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Impact of weather parameters on incidence of chilli blossom midge, *Asphondylia capsici* barens in Andhra Pradesh

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Abstract
To know the initial occurrence and subsequent build-up of blossom midge incidence on chilli crop in relation to weather parameters, the field experiments were carried out from 2008-09 to 2012-13 at Horticultural Research station, Lam, Guntur, Andhra Pradesh. Correlation coefficients worked out between midge population and weather parameters of preceding one week indicated that among the various weather parameters, significant negative correlation was observed between weather parameters of maximum temperature (-0.41**), minimum temperature (-0.52**), whereas significant positive correlation with morning relative humidity (0.67**) evening relative humidity (0.51*), rainy fall (0.10). The correlation studies carried out with preceding two weeks weather data; similar trend was observed in the correlations. Correlation coefficients worked for 2009-10,2010-11,2011-12 and 2012-13 years also. The combined effect of weather parameters on incidence of midges shows that, 72 to 92 per cent incidence was influenced by prevailed weather parameters.

Keywords: chilli (*Capsicum annum* L.), blossom midge, weather parameters, correlation, Andhra Pradesh

1. Introduction

Chilli (*Capsicum annum* L.) is an important cash crop grown in Andhra Pradesh which has got both domestic and export market as vegetable and a condiment. Andhra Pradesh occupies a prime place in chilli cultivation (116,578 hectares) accounting for 49 % of the total cultivated area in the country (Chilli Outlook, January 2019). The cultivation of chilli has become capital intensive due to many productions constrains of which the losses caused by pests in paramount. Various biotic (pest and diseases), abiotic (rainfall, temperature, relative humidity and light intensity) and phenological factors (flower and fruit drop) limits the yield and fruit quality of chilli (Hebbar *et al*., 2011) [9]. Among the biotic factors, insect pests reduces the quality of produce and even a small blemish on the fruit will drastically reduce its market value.

Butani (1976) [3] reported over 20 insect species on chillies (*Capsicum* spp.) from India of which gall midge, *Asphondylia capsici* Barens is important pest at flowering. Damage occurs only to flower buds and flowers. Adults lay eggs on unopened flower bud soon after hatching creamy white to yellowish white maggot enter in to flower and feed on developing ovary resulted in ovary bulges prominently towards one side with white discoloration and petals towards the ovary are course textured and whitish green. Maggot pass three larval instars and pupation takes place with in ovary or among the anthers. It completes life cycle with in the flower. As result infested flower drop-off. But those retained develop in to abnormal fruits, seed set and quality in infested fruits effected. Damage causes severe/ heavy flower drop, deformed/ atrophied, twisted and dropping of pods, without seeds when it ripens yield losses. This pest is very difficult to control as its habitat with in flowers. The prevalence and buildup of these insect pests of chilli is mostly governed by weather parameters like temperature, relative humidity, rainfall, sunshine hours. Furthermore, the weather parameters vary greatly from place to place and season to season (Dhaka and Pareek, 2008) [5].

For effective pest management, study on the influence of the various factors responsible for population build up and fluctuation on a particular crop might assist in prediction of its occurrence in a given area (Subharani and Singh, 2007) [14]. Thus, the knowledge of the influence of weather parameters of chilli will help to develop a forecasting system and to implement timely plant protection measures. Therefore, the present investigation was under taken knowing the peak period of pest infestations could help in taking pest management tactics more effectively with less incorporation of highly toxic chemical substances in the field. Keeping above aspects in mind, the present investigation was aimed to study on the seasonal incidence of blossom midge in relation to various weather parameters like rainfall, temperature (Maximum and minimum), relative humidity (morning and evening) and rain fall etc. Hence the present experiments were carried out.

Materials and Methods

The experiment was carried out under open field conditions at Horticultural Research Station, Lam Farm, Guntur, Andhra Pradesh from 2008 to 2012. The popularly grown chilli variety LCA-334 was used for the study. The

experiment was laid out in 500 m ^{2}plot. The plot was divided into 5 quadrates with a gap of 1m between each quadrate. Seeds of chilli variety LCA 334 were sown in the raised nursery and one-month old healthy seedlings were transplanted in the main field with a row to row and plant to plant distance of 60 cm x 45 cm. All the recommended agronomic practices like fertilizer application, weeding, hoeing, irrigation etc., were taken up at regular intervals. The crop was raised under unprotected conditions. For recording the midge incidence, 10 healthy plants were selected randomly from each quadrate and tagged. Observations on midge per cent damage caused by blossom midge, *Asphondylia capsici* Barens were recorded on infested buds/ flowers and healthy buds/ flowers on ten randomly selected and tagged plants. Incidence was recorded at weekly intervals in the chilli crop after noticing the incidence from flower bud initiation and continued till the harvest of the crop. Per cent damage was calculated by using the formula (Flemming and Retnakaran, 1985) [6].

$$\text{Per cent damage per plant} = \frac{\text{Number of damaged flower buds/pods per plant}}{\text{Total number of flower buds/pods per plant}} \text{ X } 100$$

Results and Discussions

To find out the effect of individual abiotic factors on the population dynamics of midge species infesting chilli flowers and fruits, the correlation coefficients were worked out between midge population and weather parameters. While working out the correlation coefficients, midge population of each standard week was correlated with preceding one- and two-weeks weather data which gave better correlation coefficients than with the present week weather data. The incidence of *A.capsici* (% damage per plant) in chillies was initiated from 45th STW (7.12 /plant) and it continued up to the harvest of the crop (3rd STW 22.11/plant) with a peak activity 63.79 per cent /plant at 50th STW during 2008-09. Correlation coefficients worked out between midge population and weather parameters of preceding one week indicated that among the various weather parameters, significant negative correlation was observed between weather parameters of maximum temperature (-0.41**), minimum temperature (-0.52**), whereas significant positive correlation with morning relative humidity (0.67**) evening relative humidity (0.51*) and non-significant positive impact by rainy fall (0.10) with midge incidence. The correlation studies carried out with preceding two weeks weather data; similar trend was observed in the correlations. Significant negative correlation was observed between weather parameters of maximum temperature (-0.43**), minimum temperature (-0.49**), whereas significant positive correlation with morning relative humidity (0.72**), evening relative humidity (0.57*) and non-significant positive impact by rainy fall (0.09) with midge incidence (Table-1 & 6)

Incidence of midge in chilli was initiated from 51st STW (12.55 /plant) and it continued up to the harvest of the crop (1.75 at 11 STW) with a peak activity during 1st STW (64.81) in the year 2009-10. Correlation coefficients worked out between midge population and weather parameters of preceding one week indicated that among the various weather parameters significant negative correlation was observed between weather parameters of maximum temperature (-0.41**), minimum temperature (-0.21**), whereas significant positive correlation with morning relative humidity (0.19**), evening relative humidity (0.45*), rainy fall (0.39) with midges incidence. The correlation studies carried out with preceding two weeks weather data; similar trend was observed in the correlations. weather parameters of maximum temperature (-0.33**), minimum temperature (-0.30**) has showed significant negative correlation where as significant positive correlation with morning relative humidity (0.23**), evening relative humidity (0.33*) and non- significant impact by rainy fall (0.40) with midge population (Table-2 & 6).

During 2010-11, incidence of midge (% incidence) in chilli was initiated from 45th STW (0.54/ plant) and it continued up to the harvest of the crop (0.53/ plant at 8th STW) with a peak activity during 8th STW (96.77). Correlation coefficients of preceding one week weather data indicated that among the various weather parameters, significant negative correlation was observed between weather parameters of maximum temperature (-0.54**), minimum temperature (-0.58**), whereas significant positive correlation with morning relative humidity (0.33**),evening relative humidity (0.39*) and non-significant positive impact by rain fall (0.08) with midges population. About preceding two weeks weather data, similar trend was observed in the correlations. Significant negative correlation was observed between weather parameters of maximum temperature (-0.54**), minimum temperature (-0.58**), whereas significant positive correlation with morning relative humidity (0.33**), evening relative humidity (0.39*) and non-significant impact by rain fall (0.39) with midge population (Table-3 & 6)

Incidence of midge (% incidence) in chilli was initiated from was initiated from 45th STW (0.11per plant) and it continued up to the harvest of the crop (7.53/plant at 8 STW) with a peak activity during 4th STW (73.84) during 2011-12. Correlation coefficients worked out between midge population and weather parameters of preceding one week indicated that among the various weather parameters significant negative correlation was observed between weather parameters of maximum temperature (-0.68**), minimum temperature (-0.19**), whereas significant positive correlation with morning relative humidity (0.53**),evening relative humidity (0.51*) and non-significant positive impact rain fall (0.41) with midges population. With preceding two weeks weather data, indicated that among the various weather parameters significant negative correlation was observed between weather parameters of maximum temperature (-0.41**), minimum temperature (-0.26**), whereas significant positive correlation with morning relative humidity (0.74**),evening relative humidity (0.51*) and non-significant positive impact rain fall (0.30) with midge population (Table-4 & 6)

During 2012-13, incidence of midge (% incidence) in chillies was initiated from 43th STW (2.13 /plant) and it continued up to the harvest of the crop (1.28 at 8 STW) with a peak activity during 51st STW (124.34) during 2012-13. Correlation coefficients worked out between midge population and weather parameters of preceding one week indicated that among the various weather parameters significant negative correlation was observed between weather parameters of maximum temperature (-0.29**), minimum temperature (-0.64**), whereas significant positive correlation with morning relative humidity (0.55**), evening relative humidity (0.61*) and non-

significant positive impact by rain fall (0.50) with midges population. The correlation studies carried out with preceding two weeks weather data; similar trend was observed in the correlations. Weather parameters of preceding two weeks indicated that among the various weather parameters significant negative correlation was observed between weather parameters of maximum temperature (-0.55**), minimum temperature (-0.58**), whereas significant positive correlation with morning relative humidity (0.50**), evening relative humidity (0.53*) and non-significant positive impact by rain fall (0.24) with midge population. (Table-5 & 6)

From the findings it was evident that population build-up of midges on chilli was mainly influenced by relative humidity and rainfall and other parameters like temperature and sunshine hours did not show any significant effect. The population levels also vary with year to year because of variations in the weather parameters.

The overall results obtained from five years of study, the seasonal incidence of chilli midge and its relation with weather parameters clearly indicated the peak period of activity of midge incidence was influenced by preceding one and two week weather parameters and significant role of weather parameters on the population dynamics of midges inhabiting the flower and fruit parts of chilli crop. The information obtained from these studies used in developing weather-based pest prediction models which in turn are helpful in taking up timely control measures.

The combined effect of weather parameters on incidence of midges was worked out (Table-7), the variation in the incidence (72 to 92%) was contributed by the weather parameters. Similar findings by Pathipati *et al*. 2014 and Bindu and Patil 2000 as 81 % and 69 % incidence was contributed by weather parameters. The present findings are in conformity of the results obtained by Chatterjee, 2004 who reported that midge population was significantly positively correlated with relative humidity and rainfall. Similar to our findings were by Patil and Nandihalli, 2009 [12], Gupta *et al*., 2016 [7]. Thriveni KP, 2019 have also reported that midge population showed negative correlation with Maximum and minimum temperature and positive correlation with morning and evening humidity, rainfall. Similar results have been observed by Kumar, 2010, Meena and Kanwat 2013 [1] and Asma and Hanumantharaya 2015 [1].

Table 1: Seasonal incidence of Chilli gall midge, *Asphondylia capsici* Barens during 2008-09

Sl. No.	Standard week	Date & Month	Temp^{0}C		RH%		Rainfall (mm)	Blossom midge % damage per plant
			Max	Min	Morn	Eve		
6	42	Oct15-21-2008	33	20.7	86.1	57.9	15	0
7	43	Oct22-28.	31.9	18.3	81	49.4	8.2	0
8	44	Oct 29-Nov4	33.95	16.1	82	35.85	0	0
9	45	Nov05-11	32	26	78	47	0	7.12
10	46	Nov12-18	29.8	17.1	83	63	34.8	12.15
11	47	Nov19-25	31.8	19.4	87.8	53.8	1.4	39.61
12	48	Nov26-Dec02'08	29.8	17.8	81.4	72.2	65.8	59.58
13	49	Dec03-09'08	29.9	15.65	95	61	0	61.56
14	50	Dec11-16'08	30.6	14.9	96.1	60.4	0	63.79
15	51	Dec17-23'08	30.2	13.4	96.8	61.2	0	57.64
16	52	Dec24-31'08	21.2	16.4	98.1	82.2	0	51.52
17	1	Jan 1-7'09	31.25	18.25	95.28	79.4	0	50.11
18	2	Jan 8-14'09	31.13	19.28	91.42	76.85	0	31.19
19	3	Jan 15-21'09	31.21	18.8	92.28	71.57	0	22.11

Table 2: Seasonal incidence of Chilli gall midge, *Asphondylia capsici* Barens during 2009-10

Sl. No.	Standard week	Date & Month	Temp^{0}C		RH%		Rainfall (mm)	Blossom midge % damage per plant
			Max	Min	Morn	Eve		
1	50	Dec11-16-2009	29.78	18.07	86.57	58	0	-
2	51	Dec17-23	28.54	19.07	90	57	0	0
3	52	Dec24-31	28.65	18.35	80.28	49	0	0
4	1	Jan 1-7,2010	29.78	16	86.28	61.42	0	64.81
5	2	Jan 8-14	29.57	16	86.28	61.42	0	51.58
6	3	Jan 15-21	29.42	15.7	87.71	43.71	2	51.12
7	4	Jan 22-28	29.71	15.2	86.14	45.41	0	33.78
8	5	Jan 29-4 Feb	26.74	15.07	83	42.7	0	17.41
9	6	Feb 5-11	31.6	18.24	92	43.5	0	10.99
10	7	Feb 12-18	32	16.5	88.28	51.71	0	3.55
11	8	Feb 19-25	33.11	16.28	89.42	48	0	2.11
12	9	Feb26-4rd March	33.75	13.88	96	51.42	0	1.75
13	10	Mar5-11	33.78	16.11	85.57	47.28	0	-
14	11	Mar12-18	30	16.2	90.85	44.71	0	-

Table 3: Seasonal incidence of Chilli gall midge, *Asphondylia capsici* Barens during 2010-11

Sl.	Standard week	Max	Min	Morn	Eve	Rainfall	%Blossom midge damage/plant
43	Oct22-28. 2010	32.2	23.97	92.43	70.57	62.3	0
44	Oct 29-Nov4	29.8	23.56	92.57	81.86	48.8	0
45	Nov05-11	29.2	23.23	91.29	76.86	23.4	0.32
46	Nov12-18	29.97	23.74	86.43	74.29	27.8	0.95
47	Nov19-25	31.89	22.43	86.43	68.14	0	1.59
48	Nov26-Dec02	30.7	20.59	88	59.86	0	7.56
49	Dec03-09	26.76	20.51	85	71.29	115.3	45.48
50	Dec11-16	29.87	20.73	91.71	58.14	0	48.78
51	Dec17-23	27.94	14.61	83.14	46.43	0	68.77
52	Dec24-31	28.89	16.44	88.88	54.75	0	88.79
1	Jan 1-7,2011	29.24	17.34	84.57	49	0	96.77
2	Jan 8-14	30.27	15.23	80.29	43.57	0	73.19
3	Jan 15-21	31.24	16.91	93.43	46.29	0	43.21
4	Jan 22-28	31.24	15.63	95.14	45.91	0	15.73
5	Jan 29-4 Feb	31.74	17.43	95.29	46.86	0	11.89
6	Feb 5-11	32.77	16.13	89.86	41.29	0	3.19
7	Feb 12-18	33.61	17.41	77.14	40.57	0	1.28
8	Feb 19-25	30.07	20.84	93.14	63.86	7.7	0.53

Tables 4: Seasonal incidence of Chilli gall midge, *Asphondylia capsici* Barens during 2011-12

Sl. No.	Standard week	Date & Month	Temp^{0}C		RH%		Rainfall (mm)	%Blossom midge damage
			Max	Min	Morn	Eve		
1	42	Oct15-21-2011	30.03	22.99	80.91	70.44	30.48	0
2	43	Oct22-28.	31.29	23.97	92.43	70.57	42.33	0
	44	Oct 29-Nov4	28.89	23.56	92.57	81.86	50.12	0
4	45	Nov05-11	29.2	23.23	91.29	76.86	33.31	0.11
5	46	Nov12-18	29.97	23.74	86.43	74.29	27.8	1.16
6	47	Nov19-25	31.89	22.43	86.43	68.14	0	1.59
7	48	Nov26-Dec02	30.7	20.59	88	59.86	0	2.56
8	49	Dec03-09	26.76	20.51	85	71.29	44.69	8.44
9	50	Dec11-16	29.87	20.73	91.71	58.14	0	13.54
10	51	Dec17-23	27.94	14.61	83.14	46.43	0	19.96
11	52	Dec24-31	28.89	16.44	88.88	54.75	0	24.54
12	1	Jan 1-7,2012	29.24	17.34	84.57	49	0	36.65
13	2	Jan 8-14	30.27	15.23	80.29	43.57	0	42.58
14	3	Jan 15-21	31.24	16.91	93.43	46.29	0	66.78
15	4	Jan 22-28	31.24	15.63	95.14	45.91	0	73.84
16	5	Jan 29-4 Feb	31.74	17.43	95.29	46.86	0	41.22
17	6	Feb 5-11	32.77	16.13	89.86	41.29	0	32.12
18	7	Feb 12-18	32.66	17.17	89.91	42.66	0	22.03
19	8	Feb 19-25	33.12	17.99	88.99	42.16	7.7	2.53

Table 5: Seasonal incidence of Chilli gall midge, *Asphondylia capsici* Barens during 2012-13

Sl. No.	Standard week	Date & Month	Temp^{0}C		RH%		Rainfall (mm)	%Blossom midge damage
			Max	Min	Morn	Eve		
1	42	Oct15-21-2012	29.19	22.15	88.16	73.19	0	0
2	43	Oct22-28.	29.45	22.79	88.45	74.98	11.59	2.17
	44	Oct 29-Nov4	29.99	22.91	88.66	75.55	18.22	5.14
4	45	Nov05-11	29.2	23.23	91.29	76.86	23.4	6.45
5	46	Nov12018	29.97	23.74	86.43	74.29	27.8	29.78
6	47	Nov19025	31.89	22.43	86.43	68.14	0	41.22
7	48	Nov260Dec02	30.7	20.59	88	59.86	0	74.11
8	49	Dec03009	26.76	20.51	85	71.29	115.3	92.78
9	50	Dec11016	29.87	20.73	91.71	58.14	0	95.66
10	51	Dec17023	27.94	14.61	83.14	46.43	0	124.34
11	52	Dec24031	28.89	16.44	88.88	54.75	0	112.55
12	1	Jan 1-07,2013	29.24	17.34	84.57	49	0	110.14
13	2	Jan-14	30.27	15.23	80.29	43.57	0	88.56
14	3	Jan 15-21	31.24	16.91	93.43	46.29	0	81.45
15	4	Jan 22-28	31.24	15.63	95.14	45.91	0	71.95
16	5	Jan 29-04 Feb	31.74	17.43	95.29	46.86	0	62.12

17	6	Feb-11	31.77	17.55	95.77	46.22	0	44.78
18	7	Feb 12-18	31.99	17.59	95.84	46.74	0	12.75
19	8	Feb 19-25	32.12	16.48	96.12	47.54	7.7	1.25

Table 6: Correlation co-efficient between midge *A.capsici* incidence and weather parameters (preceding one and two weeks from 2008 to 2012)

Observatory Weather Parameters	2008-09		2009-10		2010-11		2011-12		2012-13	
	Preceding 1 Week	Preceding 2 Week	Preceding 1 Week	Preceding 2 Week	Preceding 1 Week	Preceding 2 Week	Preceding 1 Week	Preceding 2 Week	Preceding 1 Week	Preceding 2 Week
Maximum Temperature	-0.46**	-0.43**	-0.41**	-0.30**	-0.41**	-0.54**	-0.68**	-0.41**	-0.29**	-0.55**
Minimum Temperature	-0.52**	-0.49**	-0.21**	-0.36**	-0.58**	-0.58**	-0.19**	-0.26**	-0.64**	-0.58**
Morning Relative Humidity (RH-1%)	0.67**	0.72**	0.19**	0.33**	0.33**	0.33**	0.53**	0.74**	0.55**	0.50**
Evening Relative Humidity (RH-II %)	0.51*	-0.57*	0.45*	0.23*	0.34*	0.39*	-0.51*	-0.51*	-0.61*	-0.53*
Rain fall (mm)	0.10	0.09	0.39	0.40	0.08	0.15	0.41	0.30	0.50	0.24

*Significant at 5 per cent level (r =0.22) ** Significant at 1 per cent level (r =0.18)

Table 7: Multiple regression equation developed for *A.capsici* incidence on chilli and weather parameters from 2008 to 2012)

Observation	Step down multiple linear equation	Co-efficient of determination (R^2)
2008-09 Preceding 1 week	Y= 33.30+ 0.28**T.max -6.96 T.Min +8.85* RH-1-1.86* RH-1I+1.84 RF	0.91
2008-09 Preceding 2 week	Y= 54.33+ 0.21*T.max+ 6.19* T.Min +8.18* RH-1- 1.71+1.71RH-II+0.7RF	0.92
2009-10 Preceding 1 week	Y= 31.67-10.23* Tmax- -0.05 T. min * +3.11 RH-I-2.53 RH-II-17.79RF	0.76
2009-10 Preceding 2 week	Y= 30.99 – 10.23* Tmax -6.28T min + 1.00 RH-I -1.92 RH-II -19.86RF	0.61
2010-11 Preceding 1 week	Y=36.24-18.61* Tmax- 0.51T min+0.64+1.06*RH-I- 1.31 RH-II-0.33RF	0.77
2010-11 Preceding 2 week	Y=18.87-16.83*Tmax- 0.93T min+1.66+1.71*RH-I 0.88 RH-II-0.13RF	0.74
2011-12 Preceding 1 week	Y=41.80-13.30* Tmax- 0.66T min+0.69*RH-I+0.50 RH-II-0.04RF	0.72
2011-12 Preceding 2 week	Y=44.22-11.49* Tmax- 3.22T min +0.57*RH-I+0.29 RH-II-0.49RF	0.70
2012-13 Preceding 1 week	Y=22.99-11.90* Tmax- 2.47T min+0.54*RH-I-0.69 RH-II-0.62RF	0.76
2012-13 Preceding 2 week	Y=34.07-14.48* Tmax- 2.88T min+0.88*RH -I-0.60 RH-II-0.54RF	0.75

Conclusion

The findings of present investigation on seasonal incidence of midge could help in taking suitable pest control measures by identifying the vulnerable stages of these pest and minimizing the frequent application of toxic pesticides providing suitable opportunities to grow natural enemies in less hazardous environment which will be helpful in the conservation process of biological control programme.

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References

1. Asma A, Hanumantharaya L. Population dynamics of major insect and mite pests of chilli. Journal of Experimental Zoology. 2015; 18(1):173-176.
2. Bindu KP, Patel JR. Population dynamics of different species of thrips on chilli, cotton and pigeon pea. Indian Journal of Entomology. 2001; 63(1):170-175.
3. Butani DK. Pests and diseases of chilli and their control. *Pesticides*, 1976; 10:38-41.
4. Chatterjee M. Occurrence of yellow mite, *Polyphagotarsonemus latus* Banks Acari: Tarsonemidae and predatory mites in diversified groups of chilli cultivars. Approved M.Sc. Thesis, 2004, 86-87.
5. Dhaka SR, Pareek BL. Weather factors influencing population dynamics of major insect pests of cotton under semi-arid Agro. ecosystem. Indian Journal of Entomology. 2008; 70(2):157-163.
6. Flemming R, Retnakaran A. Evaluation of single treatment data using Abbott's formula with reference to insect. Indian Journal of Economic Zoology. 1985; 78:1179-1181.
7. Gupta JK, Ashok Bhatnagar, Agrawal VK, Mukherjee S, Sharma BK. Population dynamics and extent of damage due to pest complex on capcicum (Capsicum annumL.) Under shade net house. J of Prog Agri, 2016, 7(2).
8. Hand Book of Horticultural Statistics, India. Vegetables, 2014, pp: 12-15
9. Hebbar SS, Balakrishan B, Prabhakar M, Srinivas V, Anil Kumar N, Ravi Kumar, Girija G, *et al*. Protected Cultivation of Capsicum. IIHR Technical Bulletin, 2011, 22.
10. Kumar NKK, Nagaraju D, Gall K. Gall insects damaging eggplant, bell peppers in south India. Eds. J Prohens & A.Rodriguez – Burruezo, 2010.
11. Meena NK, Kanwat PM. Studies on seasonal incidence and relative safety of pesticides against Coccinellids in okra ecosystem. Journal of Biological Control. 2010; 24(2):116-122.
12. Patil RS, Nandihalli BS. Seasonal incidence of mite pests on brinjal and chilli. Karnataka Journal of Agricultural Sciences. 2009; 22(3):729-731.
13. Rajpur BC, Patil BC, Basavaraj H. Economics of chilli production in Karnataka. Karnataka Journal of Agricultural Sciences. 2008; 21:3237-240.

14. Subha Rani S, Singh TK. Influence of meteorological factors on population dynamics of pod fly *Melanogromyza obtuse* Malloch (Diptera: Agromyzidae) in pigeon pea under agro- climatic conditions of Manipur, Indian Journal of Entomology. 2007; 69(1):78-80.
15. Triveni KP. Correlation of ehite fly population with weather parameters and management of leaf curl in chilli. Journal of Pharmacognosy and phytochemistry. 2019; 8(3):4624-4628
16. Pathipati VL, Vijayalakshmi T, Naram Naidu L. Seasonal incidence of major insect pests of chilli in relation to weather parameters in Andhra Pradesh. Pest Management in Horticultural Ecosystems. 2014; 20(1):36-40.