

## Insect Pests and Predators Associated with Mango Varieties

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### ABSTRACT

The experiments were conducted to examine the insect pests and predators associated with mango varieties commonly cultivated in Sindh province. Four mango varieties were included in this study (Sirroli, Langra, Sindhri and Neelum) and insect pests were assessed through trap catches. The results showed that the insect pests associated with different mango varieties as observed from the weekly trap catches were mango hoppers, *Amritodus atkinsoni*, *Idioscopus clypealis*, mango thrips, *Rhipphorothrips cruentatus*, Thripstabaci, mango fruitflies, *Dacus zonatus*, *D. dorsalis*, mango scales, *Aspidiotus destructor*, *Parlatoria pegandei* and mango mealy bugs, *Drosicha stebingi*; while the predators were identified as *Chrysopalac ciperda*, *Mallada boninensis* and *Polynema*. The predators did not show a linear trend either for increase or for decrease in population. The trap catches were higher in the months of June and July. Varieties Neelum and Langra attracted more predators as compared to Sindhri and Sirroli varieties.

**Keywords:** Mango varieties; Sindh; Predators; Pests; Pakistan

### INTRODUCTION

Mango, the choicest fruit and is rightly titled as the king of fruits because of its wide adaptability, high nutritive value, richness in variety, delicious taste, excellent flavor, attractive appearance and popularity among the masses. However, the performance of varieties is found to vary under different climatic conditions [1]. As an export crop, mango earns the country foreign exchange while at the same time acts as a source of food and household income for resource poor farmers [1,2].

The production of mango is threatened by the attack of many insect pests and due to infestation of these insect pests the mango crop suffers heavy losses [3]. Insect pests attack both ripe and unripe fruits and females lay eggs under the skin of the fruit. The eggs of some insects hatch into larvae which feed on the fruit tissue resulting in the rotting of the fruit and premature fruit drop [3]. Out of 260 species of insects and mites that have been recorded as minor or major pests [4], major insect pests of mango which pose a serious threat to foliage and fruit included: Hopper (*Idioscopus clypealis*, *Idioscopus nitidulus* and *Amritodus atkinsoni*), Mealy Bugs (*Drosicha mangiferae*), Inflorescence Midge (*Erosomyia indica*), Fruitfly (*Daccus dorsalis*, *D. zonatus* and *D.*

*correctus*), Scale Insects, (*Pulvinana polygonata*, *Aspidiotus destructor*, *Ceroplastis* sp. and *Rastococcus* sp.), Shoot Borer (*Chlumetia transversa*), Bark Eating Caterpillar (*Indarbella quadrinotata*), Stem Borer (*Batocera rufomaculata*), Shoot Gall Psylla (*Apsylla cistellata*), Leaf Webber (*Ortoba euadrusalis*) and Stone Weevil (*Sternochetus mangiferae*). Losses caused by these insects are not confined to feeding activities alone but also intensified by disseminating disease pathogens. The spiders compose major predator population and prey behavior of these predatory spiders on different insect pests differs by species. The susceptibility of the different mango varieties has not been studied [5]. The present study therefore, carried out to examine the insect pests and predators associated with mango varieties commonly cultivated in Sindh province, Pakistan. Objectives of this study monitor the insect pests associated with different mango varieties. The predators population on different mango varieties and identify the varietal preference of different insect pests and predators on mango.

### MATERIALS AND METHODS

The study comprised of the monitoring of mango varieties cultivated at the Horticulture Orchard of Sindh Agriculture

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University Tandojam for population of various insect pests and predators. The experiment was planned in a four replicated Randomized Complete Block Design. Following mango varieties were monitored for insect pests and their predators:

- Sirroli
- Langra
- Sindhri
- Neelum

The mango trees were well worked for rings around and field was well prepared. In all, 16 trees were selected at random, four trees of each variety. One tree was considered as one replication. After proper labeling of the varieties and replications with white paint, pheromone traps were installed.

### Preparation and placement of pheromone traps

Pheromone traps were prepared locally, and the method of its preparation is very simple and affordable for average grower. Plastic bottles containing trapping lure and hanging wire with surf water in the base provided support with a stick and installed it at the height of the crop so that the insect is trapped easily. One pheromone trap was found to be sufficient for one tree. Sex-pheromone trap lures during trials were replaced after one month for each variety. All the experimental trees were provided equally with pheromone traps. The experimental mango trees were visited on daily basis and the insect pest infestation was monitored on weekly basis. The data thus collected were subjected to statistical analysis using analysis of variance to know the significance of differences in the population of various insect pests and infestation at different intervals after treatment, and LSD (Least Significance

Difference) test was applied to compare different treatments for their efficacies against these insect pests.

## RESULTS

The study was carried out to examine the insect pests and predators associated with mango varieties commonly cultivated in Sindh province during 2012 at the Horticulture Garden, Department of Horticulture, Sindh Agriculture University Tandojam. Four mango varieties were included in this study (Sirroli, Langra, Sindhri and Neelum) and insect pests were assessed through trap catches. The insect pests identified during weekly trap catches included mango hoppers, *Amrirtodus atkinsoni*, *Idioscopus clypealis*, mango thrips, *Rhipphorothrips cruentatus*, *Thrips tabaci*, mango fruit flies, *Dacus zonatus*, *D. dorsalis*, mango scales, *Aspidiotus destructor*, *Parlatoria pegandei* and mango mealy bugs, *Drosicha stebingi*; while the predators were identified as *Chrysopalac ciperda*, *Mallada boninensis* and *Polynema*. The data on these insect pests and predators are presented in Tables 1 to 12 in this chapter and accordingly the results are described.

### Mango hoppers, *Amrirtodus atkinsoni*, *Idioscopus clypealis*

The mango hoppers were identified in the trap catches as *Amrirtodus atkinsoni* and *Idioscopus clypealis* and the analysis of variance (Table 1) indicated a significant ( $p < 0.05$ ) difference in varietal preference of mango hoppers ( $F = 5.37$ ;  $DF = 351$ ;  $p < 0.05$ ) and as well as observation dates ( $F = 680.92$ ;  $DF = 351$ ;  $p < 0.05$ ); while interactive effect of mango variety  $\times$  observation dates for mango hopper population was non-significant ( $F = 0.34$ ;  $DF = 351$ ;  $p > 0.05$ ).

**Table 1:** Analysis of variance for trap catches for mango hoppers.

Source	Degrees of freedom	Sum of squares	Mean squares	F. ratio	Probability
Replications	3	373.1	124.38	-	-
Varieties(V)	3	29.2	9.73	5.37	0.0013
Obs. Dates(D)	21	25889.3	1232.82	680.92	0.0000
V $\times$ D	63	39.2	0.62	0.34	0.9800
Error	261	472.5	1.81	-	-
Total	351	26803.4	-	-	-

The mango hoppers showed relatively more preference to mango varieties Sindhri (7.97/week) and Langra (7.83/week); while relatively less preferred varieties of mango hoppers were Sirroli (7.50/week) and Neelum (7.23/week). The data (Table 2) showed that initially on 14<sup>th</sup> March observation, the average mango hoppers trap catches were 15.82/week averagely on four varieties and remarkable increase in trap catches were found on the following observations of 21<sup>st</sup> March (21.87/week) and 28<sup>th</sup> March (30.14/week) and then started decreasing fast. The peak population of mango hoppers was found on 28<sup>th</sup> March. On 9<sup>th</sup>

May observation, minor trap catches of mango hoppers were found and no change was found afterwards up to the end of the study period on 8<sup>th</sup> August. This indicates that the major period of mango hopper infestation spread over March and April months. All the mango varieties showed similar trend of response to mango hopper infestation as observed from the weekly trap catches from 14<sup>th</sup> March to 8<sup>th</sup> August. It was further observed that none of these four mango varieties showed resistance to mango hoppers, but varietal preference of the insect differed significantly.

Table 2: Weekly mango hopper trap catches on different mango varieties from 14<sup>th</sup> March to 8<sup>th</sup> August.

Obs. Date	Sirroli	Langra	Sindhi	Neelum	Mean
14-Mar	15.66	16.13	16.44	15.03	15.82
21-Mar	21.65	22.3	22.73	20.78	21.87
28-Mar	29.84	30.74	31.33	28.65	30.14
04-Apr	19.32	19.90	20.29	18.55	19.51
11-Apr	16.65	17.15	17.48	15.98	16.82
18-Apr	15.65	16.12	16.43	15.02	15.81
25-Apr	14.65	15.09	15.38	14.06	14.80
02-May	9.25	9.53	9.71	8.88	9.34
09-May	2.33	2.40	2.45	2.24	2.35
16-May	1.23	1.27	1.29	1.18	1.24
23-May	1.25	1.29	1.31	1.20	1.26
30-May	2.32	2.39	2.44	2.23	2.34
06-Jun	1.35	1.39	1.42	1.30	1.36
13-Jun	1.85	1.91	1.94	1.78	1.87
20-Jun	0.55	3.02	2.65	1.25	1.87
27-Jun	2.32	2.39	2.44	2.23	2.34
04-Jul	2.15	2.21	2.26	2.06	2.17
11-Jul	1.25	1.29	1.31	1.20	1.26
18-Jul	1.65	1.70	1.73	1.58	1.67
25-Jul	1.45	1.49	1.52	1.39	1.46
01-Aug	1.33	1.37	1.40	1.28	1.34
08-Aug	1.23	1.27	1.29	1.18	1.24
Mean	7.50 b	7.83 a	7.97 a	7.23 b	7.63
	<b>Varieties (V)</b>		<b>Obs. Date (D)</b>		<b>V × D</b>
S.E. ±	0.2029		0.4757		0.9515
LSD 0.05	0.3994		0.9368		-
LSD 0.01	0.5264		1.2344		-
p-Value	0.0013		0.0001		0.9800
CV%	17.63		-		-

**Mango thrips, *Rhipphorhrips cruentatus*, *Thrips tabaci***

The thrips infesting mango varieties were identified in the trap catches as *Rhipphorhrips cruentatus* and *Thrips tabaci* and the analysis of variance (Table 3) indicated a significant ( $p < 0.05$ )

difference in varietal preference of mango thrips ( $F = 46.33$ ;  $DF = 351$ ;  $p < 0.05$ ), observation dates ( $F = 671.02$ ;  $DF = 351$ ;  $p < 0.05$ ) as well as for variety  $\times$  observation dates interaction ( $F = 1.74$ ;  $DF = 351$ ;  $p < 0.05$ ).

**Table 3:** Analysis of variance for trap catches for thrips.

Source	Degrees of freedom	Sum of squares	Mean squares	F. Ratio	Probability
Replications	3	50285	16762	-	-
Varieties(V)	3	21461	7154	46.33	0.0000
Obs. Dates(D)	21	2175787	103609	671.02	0.0000
V $\times$ D	63	16901	268	1.74	0.0015
Error	261	40299	154	-	-
Total	351	2304734	-	-	-

The data (Table 4) indicated that the seasonal mango thrips population as observed from the trap catches ranged between 24.32-240.65/week in Sirroli, 27.00-267.12/week in Langra, 28.94-286.37/week in Sindhri and 23.10-228.62/week in Neelum. Mango thrips showed significantly different varietal preference and trap catches count showed that thrips infestation was markedly higher on mango varieties Sindhri (99.23/week) and Langra (92.56/week) when compared with thrips trap catches on mango varieties Sirroli (83.39/week) and Neelum (79.22/week). Initially on 14<sup>th</sup> March observation, the average of mango thrips trap catches was 25.84/week on four varieties which started increasing gradually and reached to peak

population on 25<sup>th</sup> July (255.69/week). Remarkable increase in the thrip trap catches was noted from 20<sup>th</sup> July onwards. At the end of observational period of 22 weeks, the thrips trap catches at the final observation were 96.01/week showing its infestation persistence on mango trees. This indicates that the major period of mango thrips infestation spread over months of June and July. Regardless the varieties, the trend of thrips infestation was similar, so far the observation dates are concerned from 14<sup>th</sup> March to 8<sup>th</sup> August. It was further observed that some tolerance to thrips was observed in case of mango varieties Neelum and Sirroli when compared with the Sindhri and Langra varieties.

**Table 4:** Weekly mango thrips trap catches on different mango varieties from 14<sup>th</sup> March to 8<sup>th</sup> August.

Obs. Date	Sirroli	Langra	Sindhri	Neelum	Mean
14-Mar	24.32	27.00	28.94	23.1	25.84
21-Mar	26.54	29.46	31.58	25.21	28.20
28-Mar	31.25	34.69	37.19	29.69	33.20
04-Apr	32.21	35.75	38.33	30.60	34.22
11-Apr	33.32	36.99	39.65	31.65	35.40
18-Apr	29.65	32.91	35.28	28.17	31.50
25-Apr	31.26	34.70	37.2	29.70	33.21
02-May	28.54	31.68	33.96	27.11	30.32
09-May	41.65	46.23	49.56	39.57	44.25
16-May	42.45	47.12	50.52	40.33	45.1
23-May	40.32	44.76	47.98	38.30	42.84

30-May	41.26	45.8	49.10	39.20	43.84
06-Jun	55.62	61.74	66.19	52.84	59.1
13-Jun	61.87	68.68	73.63	58.78	65.74
20-Jun	100.00	111.00	119.00	95.00	106.25
27-Jun	101.26	112.40	120.50	96.20	107.59
04-Jul	225.32	250.11	268.13	214.05	239.4
11-Jul	235.65	261.57	280.42	223.87	250.38
18-Jul	225.32	250.11	268.13	214.05	239.4
25-Jul	240.65	267.12	286.37	228.62	255.69
01-Aug	95.65	106.17	113.82	90.87	101.63
08-Aug	90.36	100.30	107.53	85.84	96.01
Mean	83.39 c	92.56 b	99.23 a	79.22 d	88.6
	<b>Varieties (V)</b>		<b>Obs. Date (D)</b>		<b>V × D</b>
S.E. ±	1.8733		4.3932		8.7865
LSD 0.05	3.6887		8.6507		17.301
LSD 0.01	4.8608		11.400		22.799
p-Value	0.0000		0.0000		0.0015
CV%	14.03		-		-

### Mango fruitflies, *Dacus zonatus*, *D. dorsalis*

The fruit flies infesting mango varieties were identified in the trap catches as *Dacus zonatus* and *D. dorsalis* and the analysis of variance (Table 5) showed that the mango fruit flies showed significantly ( $p < 0.05$ ) different varietal preference ( $F = 345.64$ ;

$DF = 351$ ;  $p < 0.05$ ) with significant variation in trap catches observed on various dates ( $F = 623.33$ ;  $DF = 351$ ;  $p < 0.05$ ) as well as for variety × observation dates interaction ( $F = 3.55$ ;  $DF = 351$ ;  $p < 0.05$ ).

**Table 5:** Analysis of variance for trap catches for fruit fly.

Source	Degrees of freedom	Sum of squares	Mean squares	F. Ratio	Probability
Replications	3	1277.1	425.714	-	-
Varieties(V)	3	1200.4	400.13	345.64	0.0000
Obs. Dates(D)	21	15153.5	721.596	623.33	0.0000
V × D	63	259.1	4.112	3.55	0.0000
Error	261	302.1	1.158	-	-
Total	351	18192.3	-	-	-

The data (Table 6) showed that the seasonal mango fruit fly population as counted from the trap catches ranged between 4.25-26.65/week in Sirroli, 3.91-24.52/week in Langra, 5.19-32.51/week in Sindhri and 3.74-23.45/week in Neelum. Mango fruit flies showed significantly different varietal preference and trap catches count indicated that fruit flies infestation was markedly higher on mango varieties Sindhri (17.14/week), followed by Sirroli (14.05/week) and equally less varietal preference of mango fruit fly was observed on varieties Langra (12.93/week) and Neelum (12.36/week). Initially on 14<sup>th</sup> March observation, the average of mango fruit flies trap catches was 4.27/week on four varieties which started increasing gradually and reached to peak population on 20<sup>th</sup> June (26.78/

week). Significant increase fruit fly trap catches was noted from 25<sup>th</sup> April onwards and fruit flies persistently remained in the field up to the end of experimental period, although less in number when mango fruits were harvested and marketed; and at the end of observational period of 22 weeks, the fruit flies trap catches were 6.28/week. The results further showed that the peak infestation period of mango fruit flies spread over months of June and July. Irrespective of varieties, the trend of fruit fly infestation showed similarity in insect infestation during 14<sup>th</sup> March to 8<sup>th</sup> August study period. It was further observed that Langra and Neelum showed some resistance to fruit flies when compared with the Sindhri and Sirroli mango varieties.

**Table 6:** Weekly mango fruit fly trap catches on different mango varieties from 14<sup>th</sup> March to 8<sup>th</sup> August.

Obs. Date	Sirroli	Langra	Sindhri	Neelum	Mean
14-Mar	4.25	3.91	5.19	3.74	4.27
21-Mar	6.25	5.75	7.63	5.50	6.28
28-Mar	7.12	6.55	8.69	6.27	7.16
04-Apr	6.25	5.75	7.63	5.50	6.28
11-Apr	8.12	7.47	9.91	7.15	8.16
18-Apr	9.36	8.61	11.42	8.24	9.41
25-Apr	11.12	10.23	13.57	9.79	11.18
02-May	12.25	11.27	14.95	10.78	12.31
09-May	13.25	12.19	16.17	11.66	13.32
16-May	14.36	13.21	17.52	12.64	14.43
23-May	15.26	14.04	18.62	13.43	15.34
30-May	18.25	16.79	22.27	16.06	18.34
06-Jun	19.32	17.77	23.57	17.00	19.42
13-Jun	22.65	20.84	27.63	19.93	22.76
20-Jun	26.65	24.52	32.51	23.45	26.78
27-Jun	25.54	23.5	31.16	22.48	25.67
04-Jul	23.65	21.76	28.85	20.81	23.77
11-Jul	18.65	17.16	22.75	16.41	18.74
18-Jul	16.65	15.32	20.31	14.65	16.73
25-Jul	11.25	10.35	13.73	9.90	11.31

01-Aug	12.65	11.64	15.43	11.13	12.71
08-Aug	6.25	5.75	7.63	5.50	6.28
Mean	14.05 b	12.93 c	17.14 a	12.36 d	14.12
	<b>Varieties (V)</b>		<b>Obs. Date (D)</b>		<b>V × D</b>
S.E. ±	0.1622		0.3804		0.7608
LSD 0.05	0.3194		0.7490		1.4981
LSD 0.01	0.4209		0.9871		1.9741
p-Value	0.0000		0.0000		0.0000
CV%	7.62		-		-

### Mango scales, *Aspidiotus destructor*, *Parlatoria pegandei*

The mango scales on different varieties were identified in the trap catches as *Aspidiotus destructor* and *Parlatoria pegandei* and the analysis of variance (Table 7) indicated that the varietal preference of mango scales differ significantly ( $F=245.43$ ;

$DF=351$ ;  $p<0.05$ ) with significant variation in trap catches observed on various dates ( $F=641.71$ ;  $DF=351$ ;  $p<0.05$ ) as well as for variety × observation dates interaction ( $F=1.84$ ;  $DF=351$ ;  $p<0.05$ ).

**Table 7:** Analysis of variance for trap catches for scales.

Source	Degrees of freedom	Sum of squares	Mean squares	F. Ratio	Probability
Replications	3	653.33	217.778	-	-
Varieties(V)	3	308.38	102.794	245.43	0.0000
Obs. Dates(D)	21	5644.12	268.768	641.71	0.0000
V × D	63	48.47	0.769	1.84	0.0005
Error	261	109.32	0.419	-	-
Total	351	6763.62	-	-	-

The data (Table 8) indicated that the seasonal population of mango scales as computed from the trap catches ranged between 6.25-18.25/week in Sirroli, 6.81-19.89/week in Langra, 5.81-16.97/week in Sindhri and 7.44-21.72/week in Neelum. Mango scales showed significantly different varietal preference and trap catches count indicated that scales infestation was markedly higher on mango variety Neelum (11.42/week), followed by Langra (10.46/week) and Sirroli (9.60/week); was less varietal preference of mango scales was observed on variety Sindhri (8.92/week). Initially on 14<sup>th</sup> March observation, the average trap catches of mango scales were 6.58/week on four varieties which started increasing gradually and reached to peak population on 8<sup>th</sup> August (19.21/week). Significant increase in trap catches of scales was noted from 30<sup>th</sup> May onwards and scales persistently remained in the field; and at the end of observational period of 22 weeks, the scales trap catches were

19.21/week. It was observed that the peak infestation period of mango scales spread over months of June, July and August. However, the trend of infestation of mango scales showed similarity during 14<sup>th</sup> March to 8<sup>th</sup> August study period. Mango variety Sindhri showed some resistance to infestation of scales, followed by Sirroli when compared with the Langra and Neelum mango varieties.

### Mango mealy bug, *Drosicha stebingi*

The mango mealy bug on various varieties in the trap catches was scientifically identified as *Drosicha stebingi* and the analysis of variance (Table 9) showed that the varietal preference of mango mealy bug varied significantly ( $F=146.93$ ;  $DF=351$ ;  $p<0.05$ ), trap catches count differed significantly when observed on various dates ( $F=659.21$ ;  $DF=351$ ;  $p<0.05$ ); and the effect of variety × observation dates interaction on mealy bug population was non-significant ( $F=0.84$ ;  $DF=351$ ;  $p>0.05$ ).

**Table 8:** Weekly trap catches of mango scales on different mango varieties from 14<sup>th</sup> March to 8<sup>th</sup> August.

Obs. Date	Sirroli	Langra	Sindhi	Neelum	Mean
14-Mar	6.25	6.81	5.81	7.44	6.58
21-Mar	7.12	7.76	6.62	8.47	7.49
28-Mar	6.36	6.93	5.91	7.57	6.69
04-Apr	6.25	6.81	5.81	7.44	6.58
11-Apr	5.69	6.20	5.29	6.77	5.99
18-Apr	6.25	6.81	5.81	7.44	6.58
25-Apr	7.12	7.76	6.62	8.47	7.49
02-May	6.25	6.81	5.81	7.44	6.58
09-May	7.58	8.26	7.05	9.02	7.98
16-May	8.25	8.99	7.67	9.82	8.68
23-May	7.32	7.98	6.81	8.71	7.70
30-May	11.22	12.23	10.43	13.35	11.81
06-Jun	12.32	13.43	11.46	14.66	12.97
13-Jun	10.25	11.17	9.53	12.20	10.79
20-Jun	8.65	9.43	8.04	10.29	9.10
27-Jun	6.25	6.81	5.81	7.44	6.58
04-Jul	12.32	13.43	11.46	14.66	12.97
11-Jul	13.65	14.88	12.69	16.24	14.37
18-Jul	10.25	11.17	9.53	12.2	10.79
25-Jul	16.25	17.71	15.11	19.34	17.10
01-Aug	17.25	18.80	16.04	20.53	18.16
08-Aug	18.25	19.89	16.97	21.72	19.21
Mean	9.60 c	10.46 b	8.92 d	11.42 a	10.1
	<b>Varieties (V)</b>		<b>Obs. Date (D)</b>		<b>V × D</b>
S.E. ±	0.0976		0.2288		0.4576
LSD 0.05	0.1921		0.9011		0.9011
LSD 0.01	0.2532		0.5937		1.1874
p-Value	0.0000		0.0000		0.0005
CV%	6.41		-		-

**Table 9:** Analysis of variance for trap catches for mealy bug.

Source	Degrees of freedom	Sum of squares	Mean squares	F. Ratio	Probability
Replications	3	473.02	157.672	-	-
Varieties(V)	3	99.54	33.179	146.93	0.0000
Obs. Dates(D)	21	3125.97	148.856	659.21	0.0000
V × D	63	11.96	0.190	0.84	0.7931
Error	261	58.94	0.226	-	-
Total	351	3769.42	-	-	-

The data (Table 10) showed that the seasonal population of mango mealy bug as computed from the trap catches ranged between 8.65-14.25/week in Sirroli, 7.87-12.97/week in Langra, 8.82-14.54/week in Sindhri and 7.61-12.54/week in Neelum. Mango mealy bug showed significantly different varietal preference and trap catches count showed that mealy bug infestation was relatively higher on mango varieties Sindhri (9.20/week) and Sirroli (9.02/week), followed by Langra (8.21/week) and minimum on variety Neelum (7.94/week). At the start on 14<sup>th</sup> March observation, the average trap catches of mango mealy bug were 8.24/week on four varieties which started decreasing gradually and reached baseline population on

6<sup>th</sup> June (8.69/week); while reached to its seasonal peak (13.57/week) on 18<sup>th</sup> July. Significant increase in trap catches of mealy bug was noted from 13<sup>th</sup> June onwards and mealy bug persistently remained in the field; and at the end of observational period of 22 weeks, the mealy bug trap catches were 6.23/week. It was observed that the peak infestation period of mango mealy bug spread over months of June and July. However, the trend of infestation of mango mealy bug showed similarity during 14<sup>th</sup> March to 8<sup>th</sup> August study period. Mango variety Neelum showed some resistance to mealy bug infestation with minimum infestation, followed by Langra when compared with the Sirroli and Sindhri varieties.

**Table 10:** Weekly trap catches of mango mealy bugs on different mango varieties from 14<sup>th</sup> March to 8<sup>th</sup> August.

Obs. Date	Sirroli	Langra	Sindhri	Neelum	Mean
14-Mar	8.65	7.87	8.82	7.61	8.24
21-Mar	6.25	5.69	6.38	5.50	5.95
28-Mar	5.14	4.68	5.24	4.52	4.90
04-Apr	4.65	4.23	4.74	4.09	4.43
11-Apr	7.12	6.48	7.26	6.27	6.78
18-Apr	6.35	5.78	6.48	5.59	6.05
25-Apr	6.45	5.87	6.58	5.68	6.14
02-May	8.25	7.51	8.42	7.26	7.86
09-May	4.65	4.23	4.74	4.09	4.43
16-May	8.25	7.51	8.42	7.26	7.86
23-May	6.35	5.78	6.48	5.59	6.05
30-May	8.32	7.57	8.49	7.32	7.92

06-Jun	9.12	8.30	9.30	8.03	8.69
13-Jun	11.25	10.24	11.48	9.90	10.72
20-Jun	12.32	11.21	12.57	10.84	11.73
27-Jun	13.65	12.42	13.92	12.01	13.00
04-Jul	12.35	11.24	12.6	10.87	11.76
11-Jul	13.65	12.42	13.92	12.01	13.00
18-Jul	14.25	12.97	14.54	12.54	13.57
25-Jul	13.25	12.06	13.52	11.66	12.62
01-Aug	11.65	10.60	11.88	10.25	11.10
08-Aug	6.54	5.95	6.67	5.76	6.23
Mean	9.02 b	8.21 c	9.20 a	7.94 d	8.59
	<b>Varieties (V)</b>		<b>Obs. Date (D)</b>		<b>V × D</b>
S.E. ±	0.0716		0.1680		0.3360
LSD 0.05	0.1411		0.3308		-
LSD 0.01	0.1859		0.4359		-
p-Value	0.0000		0.0000		0.7931
CV%	5.53		-		-

**Predators, *Chrysopalac ciperda*, *Mallada boninensis* and *Polynema***

The predators of mango insect pests on various varieties in the trap catches were identified as *Chrysopalac ciperda*, *Mallada boninensis* and *Polynema* and the analysis of variance (Table 11)

indicated that the trap catches count of predators varied significantly on mango varieties (F=273.95; DF=351; p<0.05), seasonal trap catches of predators (F=498.05; DF=351; p<0.05) as well as variety × observation dates interaction (F=48.88; DF=351; p>0.05).

**Table 11:** Analysis of variance for trap catches for predators.

Source	Degrees of freedom	Sum of squares	Mean squares	F. Ratio	Probability
Replications	3	17.743	5.91424	-	-
Varieties(V)	3	16.034	5.34472	273.95	0.0000
Obs. Dates(D)	21	204.052	9.71674	468.05	0.0000
V x D	63	60.080	0.95365	48.88	0.0000
Error	261	5.092	0.01951	-	-
Total	351	303.001	-	-	-

The data (Table 12) showed that the population of predators of mango insect pests as counted from the trap catches ranged between 0.00-2.45/week in Sirroli, 0.93-2.85/week in Langra,

0.00-2.57/week in Sindhri and 0.00-2.96/week in Neelum. The trap catches count of predators of mango insect pests showed significantly different trend in various varieties and weekly trap

catches count was relatively higher on mango varieties Neelum (1.88/week) and Langra (1.80/week), and relatively lower in varieties Sindhri (1.65/week) and Sirroli (1.22/week). At the start, the average trap catches of predators were 1.45/week and

the predators did not show a linear trend either for increase or for decrease in population. However, the trap catches were higher in the months of June and July.

**Table 12:** Weekly trap catches of predators (*Chrysopalac ciperda*, *Mallada boninensis* and *Polynema*) of various mango insect pests on different mango varieties from 14<sup>th</sup> March to 8<sup>th</sup> August.

Obs. Date	Sirroli	Langra	Sindhri	Neelum	Mean
14-Mar	1.25	1.73	1.31	1.51	1.45
21-Mar	0.00	1.25	1.25	2.65	1.29
28-Mar	0.00	1.03	0.00	0.00	0.26
04-Apr	0.00	0.93	2.00	1.25	1.05
11-Apr	2.35	1.42	2.47	2.84	2.27
18-Apr	1.00	1.27	1.05	1.21	1.13
25-Apr	1.45	1.29	1.52	1.75	1.50
02-May	0.00	1.65	0.00	1.25	0.73
09-May	0.00	0.93	2.15	0.50	0.90
16-May	0.00	1.65	0.00	0.50	0.54
23-May	2.35	1.27	2.47	2.84	2.23
30-May	2.24	1.66	2.35	2.71	2.24
06-Jun	1.45	1.82	1.52	1.75	1.64
13-Jun	1.65	2.25	1.73	2.00	1.91
20-Jun	1.98	2.46	2.08	2.40	2.23
27-Jun	2.45	2.73	2.57	2.96	2.68
04-Jul	2.15	2.47	2.26	2.60	2.37
11-Jul	2.35	2.73	2.47	2.84	2.60
18-Jul	1.98	2.85	2.08	2.40	2.33
25-Jul	2.35	2.65	2.47	2.84	2.58
01-Aug	2.15	2.33	2.26	2.60	2.33
08-Aug	0.00	1.31	0.25	0.00	0.39
Mean	1.33 d	1.80 b	1.65 c	1.88 a	1.67
	<b>Varieties (V)</b>		<b>Obs. Date (D)</b>		<b>V × D</b>
S.E. ±	0.0211		0.0494		0.0988
LSD 0.05	0.0415		0.0972		0.1945

LSD 0.01	0.0546	0.1281	0.2563
p-Value	0.0000	0.0000	0.0000
CV%	8.39	-	-

## DISCUSSION

Mango production is hampered by the attack of many insect pests and they not only decline the mango productive quantitatively; but the quality of the produce is also deteriorated. The study was carried out assess insect pests and predators associated with mango using four mango varieties (Sirroli, Langra, Sindhri and Neelum) and insect pests were assessed through trap catches. The present study showed that insect pests associated with different mango varieties as observed from the weekly trap catches were mango hoppers, *Amritodus atkinsoni*, *Idioscopus clypealis*, mango thrips, *Rhipphorothrips cruentatus*, *Thrips tabaci*, mango fruitflies, *Dacus zonatus*, *D. dorsalis*, mango scales, *Aspidiotus destructor*, *Parlatoria pegandei* and mango mealy bugs and *Drosicha stebingi*, similar insect pests on mango trees in Taiwan which were observed in the present study. The most destructive insects are the mango hoppers, *Idioscopus niveosparsus* and *I. clypealithrips*, *Scirtothrips dorsalis* and *Thrips hawaiiensis*, *S. dorsalis*, mealybug, *Planococcus citri*, and there are many other species of minor insect pests, such as the great number of scale insects, beetles, and lepidoptrous insects, which sometimes cause considerably damages on mango trees. But control measures should be taken in time to prevent from serious infestations [6]. A systematic investigation of insect pests of mango plants in 24 cities and counties in Guangxi Zhuang Autonomous Region and ninety-four insect pests, from 8 orders and 38 families, were found. Major insect pests were *Pseudonoorda minor* Munroe, *Chlumetia transversa* Walker, *Scirtothrips dorsalis* Hood, *Dacus dorsalis* Hendel and *Idioscopus incertus* Baker. A species of noxious gastropod was also found [7]. The varieties of mango differ significantly for insect pest infestation. The seasonal weekly mango hoppers trap catches ranged between 0.22-15.66 in Sirroli, 1.27-30.74 in Langra, 1.29-31.33 in Sindhri and 1.18-28.65 in Neelum. The major period of mango hopper infestation was March and April months and varietal preference differed significantly. Infestation of mango hoppers in the orchards gives heavy economic losses [6].

In the present study, weekly thrips trap catches ranged between 24.32-240.65 in Sirroli, 27-267.12 in Langra, 28.94-286.37 in Sindhri and 23.10-228.62 in Neelum; and major period of mango thrips infestation was June-July. Some tolerance to thrips was observed in Neelum and Sirroli over Sindhri and Langra varieties. A number of thrips species in mango orchards infesting foliage and fruits including *Scirtothrips dorsalis* and *Thrips hawaiiensis* reporting serious infestations [6]. The present study further showed that weekly fruit fly trap catches ranged between 4.25-26.65 in Sirroli, 3.91-24.52 in Langra, 5.19-32.51 in Sindhri and 3.74-23.45 in Neelum; the peak infestation period was June-July. Langra and Neelum showed some resistance to fruitfly over Sindhri and Sirroli varieties. Weekly

trap catches of mango scales ranged between 6.25-18.25 in Sirroli, 6.81-19.89 in Langra, 5.81-16.97 in Sindhri and 7.44-21.72 in Neelum. Studies carried out on the relative abundance of *Dacus zonatus* [*Bactrocera zonata*] and *D. dorsalis* [*B. dorsalis*] in 6 varieties of mango. The pupal recovery and pupal survival from 1 kg of infested fruit showed that cvs Sonehra and Beganpali were preferred over cvs Sindhri, Desi, Almas and Langra [8]. While numbers of *B. zonatus* were higher than those of *B. dorsalis* in all varieties, relative preference of both species was very similar. Trap catches in mango orchards in Pakistan also showed a dominance of *B. zonatus* over *B. dorsalis*. Adult fly populations were at their peak during fruit maturation in June. Fruit flies associated with mango trees were monitored in two orchards and reported that trapping and rearing data indicated that *Ceratitis quinaria* and *Ceratitis silvestrii* were abundant only in the dry season, causing damage only to early cultivars. *C. cosyra*, also common during the dry season, attacked both early cultivars or mid season cultivars [9]. It is also indicated that fruit flies are the major insect pests of the mangoes and among the 11 species identified, *B. invadens* was the major pest in the traps (86.53%) and in the mangoes (96.14%). The fruit flies were present all year round with different seasonal ratios. Populations of *B. invadens* increased during the rainy season (mango season), from March to August [10]. The present study showed that peak infestation period of mango scales was June-July and Sindhri showed some resistance to scales, followed by Sirroli as compared to Langra and Neelum varieties. Weekly trap catches of mealy bug ranged between 8.65-14.25 in Sirroli, 7.87-12.97 in Langra, 8.82-14.54 in Sindhri and 7.61-12.54 in Neelum, and peak infestation period was June-July. Neelum showed some resistance to mealy bug, followed by Langra over Sirroli and Sindhri varieties. Lee [6] also observed infestation of mango scales and reported heavy economic losses due to their infestation. A preliminary inventory of scale insects (Hemiptera: Coccoidea) developing on the mango tree for Northern and Central Benin. The following species, *Gigantococcus euphorbiae*, *Gigantococcus nigroareolatus*, *Ceroplastes apacae*, *Parasaissetia nigra*, *Saissetia privigna*, *Udinia catori*, *Ferrisia virgata*, *Paracoccus interceptus*, *Phenacoccus solenopsis*, *Rastrococcus invadens*, *Aonidiella orientalis* and *Lepidosaphes tapleyi*, were collected from 2005 to 2007 in mango orchards in the Sudanian area of Benin, on branches, leaves, and particularly on mango petioles and fruits. Nine of these species are recorded for the first time in Benin while *P. interceptus* recorded in Africa for the first time. Only two, *R. invadens* and *A. orientalis*, of the 12 species are considered as mango pests [11].

It was observed from the present study that the predators were identified as *Chrysopalac ciperda*, *Mallada boninensis* and *Polynema* weekly trap catches of predators of mango insect pests ranged between 0-2.45 in Sirroli, 0.93-2.85 in Langra, 0-2.57 in Sindhri and 0-2.96 in Neelum. At the start, the average trap catches of

predators were 1.45/week and the predators did not show a linear trend either for increase or for decrease in population. The trap catches were higher in the months of June and July. Varieties Neelum and Langra attracted more predators as compared to Sindhri and Sirroli varieties. These results are in accordance with those of [12] who found 11 species of predators including included *Araneus sinhagadensis* Tikader (preyed on *Idioscopus clypealis* and *Chlumetia transversa*), *Stegodyphus sarasinorum* Karsch (on *I. clypealis*, *Drosicha mangiferae* (Green), *Chlumetia transversa* and *Altica* sp.), *Uloborus* sp., (on *I. clypealis*), *Linyphia* sp. (on *Idioscopus* sp.), *Phidippus* sp. and *Marpissa* sp. (both on *D. mangiferae* and *I. clypealis*). These predatory spiders were found effective against various insect pests on mango orchards. Weaver ant as the major predator of various insect pests of mango but the farmers reported that the weaver ant marks reduce internal fruit quality and induce fruit rot, which is economically important [13,14].

## SUMMARY

The experiments were conducted to examine the insect pests and predators associated with mango varieties commonly cultivated in Sindh province during 2012 at the Horticulture Garden, Department of Horticulture, Sindh Agriculture University Tandojam. Four mango varieties were included in this study (Sirroli, Langra, Sindhri and Neelum) and insect pests were assessed through trap catches. The findings of the study are summarized as under:

The results showed that the insect pests associated with different mango varieties as observed from the weekly trap catches were mango hoppers, *Amrittodus atkinsoni*, *Idioscopus clypealis*, mango thrips, *Rhipphorothrips cruentatus*, *Thrips tabaci*, mango fruitflies, *Dacus zonatus*, *D. dorsalis*, mango scales, *Aspidiotus destructor*, *Parlоторia pegandei* and mango mealy bugs, *Drosicha stebingi*; while the predators were identified as *Chrysopalac ciperda*, *Mallada boninensis* and *Polynema*.

The mango hoppers *Amrittodus atkinsoni* and *Idioscopus clypealis* showed relatively more preference to varieties Sindhri (7.97/week) and Langra (7.83/week); while relatively less preferred varieties of mango hoppers were Sirroli (7.50/week) and Neelum (7.23/week). At the start, the average mango hoppers trap catches were 15.82/week averagely on four varieties and remarkable increase in trap catches were found on the following observations of 21<sup>st</sup> March (21.87/week) and 28<sup>th</sup> March (30.14/week) and then started decreasing fast.

The thrips infesting mango varieties were identified as *Rhipphorothrips cruentatus* and *Thrips tabaci* and their seasonal population ranged between 24.32-240.65/week in Sirroli, 27.00-267.12/week in Langra, 28.94-286.37/week in Sindhri and 23.10-228.62/week in Neelum. Mango thrips showed significantly different varietal preference and trap catches count showed that thrips infestation was markedly higher on mango varieties Sindhri (99.23/week) and Langra (92.56/week) when compared with thrips trap catches on mango varieties Sirroli (83.39/week) and Neelum (79.22/week). Initially on 14<sup>th</sup> March observation, the average of mango thrips trap catches was 25.84/week on four varieties which started increasing gradually and reached to peak population on 25<sup>th</sup> July (255.69/week).

Fruit flies infesting mango varieties were identified as *Dacus zonatus* and *D. dorsalis* and their seasonal population ranged between 4.25-26.65/week in Sirroli, 3.91-24.52/week in Langra, 5.19-32.51/week in Sindhri and 3.74-23.45/week in Neelum. Mango fruit flies showed significantly different varietal preference and trap catches count indicated that fruit flies infestation was markedly higher on mango varieties Sindhri (17.14/week), followed by Sirroli (14.05/week) and equally less varietal preference of mango fruit fly was observed on varieties Langra (12.93/week) and Neelum (12.36/week).

The mango scales were identified as *Aspidiotus destructor* and *Parlоторia pegandei* and their seasonal population ranged between 6.25-18.25/week in Sirroli, 6.81-19.89/week in Langra, 5.81-16.97/week in Sindhri and 7.44-21.72/week in Neelum. Mango scales showed significantly different varietal preference and trap catches count indicated that scales infestation was markedly higher on mango variety Neelum (11.42/week), followed by Langra (10.46/week) and Sirroli (9.60/week); was less varietal preference of mango scales was observed on variety Sindhri (8.92/week). Initially on 14<sup>th</sup> March observation, the average trap catches of mango scales were 6.58/week on four varieties which started increasing gradually and reached to peak population on 8<sup>th</sup> August (19.21/week).

The mango mealy bug was scientifically identified as *Drosicha stebingi* and its seasonal population ranged between 8.65-14.25/week in Sirroli, 7.87-12.97/week in Langra, 8.82-14.54/week in Sindhri and 7.61-12.54/week in Neelum. Mango mealy bug showed significantly different varietal preference and trap catches count showed that mealy bug infestation was relatively higher on mango varieties Sindhri (9.20/week) and Sirroli (9.02/week), followed by Langra (8.21/week) and minimum on variety Neelum (7.94/week). At the start on 14<sup>th</sup> March observation, the average trap catches of mango mealy bug were 8.24/week on four varieties which started decreasing gradually and reached baseline population on 6<sup>th</sup> June (8.69/week); while reached to its seasonal peak (13.57/week) on 18<sup>th</sup> July.

The predators of mango insect pests were identified as *Chrysopalac ciperda*, *Mallada boninensis* and *Polynema* and their consolidated population ranged between 0.00-2.45/week in Sirroli, 0.93-2.85/week in Langra, 0.00-2.57/week in Sindhri and 0.00-2.96/week in Neelum. The trap catches count of predators of mango insect pests showed significantly different trend in various varieties and weekly trap catches count was relatively higher on mango varieties Neelum (1.88/week) and Langra (1.80/week), and relatively lower in varieties Sindhri (1.65/week) and Sirroli (1.22/week).

## CONCLUSION

The major period of mango hopper infestation spread over March and April months. The peak population of mango hoppers was found on 28<sup>th</sup> March. None of these four mango varieties showed resistance to mango hoppers, but varietal preference of the insect differed significantly. Remarkable increase in the thrip trap catches was noted from 20<sup>th</sup> July onwards. The major period of mango thrips infestation spread over months of June and July. Some tolerance to thrips was observed in case of mango varieties Neelum and Sirroli when

compared with the Sindhri and Langra varieties. Mango fruit flies reached to their peak population on 20<sup>th</sup> June (26.78/week). The peak infestation period of mango fruit flies spread over months of June and July. Langra and Neelum showed some resistance to fruit flies when compared with the Sindhri and Sirroli mango varieties. Significant increase in trap catches of scales was noted from 30<sup>th</sup> May onwards and scales persistently remained in the field. The peak infestation period of mango scales spread over months of June, July. Mango variety Sindhri showed some resistance to infestation of scales, followed by Sirroli when compared with the Langra and Neelum mango varieties. Significant increase in trap catches of mealy bug was noted from 13<sup>th</sup> June onwards and mealy bug persistently remained in the field throughout the season. The peak infestation period of mango mealy bug spread over months of June and July. The trend of infestation of mango mealy bug showed similarity during 14<sup>th</sup> March to 8<sup>th</sup> August study period. Mango variety Neelum showed some resistance to mealy bug infestation with minimum infestation, followed by Langra when compared with the Sirroli and Sindhri varieties. At the start, the average trap catches of predators were 1.45/week and the predators did not show a linear trend either for increase or for decrease in population. The trap catches were higher in the months of June and July. Varieties Neelum and Langra attracted more predators as compared to Sindhri and Sirroli varieties.

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