

Ongoing experiments:

Experiment No. 17.3.3.105

1. Title	:	Status of insect pests and natural enemies in organic mango orchard
2. Background information	:	In India, key challenges for mango production are insect pests and diseases. The major insect pests of mango include hoppers, thrips, mealy bugs, gall midge, leaf webber, scale insects, stem borer and fruit fly (Reddy <i>et al.</i> , 2018). Insect pest management is very important for the profitable cultivation of mango. Among the insect pest management methods, biological control play crucial role in checking the insect pests under detrimental levels by predators and parasitoids. Exploration of natural enemies in local or in the native region of the pest, or introduction of natural enemies from foreign countries and augmenting them for the pest management can be used as an effective strategy in biological control program (Barratt <i>et al.</i> , 2018). The value of biological control often becomes evident when predators and parasitoids are disturbed by spraying of insecticides or weather aberrations (Messing and Brodeur, 2018). Decisions for pest spraying should be carefully weighed against the possible effects on predators and parasitoids. These decisions require a better understanding of the complex of natural enemies and the relative abundance of natural enemies.
3. Objectives	:	To know presence of insect pests and natural enemies in mango orchard
4. Investigator & Associates	:	Dr. Snehal Patel, Dr. H.V. Pandya and Dr. Anand Kaswala
5. Location	:	Organic farm, ACHF, NAU., Navsari
6. Name of Res. Scheme & B.H.	:	Departmental Trial 12237
7. Year and season	:	2022-23
8. Crop and Variety	:	Mango – Kesar
9. Experimental Details	:	-
a. Observation period	:	Observations will be recorded at fortnightly interval
b. Methodology:		<p>Orchard of organic farm was chosen to monitor presence of insect pests and natural enemies of major insect pests of mango. Data on insect pests and natural enemies was recorded at fortnightly interval from ten randomly selected trees during vegetative and reproductive phases. Abundance of insect pests and predators and parasitoids will be recorded. The data on presence of insect pests and predators/parasitoids correlated with abiotic factors i.e. temperature and humidity etc.</p> <ul style="list-style-type: none"> • Sucking pests: Hopper population per ten inflorescence/ growing shoots or 10 sweeps will be recorded. For mealy bug, number of nymphs/female adults on ten terminal twigs/inflorescences was recorded. For thrips, total number of thrips per three leaves from 10 growing shoots was

recorded.

- Chewing pests: Number of damage shoot/webbed leaves per twigs were recorded for leaf webber and shoot borer .
- For recording observation on stone weevil, number of infested fruits out of 10 randomly collected fruits per tree.
- For recording observation on fruitfly install five methyl euginol traps/ hectare.
- The immature and adult stages of sucking and chewing pests along with substrate was collected and brought to laboratory and observed for emergence of parasitoid if any.
- During maturity stage of fruits, ten fruitfly infested fruits will be collected and kept in laboratory conditions to record parasitoid if any.
- To record parasitoid existing in mango orchard immature stage of each pest was collected and kept/reared in laboratory and observed for emergence of parasitoid if any.
- Number of larvae/ adults of predators were recorded by visual observation.
- Hibernated adult hoppers on tree trunks were observed for presence of parasitoids if any.

10. Research Result :

Study was carried out to know the seasonal abundance and occurrence of insect –pests and natural enemies of mango during 2022-23. The data obtained are summarized in Table-1 indicated that hopper population was observed throughout the year. Average population of hopper was recorded as 72.80 ± 74.92 hopper/ inflorescence/leaf/trunk. The incidence of hopper recorded from 29th SMW. The maximum incidence of hopper was recorded as 226.00 hopper/ inflorescence/leaf/trunk during 9th SMW. Hopper population was migrated from trunk to upper canopy as new flush and inflorescence emergence increases. Population of fruit fly reached to its peak at 17th SMW with mean number of 498.0 fruit flies per trap. Average Fruit fly population was recorded 167.35 ± 144.94 /trap. The fruit fly population most abundant from 2nd fortnight of March to 2nd fortnight of May and then onwards started declining. Population of thrips started appearing during 37th SMW. Further the population gradually increased and reached to its peak at 11th SMW with mean population of 7.0 thrips/three leaves. The average population of thrips during the year is 3.07 ± 2.08 thrips/ three leaves. Leaf gall midge incidence started at 37th SMW and reach at peak level at 51st SMW with 8.30 infested leaves/ 2 meter twig. Average population of leaf miner was recorded as 5.13 ± 3.35 infested leaves/ 2 meter twig. Infestation started at 33rd SMW and reach peak at 47th SMW with 9.20 infested leaves/ 2 meter twig. Average shoot borer infestation was recorded 1.97 ± 2.01 infested shoot/2 meter twig. Maximum population was recorded at 1st SMW with 5.50 infested shoot/2 meter twig. Leaf webber incidence started appearing during the 31st SMW, the incidence gradually increased and reached to its peak at 45 and 48 SMW with mean infestation of 5.0 active webs per tree. The average population of leaf webber was recorded 2.47 ± 1.88 . Mealybug incidence started at 5th SMW and reach at peak level at 15th SMW with 7.0 mealybug infested penicle/shoot/leaves. Stone weevil and scale insect population was recorded nil during the year 2022-23. The data on natural enemies indicated that predators like green lace wing, spider and ant nest were recorded in mango ecosystem, while no parasitism was recorded.

To know the effect of various weather parameters on the population fluctuation of important insect pests and natural enemies of mango correlation between them was worked out (Table 2). Hopper population exhibited highly significant positive correlation with Maximum temperature (0.500**) and sunshine hours (0.522**) while highly significant negative correlation with Minimum temperature (-0.551**), morning relative humidity (-0.507**), evening relative humidity (-0.741**) and rainfall (-0.543**). Fruit fly exhibited highly significant positive correlation with Maximum temperature (0.623**) and sunshine hours (0.577**) and significant negative correlation with rainfall (-0.414*). Thrips exhibited highly significant positive correlation with Maximum temperature (0.645**) and sunshine hours

(0.725**) whereas highly significant negative correlation with Minimum temperature (-0.513**), morning relative humidity (-0.575**), evening relative humidity (-0.826**), and rainfall (-0.704**). Gall midge exhibits highly significant positive correlation with sunshine hours (0.603**) while highly significant negative correlation with minimum temperature (-0.856**), morning relative humidity (-0.508**), evening relative humidity (-0.851**) and rainfall (-0.640**). Leaf miner exhibited significant positive correlation with sunshine hours (0.394*) and highly significant negative correlation with minimum temperature (-0.703**), evening relative humidity (-0.603**) and significant negative correlation with rainfall (-0.489). Shoot borer exhibited significant positive correlation with sunshine hours (0.396*) and highly significant negative correlation with minimum temperature (-0.928**), evening relative humidity (-0.762**) and rainfall (-0.518). Leaf webber exhibited highly significant negative correlation with minimum temperature (-0.776**) and evening relative humidity (-0.619**). Mealybug population exhibited highly significant positive correlation with Maximum temperature (0.711**) and sunshine hours (0.561**) while significant negative correlation with rainfall (-0.396*).

Green lace wing exhibited highly significant positive correlation with maximum temperature (0.564**) and sunshine hours (0.762**) while highly significant negative correlation with minimum temperature (-0.688**), morning relative humidity (-0.716**), evening relative humidity (-0.920**) and rainfall (-0.764**). Spider exhibit highly significant positive correlation with maximum temperature (0.621**) and sunshine hours (0.713**) while highly significant negative correlation with minimum temperature (-0.613**), morning relative humidity (-0.627**), evening relative humidity (-0.873**) and rainfall (-0.697**). Red ant shows highly significant positive correlation with maximum temperature (0.732**) and sunshine hour (0.690**). while significant negative correlation with morning relative humidity (-0.450*), evening relative humidity (-0.417) and rainfall (-0.493*).

Table-1 Seasonal abundance of important insect-pests of mango (2022-23)

SM W	Month	Hopper (No. of Leaf hopper/Panicle or shoot)	Fruit fly (No. of fruit fly/trap)	Thrips Ave. no. of thrips/ 3 leaves	Gall midge (No. of infested leaves/ 2 meter twig)	Leaf miner (No. of infested leaves/ 2 meter twig)	Shoot borer (No. of infested shoot/2 meter twig)	Leaf webber (No. of webs/ tree)	Mealybug (No./ Penicle/ shoot/ leaves)	Green lace wing (egg/larva/ pupae of green lace wing/ twig)	Spider (No. of spider / twig)	Red Ant (No. of ant nest/ twig)
29	July	3.20	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.30
31	August	4.50	70.00	0.00	0.00	0.00	0.00	1.00	0.00	0.40	0.00	0.30
33	August	5.60	55.00	0.00	0.00	5.80	0.00	1.50	0.00	0.30	0.20	0.20
35	September	6.80	78.00	0.00	0.00	6.90	0.00	2.20	0.00	0.40	0.30	0.30
37	September	7.00	72.00	2.00	4.20	7.50	1.00	3.00	0.00	0.60	0.50	0.40
39	October	9.00	85.00	3.00	5.10	8.00	1.50	3.90	0.00	0.90	0.70	0.50
41	October	14.00	81.00	2.60	5.50	8.20	2.20	4.30	0.00	1.10	0.60	0.50
43	October	28.00	78.00	3.10	7.00	8.50	3.00	4.70	0.00	1.30	0.80	0.60
45	November	32.00	66.00	3.60	7.70	9.00	3.80	5.00	0.00	1.30	0.90	0.70
47	November	49.00	78.00	3.20	7.60	9.20	4.20	4.80	0.00	1.50	0.80	0.50
49	December	58.00	75.00	4.00	8.00	8.00	4.90	4.60	0.00	1.70	1.00	0.40
51	December	72.50	92.00	3.50	8.30	8.60	5.20	5.00	0.00	1.60	1.20	0.30
1	January	106.00	101.00	3.80	7.90	8.20	5.50	4.70	0.00	1.80	1.20	0.40
3	January	132.60	123.00	4.00	8.20	7.80	5.20	4.20	0.00	2.00	1.40	0.50
5	February	172.50	138.00	4.60	7.50	7.10	4.00	3.60	3.20	2.50	1.60	0.60
7	February	198.00	153.00	5.40	7.20	6.80	3.80	3.30	3.80	2.20	2.10	0.60
9	March	226.00	189.00	6.00	6.50	6.30	3.10	3.00	4.60	2.20	2.00	0.70
11	March	215.00	299.00	7.00	6.00	5.10	2.60	2.60	5.00	2.00	1.70	0.80
13	April	208.50	452.00	6.60	5.20	4.20	1.20	2.00	6.20	2.00	1.80	0.80
15	April	132.50	480.00	5.50	4.30	3.40	0.00	0.90	7.00	1.70	1.30	0.90
17	April	100.50	498.00	4.00	3.90	3.00	0.00	0.00	6.60	1.80	1.20	1.10
19	May	52.00	451.00	3.20	2.20	1.80	0.00	0.00	5.80	1.20	1.00	0.90
21	May	36.00	315.00	2.80	0.00	0.00	0.00	0.00	4.10	1.30	0.80	0.70
23	June	12.00	127.00	2.00	0.00	0.00	0.00	0.00	2.80	0.80	0.50	0.60
25	June	9.00	110.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.20	0.50
27	July	2.50	60.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.00	0.30
	MIN	2.50	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.20
	MAX	226	498.00	7.00	8.30	9.20	5.50	5.00	7.00	2.50	2.10	1.10
	AV ± SD	72.80±74.92	167.35±144.94	3.07±2.08	4.32±3.22	5.13±3.35	1.97±2.01	2.47±1.88	1.89±2.54	1.29±0.68	0.92±0.61	0.55±0.22

Table-2 Correlation between weather parameters and population of insect-pest and natural enemies (2022-23).

Insect-pests	Maximum Temperature °C	Minimum Temperature °C	Morning Relative Humidity	Evening Relative Humidity (%)	Sunshine Hours	Rainfall (mm)
Hopper	0.500**	-0.551**	-0.507**	-0.741**	0.522**	-0.543**
Fruit fly	0.623**	0.242 ^{NS}	-0.282 ^{NS}	-0.264 ^{NS}	0.577**	-0.414*
Thrips	0.645**	-0.513**	-0.575**	-0.826**	0.725**	-0.704**
Gall midge	0.286 ^{NS}	-0.856**	-0.508**	-0.851**	0.603**	-0.640**
Leaf miner	0.112 ^{NS}	-0.703**	-0.299 ^{NS}	-0.603**	0.394*	-0.489*
shoot borer	0.013 ^{NS}	-0.928**	-0.493*	-0.762**	0.396*	-0.518**
Leaf webber	0.025 ^{NS}	-0.776**	-0.316 ^{NS}	-0.619**	0.337 ^{NS}	-0.484*
Mealybug	0.711**	0.155 ^{NS}	-0.365 ^{NS}	-0.345 ^{NS}	0.561**	-0.396*
Green lace wing	0.564**	-0.688**	-0.716**	-0.920**	0.762**	-0.764**
Spider	0.621**	-0.613**	-0.627**	-0.873**	0.713**	-0.697**
Red Ant	0.732**	0.089 ^{NS}	-0.450*	-0.417*	0.690**	-0.493*

Experiment No. 17.3.3.106

1.Title	:	Status of insect pests and natural enemies of okra under field condition
2.Background Information	:	Okra <i>Abelmoschus esculentus</i> L. (Moench) belonging to the family Malvaceae is one of the most commonly grown vegetable crop. In India it is grown in a large area covering about 530.8 thousand hectare area, producing about 6350.3 thousand MT with a productivity about 12 MT/ha (Anonymous, 2013). Although okra is a rich source of nutrients but in addition to this, it also serves as the house of pest and diseases. In India, more than 13 species of insect pests have been reported to infest okra crop (Mandal <i>et al.</i> , 2007). Mani and Singh, 2012 reported 15 arthropod species in okra ecosystem. Leafhopper (<i>Amrasca bigutulla bigutulla</i>), whiteflies (<i>Bemisia tabaci</i>), aphids (<i>Aphis gossypii</i>), red spider mite (<i>Tetranychus cinnabarinus</i>), red cotton bug (<i>Dysdercus koenigii</i>), pumpkin beetle (<i>Aulacophora foveicollis</i>), pod borer (<i>Helicoverpa armigera</i>) and shoot and fruit borer (<i>Earias vittella</i>) and one species of unidentified coleopteran beetle were also reported. Four species of predator <i>viz.</i> ladybird beetle (<i>Coccinella septempunctata</i> , <i>Coccinella sexmaculata</i> and <i>Menochilus discolor</i>) and preying mantid (<i>Mantis religiosa</i>) were also reported feeding on aphids (Bhatt <i>et al.</i> ,2018) Although several reports have been published on the pests of okra but the perusal of literature reveals that the consolidated account on the biodiversity of insect fauna is still lacking. Therefore, an effort has been made in the present study to provide the current status of the insect (natural enemies) fauna diversity prevailing in okra ecosystem under the climatic conditions of Navsari.
3.Objectives	:	To record insect pests and natural enemies in okra ecosystem
4.Principal Investigator & Associates	:	Dr. H.V. Pandya, Dr. Snehal Patel and Dr. Anand Kaswala
5.Location	:	RHRS, ACHF, NAU, Navsari
6. Name of Res. Scheme & B.H	:	Departmental Trial 12237
7.Year and season of commencement	:	2021-22, Summer
8.Crop and variety	:	Okra
9.Experimental Details	:	-
a.Observation period	:	Observations was recorded at fortnightly interval
b.Methodology	:	Survey was carried out to record information on natural enemies of major insect-pests in okra ecosystem under field condition. Data was recorded at fortnightly interval by randomly selected 20 plants by adopting standard methodology. The mean presence of insect pests and predators/parasitoids per plant was worked out. The data on presence of insect pests and predator/parasitoid correlated with abiotic factors, i.e. temperature and humidity etc., and regression equation was worked out for those parameters having significant correlation.

	<ul style="list-style-type: none"> • To record parasitoid existing in okra ecosystem immature stage of lepidopteron pests was collected and reared in laboratory and observed for emergence of parasitoid if any. • Number of larvae/ adults of predators were recorded by visual observation.
Results	<p>Seasonal abundance of okra insect-pests and natural enemies was carried out during year 2022-23. The results (Table-1) indicated that average population of fruit and shoot borer, whitefly, aphid, jassid, mite and lady bird beetle were recorded as 0.93 ± 0.60 larvae/plants, 5.02 ± 2.48, 1.98 ± 1.28, 7.84 ± 3.19 nymphs and adults/leaf and 3.37 ± 1.86 nymphs and adults/cm² leaf and 0.48 ± 0.23 larvae and adults per plants, respectively. The incidence of fruit and shoot borer started from 12th SMW and maximum incidence was recorded 1.92 larvae/plants during 16th SMW. The incidence of whitefly, aphid, jassid and mite were started from 10th SMW. The maximum incidence of whitefly, aphid, jassid and mite was recorded as 9.46, 4.11, 13.37 and 6.21 nymphs & adults/leaf during 14th, 15th, 16th and 17th SMW, respectively.</p> <p>Lady bird beetle started appearing from 10th SMW with peak population recorded as 0.86 larva and adults/ plant during 15th SMW.</p> <p>To know the effect of various weather parameters on the population fluctuation of important insect pests and natural enemies of okra correlation between them was worked out (Table 2). Shoot and fruit borer population exhibited significant positive correlation with minimum temperature (0.729*), average temperature (0.634*), morning and evening relative humidity (0.618* and 0.668* respectively) and sunshine hours (0.683*). Whitefly exhibited significant positive correlation with morning relative humidity (0.641*), jassid shows significant positive correlation with morning relative humidity (0.607*) and lady bird beetle exhibited highly significant positive correlation with morning relative humidity (0.793**) and sunshine hours (0.641*).</p>

Table :1 Seasonal abundance of okra insect pests and its natural enemies (2022-23)

SMW	Fruit and shoot borer (No. of larvae/ plant)	White fly (No. of nymphs and adults/leaf)	Aphid (No. of nymphs and adults/leaf)	Jassid (No. of nymphs and adults/leaf)	Mite (No. of nymphs and adults/cm ² leaf)	LBB (No. of larvae and adults/plant)
10	0	2.22	0.77	3.18	1.72	0.10
11	0	3.25	1.00	5.84	2.82	0.23
12	0.46	4.06	1.65	8.01	3.33	0.39
13	0.68	7.07	2.47	13.37	4.12	0.60
14	0.98	9.46	3.32	11.10	5.97	0.76
15	1.05	5.78	4.11	7.62	4.96	0.86
16	1.92	5.03	3.24	11.52	4.07	0.63
17	1.58	8.61	2.93	8.77	6.21	0.53
18	1.29	4.45	1.15	7.35	1.27	0.51
19	1.21	3.24	0.95	5.46	1.74	0.38
20	1.05	2.08	0.23	4.00	0.90	0.24
Min.	0	2.08	0.23	3.18	0.90	0.10
Max.	1.92	9.46	4.11	13.37	6.21	0.86
Av ± SD	0.93 ± 0.60	5.02 ± 2.48	1.98 ± 1.28	7.84 ± 3.19	3.37 ± 1.86	0.48 ± 0.23

Table: 2 Correlation between weather parameters and insect-pests and natural enemies

Insect pests and predator	Temperature			Relative humidity		Sunshine hours
	Max.	Min.	Ave.	Morning	Evening	
Fruit and shoot borer	-0.247	0.729*	0.634*	0.618*	0.668*	0.683*
White fly	0.041	-0.052	-0.031	0.641*	0.247	0.426
Aphid	-0.049	-0.081	-0.118	0.588	0.181	0.362
Jassid	-0.213	-0.050	-0.186	0.607*	0.145	0.347
Mite	0.243	-0.248	-0.117	0.405	-0.022	0.157
LBB	-0.305	0.214	0.042	0.793**	0.485	0.641*