



coefficients of % parasitization vs weather parameters [obtained from www.accuweather.com for 2015-16] were computed. The strength of the coefficients was evaluated and described following Evans (1996) as -0.00-0.19: “very weak”; 0.20-0.39: “weak”; 0.40-0.59: “moderate”; 0.60-0.79: “strong” and 0.80-1.0: “very strong”.

## RESULTS AND DISCUSSION

The parasitization of maggots of *M. obtusa* during kharif, 2015-16 presented in Table 1 reveal the significant effects of all the four genotypes. *Euderus* sp. (Hymenoptera: Chalcidoidea: Eulophidae), *Torymus* sp. (Hymenoptera: Chalcidoidea: Torymidae) and *Systasis dasyneurae* Mani (Hymenoptera: Chalcidoidea: Pteromalidae) were the ectoparasitoids identified (Fig. 1). The parasitization was observed to start on 45<sup>th</sup> standard meteorological week (SMW) and increased with pest population. The parasitism by *Euderus* sp., *Torymus* sp. and *S. dasyneurae* ranged from 2.50 to 52.38, 1.45 to 61.54 and 1.03 to 4.76%, respectively.

The peak activity of *Euderus* sp. was observed during 5<sup>th</sup> SMW on BSMR-736 (52.17%); 3<sup>rd</sup> SMW on BDN-708 (42.39%) and BDN-2010-1 (46.88%); and 4<sup>th</sup> SMW on ICP-8863 (52.38%) with a mean of 42.06% on

3<sup>rd</sup> SMW; whereas, *Torymus* sp. attained its peak activity during 3<sup>rd</sup> SMW on BSMR-736 (18.40%) and BDN-2010-1 (18.75%); 5<sup>th</sup> SMW on ICP-8863 (61.54%) and BDN-708 (27.03%) with a mean parasitism of 26.49% on 5<sup>th</sup> SMW. *Systasis dasyneurae* showed its peak activity during 4<sup>th</sup> SMW on ICP-8863 (4.76%) and no incidence was noted on the remaining genotypes. Later the parasitism decreased and reached zero during 7<sup>th</sup> SMW on all genotypes. The maximum average parasitism of 25.53% by *Euderus* sp. was observed on BSMR-736 followed by ICP-8863 (23.13%), BDN-708 (21.65%) and BDN-2010-1 (18.89%), with a mean parasitism of 22.30%.

Similarly, the four genotypes showed a significant difference in parasitism due to *Torymus* sp. exhibiting maximum on ICP-8863 (12.16%) followed by BSMR-736 (6.54%), BDN-708 (6.52%) and BDN-2010-1 (4.30%), with a mean of 7.38%. The genotypes, however, didn't show a significant effect on parasitism by *S. dasyneurae* exhibiting 0.77% only on ICP-8863 with a mean of 0.19% and the rest three genotypes didn't exhibit any parasitism of pod fly maggots which might be due to the morphological characteristics and biochemical nature of pods.



Fig. 1. A-C. Parasitoids from maggots of *M. obtusa*

Table 1. Species wise parasitism (%) of *M. obtusa* maggots

SMW	BSMR-736			BDN-2010-1			ICP-8863			Mean		
	<i>Euderus</i> sp.	<i>Torymus</i> sp.	<i>Systasis</i> sp.	<i>Euderus</i> sp.	<i>Torymus</i> sp.	<i>Systasis</i> sp.	<i>Euderus</i> sp.	<i>Torymus</i> sp.	<i>Systasis</i> sp.	<i>Euderus</i> sp.	<i>Torymus</i> sp.	<i>Systasis</i> sp.
43	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00
44	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00
45	00.00	00.00	00.00	08.33	00.00	00.00	02.50	00.00	00.00	02.71	00.00	00.00
46	41.18	00.00	00.00	07.14	00.00	00.00	11.36	00.00	00.00	14.92	00.00	00.00
47	32.00	00.00	00.00	18.75	00.00	00.00	18.33	00.00	00.00	17.27	00.00	00.00
48	28.13	03.13	00.00	29.79	00.00	00.00	22.39	00.00	00.00	23.20	00.78	00.00
49	28.21	05.13	00.00	30.61	02.04	00.00	29.41	00.00	00.00	29.67	02.15	00.00
50	27.45	05.88	00.00	30.91	03.64	00.00	26.09	04.35	00.00	28.45	04.13	00.00
51	25.37	08.96	00.00	40.48	04.76	00.00	29.17	04.17	00.00	30.50	06.16	00.00
52	27.66	08.51	00.00	39.62	05.66	00.00	36.00	08.00	00.00	32.14	07.47	00.27
01	42.06	14.95	00.00	37.31	10.45	00.00	34.48	10.34	00.00	34.65	11.26	00.26
02	41.23	16.67	00.00	34.52	10.71	00.00	37.93	13.79	00.00	38.52	17.02	00.48
03	41.60	18.40	00.00	42.39	13.04	00.00	46.88	18.75	00.00	42.06	19.07	01.09
04	41.46	12.20	00.00	33.93	14.29	00.00	27.27	13.64	00.00	38.76	21.93	01.19
05	52.17	17.39	00.00	21.62	27.03	00.00	07.14	00.00	00.00	29.85	26.49	00.00
06	05.56	00.00	00.00	26.92	19.23	00.00	00.00	00.00	00.00	16.45	08.97	00.00
07	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00
Avg.	25.53	06.54	00.00	21.65	06.52	00.00	18.89	04.30	00.00	22.30	07.38	00.19

The present observations on the species wise parasitism of *M. obtusa* maggots are in accordance with earlier ones viz., Fellowes and Amarasena (1977), Sithanatham et al. (1983), Das and Katyar (1998) and Yadav et al. (2012) who had reported that various parasitoids had been rated as abundant, common, uncommon and rare, respectively. Thakur and Odak (1982) first reported *Euderus* [near *E. messor* (Wlk.)] from India, parasitizing *M. obtusa* maggots to the tune of 28.0%. Peter (1992) and Sebastian (1993) reported 5.20 to 7.30% parasitism by *Euderus agromyzae*. Singh (1994) reported that *Senegalella* sp. (= *Pseudotorymus* sp.) as an ectoparasitoid of third instar maggot of the pod fly. Pillai and Agnihotri (2013) and Patange et al. (2017b) reported that the maximum parasitism was observed from 51<sup>st</sup> to 2<sup>nd</sup> SMW. Patange et al. (2017a) reported that *Torymoides* sp. is an ecto-parasitoid of *M. obtusa* maggots and the level of natural parasitism ranged from 3.13 to 31.82%. Chiranjeevi and Patange (2017) found that the activity of *S. dasyneurae* on pod fly maggots was observed from 3<sup>rd</sup> to 5<sup>th</sup> SMW and the parasitization ranged from 1.69 to 7.32% with a mean of 0.98%.

The results on the parasitization of *M. obtusa* with *Euderus* sp., *Torymus* sp. and *S. dasyneurae* and its dynamics with weather parameters during kharif, 2015-16 are presented in Table 2. The parasitism due to *Euderus* exhibited significant strong negative correlation with maximum temperature (-0.6494), and very strong with minimum temperature (-0.8344) and mean temperature (-0.8628). There was a significant strong negative correlation between mean parasitism due to *Torymus* and minimum temperature (-0.7029) and mean temperature (-0.6360); and a strong negative correlation between parasitism by *Torymus* and wind velocity (-0.4762). Parasitism due to *S. dasyneurae* exhibited significant strong negative correlation with maximum temperature (-0.6958), minimum temperature

(-0.6098), mean temperature (-0.7215) and wind velocity (-0.5061), indicating that with increasing temperature parasitism tends to decrease.

There was no correlation between parasitism by all three parasitoid species with morning humidity, afternoon humidity and average humidity. The results of present investigation in relation to simple correlation between parasitism and weather parameters are in accordance with Patange et al. (2017c), who observed negative correlation between parasitoid population and rainfall, maximum and minimum temperature, morning humidity and evaporation. Pillai and Agnihotri (2013) reported that the regression analysis with various abiotic factors was the most influencing factor, which contributed 86.3% variation in % parasitism of *M. obtusa*.

So far, many molecules have been evaluated against this pest, but significant control was not obtained. More than 25 hymenopteran parasitoids had been reported with natural parasitism varying from 2.0 to 90.0%. Therefore, the need based application of safer insecticides keeping in mind the weather factors as well as the parasitoid complex of *M. obtusa* will enable effective IPM.

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Table 2. Correlation coefficients - parasitization of *M. obtusa* vs. weather parameters

Parasitoids	Temperature (°C)			Relative Humidity (%)			Wind Velocity (kmph)
	Maximum	Minimum	Mean	AM	PM	Average	
<i>Euderus</i> sp.	-0.6494*	-0.8344**	-0.8628**	-0.0489	0.0426	0.0001	-0.3516
<i>Torymus</i> sp.	-0.3260	-0.7029*	-0.6360*	-0.2032	0.0898	-0.0502	-0.4762*
<i>Systasis dasyneurae</i>	-0.6958*	-0.6098*	-0.7215*	-0.1421	0.1716	0.0282	-0.5061*

\*Strong; \*\*Very Strong

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