developing countries. *Conference on International Agricultural Research for Development (Göttingen, Germany)* (2003).
- Tharanathan, R. N., Yashoda, H. M. and Prabha, T. N., Mango (*Mangifera indica* L.), the king of fruits—an overview. *Food Reviews International*, **22**, 95–123 (2006).
- Sauco, V., Mango World Production (Outside Israel, Egypt and India). *Acta Hort.*, **455**: 15–22 (1997).
- FAO Production Yearbook., Food and Agricultural Organization of the United Nations, Rome (2010).
- Minfal, Agriculture Statistics of Pakistan. *Govt. of Pakistan, Min. of Food, Agri. and Livestock Economic Wing, Islamabad* (2010).
- Mohan, S., A. Sirohi and Gaur, H.S., Successful management of mango mealy bug, *Drosicha mangiferae* by *Photorhabdus luminescens*, a symbiotic bacteria from entomopathogenic nematode, *Meterorhabbitis indica*. *International Journal of Nematology*, **14**(2): 195-198 (2004).
- Karar, H., J. Arif, S. Saeed and Sayed, H.A., A threat to mango. *DAWN Sci-tech. World*, December, 23 (2006).
- Tandon, P.L., Lal, B. and Srivastava, R.P., New records on additional hosts of mango mealy bug, *D. mangiferae* Green (Margarodidae : Hemiptera). *Indian Journal of Horticulture*, **35**(3): 281-282(1978).
- Pruthi, H.S. and Batra, H.N., Some important fruit pests of north west India. *ICAR. Bull.No.80*, 113(1960).
- Tobih, F.O., A.A. Omoloye, M.F. Ivbijaro and Enobakhare, D.A., Effects of field infestation by *Rastrococcus invadens* Williams (Hemiptera: Pseudococcidae) on the morphology and nutritional status of mango fruits, *mangiferae indica* L. *Crop Protection*, **21**(9):757-761 (2002).
- Moore, D. Biological control of *Rastrococcus invadens*. *Review article* (2004).
- Karar, H., J. Arif., H.A. Sayyed and Saeed, S., Stitch in time saves nine. *DAWN Sci-tech. World*, January **27**, (2007).
- Price, P.W., N. Cobb., T.E. Craig, G.W. Fernandes, J.K. Itarni, S. Mopper and. Preszler, R.W., Insect herbivore population dynamics on trees and shrubs: new approaches relevant to latent and eruptive species and life table development. In: *E. Bernays (ed), Insect Plant interactions, vol. II. CRC Press, Boca Raton, Florida, U.S.A.* pp. 1-38(1990).
- Dale, D., Plant-mediated effects of soil mineral stress on insects. In : E. A. Heinrichs (ed), *Plant stress-insect interactions. John Wiley & Sons, New York, U.S.A.* pp. 35-110(1988).
- Riemer, J. and Whittaker, J.B., Air pollution and insect herbivores: Observed interactions and possible mechanisms. In: *E.A. Bernays, Editor, Insect-Plant Interactions, CRC-Press, Boca Raton, Florida* pp. 73–105 (1989).
- Marino, P.C. and Cornell, H.V., Adult feeding and oviposition of *Phytomyza ilicicola* Loew (Diptera: Agromyzidae) in response to leaf and tree phenology. *Environ. Entomol.*, **22**: 1294-1301(1993).
- Wolda, H., Seasonal fluctuations in rainfall, food and abundance of tropical insects. *J. Anim. Ecol.*, **47**: 369-381(1978).
- Yousuf, M. and Gaur, M., *Prospis* species in the Arid and semi-Arid zones of India. *Proceeding of Conference held at the central Arid Zone Research Institute, Jodhpur, Rajasthan* (Nov.1-23):134 (1993).
- Yadav, J.L., S.P. Singh and Kumar, R., The population density of the mango mealy bug (*Drosicha mangiferae* G.) in mango. *Progressive Agriculture* **4**(1): 35-37(2004).
- Matokot, L., G. Reyd, P. Malonga and Ru, B.I., Population dynamics of *Rastrococcus invadens* (Homoptera: Pseudococcidae) in the Congo; influence of accidental introduction of the Asiatic parasitoid *Gyranusoidea tebygi* (Hymenoptera: Encyrtidae). *Entomophaga*, pp.123–140. (1992).
- Dwivedi, S.C., Kuldeep, S.M. Singh and. Katiyar, R.R., Seasonal incidence of insect pests associated with mango crop. *Department of Entomology, C.S.A. Univ. Agri. & Tech., Kanpur 208 002, India. Annals of Plant Protection Sciences*, **11**(1):159-160(2003).
- Anonymous, *International mango conference, Multan 27th July. Khabrain newspaper in Urdu* (2008).
- Painter, W.H., Insect resistance in crop plants. *Macmillan, New York* (1951).
- Kogan, M. and. Ortman, E.E., Antixenosis –a new term proposed to replace Painter’s non preference modality of resistance. *Bull. Entomol. Soc. Am.* **24**:175-176(1978).
- Panda, N. and Khush, G.S., Host plant resistance to insects. *CAB International, Oxan, United Kingdom* (1995).
- Karar, H., M.J. Arif, S. Saeed and Abbas, G., Losses in different cultivars of mango due to mango mealybug *Drosicha mangiferae* Green Monophlebidae: Homoptera. *XI International Symposium on Scale Insect Studies ISSIS in Oeiras, Portugal*, 24-27. p. 46 (2007).
- Kumar, A., S. K. Pandey and Kumar, R., Population dynamics of mango mealy bug, *Drosicha mangiferae* Green from Jhansi, *Uttar Pradesh Biological Forum An International Journal*, **1**(2): 77-79 (2009).
- Ashfaq, M., Khan, R.A., Khan, M.A., Fahad Rasheed, and Shahid, H., Complete control of mango mealy bug using funnel type slippery trap. *Pakistan Entomologist*, **27**(a): 45-48 (2005).
- Khan, M.A., Control of insect pests of mango. *Proc. Inter. Mango workshop 27th Feb.-1st Mar. Direct. Agric-Multan Region, Punjab*, P 224 (1989).
- Bhagat, K.C. Mango mealy bug, *Drosicha mangiferae* (Green) (Margarodidae: Hemiptera) on Ashwagandha - a medicinal plant. *Insect Environment* **10**(1): 14 pp(2004).
- Karar, H., Bio-ecology and management of mango mealybug (*Drosicha mangiferae* (Green) in mango orchards of Punjab, Pakistan. *PhD thesis, University of Agriculture, Faisalabad* (2010).
- Boavida, C.P. Neuenschwander, and Schulthess. F., Spatial distribution of *Rastrococcus invadens* Williams (Hom., Pseudococcidae) in mango trees. *Journal of applied Entomology* **114**: 381-391 (1992).