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INTERACTION O1394F *EPISURPHUS BALTEATUS* (DIPTERA: SYRPHIDAE) WITH *BRASSICA CAMPESTRIS* L. IN RELATION TO *MYZUS PERSICAE* APHID (SUZLER) (HOMOPTERA: APHIDIDAE)

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ABSTRACT

The interaction of Syrphid predator *Episurphus baltatus* with the population density of green peach aphid *Myzus persicae* of *Brassica campestris* L. grown in four fields of Hyderabad was studied during Rabi season i.e. November 2015 to March 2016. Adult hoverflies were collected by three standardized methods, Aerial netting through insect hand net, Yellow pan water trap and Malaise trap. However, larvae were directly collected from leaves, stem, growing points and inflorescence of *Brassica* plant. Monthly population dynamics revealed that the occurrence of *Episurphus baltatus* started from the 3rd week of November and attended its peak density in the 2nd week of February, which coincided with the highest density of aphids. The numerical density of *Episurphus baltatus* determined a rise in response to abundance of aphids in the field, whereas the environmental factors also influenced the density of predator. The Pearson's correlation analysis revealed a strong positive correlation of predator with prey aphid r=.895, p=.01 and a moderate positive correlation with relative humidity 0.562, p=.05. Nonetheless, rainfall and temperature were negatively correlated (r=-0.647 and r=-0.597 respectively) with predator population density in *Brassica* ecosystem. In addition, regression analysis suggested that aphid density (prey) has high effect (58.3%) on predator population. The temperature and rainfall showed a moderate and low negative effect (-32.0% and -15.1% respectively) on predator; whereas, relative humidity indicated very low positive effect (9.3%) on predator density.

Key words:*Episurphus balteatus*, *Brassica campestris* L, *Myzus persicae*, correlation, regression, Hyderabad.

INTRODUCTION

A predator or natural enemy is the one that devours adequate number of the preys at the right time to retain a pest population density lower than the economic injury threshold for crops (Michaud and Belliure 2000), whereas; a pest is an insect that attacks and causes enough decrease in quality as well as yield of different crops (Dent 2000). The family Syrphidae consists of about 6,000 species and considered as one of the largest families of order Diptera (Kuznetsov 2002; Thompson2006) and are grouped in three sub families i.e. Syrphinae, Eristalinae and Microdontinae (Rotherary and Thompson 1998).*Episyrphus balteatus*, sometimes called themarmalade hoverfliesbelong to subfamily Syrphinae and are proved to be a very important element for ecosystem, because of their two main ecological services i.e. pollination and biological control, which they provide to many ecosystems of the world. Adults help in cross pollination of different agricultural and horticultural crops, vegetables, wild plants and flowers by zipping flower to flower, whereas; their larvae are potential biological control agents of many aphid species including *Myzus persicae* (Kotwal *et al*. 1984; Lapchin *et al*. 1987; Singh *et al*. 2014) as they voraciously attack and consume large number of these aphids (Leroy *et al*. 2010).

Moreover; female mostly lay eggs only in the sites where aphids are present and usually prefer larger aphid colonies for oviposition. Wnuk (1972), Mizuno *et al*. (1997) and Razaq *et al.* (2011) reported that aphids cause serious damage to cereal crops as well as Brassica crop in southern Punjab, while Blackman and Eastop (2000) and Mushtaq *et al.* (2013) found aphids on growing tips, leaves, branched and flowers.The land and weather conditions of Hyderabad, Sindh region are suitable for good quality production of *Brassica* crop as cooler condition in winter help to grow this crop and warmer spring provides good harvesting conditions (Sarwar 2009). But Aphids especially green peach Aphid *Myzuspersicae* causes serious damage to this crop, both adult and nymph suck up sap from pods, leaves, flowers and stem resulting in depriving of pod formation, reducing oil content in seed, lowering in growth and ultimately causing huge economic loss, as about one third of the total crop yield is potentially affected (Berlandier *et al*. 2010). Syrphid larvae are ranked as one of the major natural opponents and play a key role in suppressing the aphid population density (Ghorpade 1981). Thus they have been renowned as one of the proficient bio control elements of aphids (Misra and Singh 1988; Muraleedharan and Radhakrishnan 1993).

The developmental duration and predatory preferences vary with change in environmental

conditions. Keeping this in view, the present study was aimed to survey the *Brassica campestris L.* growing fields of Hyderabad and assess the damage caused by aphids (especially green peach aphid) to this crop, to compute the predator-prey relationship (in terms of effect of occurrence of predator on density of prey *Myzus persicae*), and finally to investigate the effect of weather factors (Temperature, humidity and rainfall) on population density of predator.

MATERIALS AND METHODS

Field surveys were conducted to assess the seasonal occurrence and density of hoverfly predator, *Episurphus baltatus* (De Geer) and its prey aphid, *Myzus persicae* on *Brassica campestris* L. crop in four fields of Hyderabad during Rabi season (November 2015 to March 2016). Each field/plot was of about 12 x 8$m^{2.}$ Size and free from insecticide while the spacing was 50 cm between plants and rows. Observations were carried out on the seasonal activities of *Episurphus balteatus* and its prey *Myzus persicae* at 10 days interval and the density of predator as well as prey was evaluated from 20 randomly chosen plants from four fields (5 plants in each field) by following Church and Stricklnd (1954) method. During study period, weekly data of Metrological parameters (humidity, temperature and rainfall) were recorded from metrological station Hyderabad. In order to study interaction of *Episurphus balteatus* hoverflies (adult and larvae) with their aphid prey, adults were collected/trapped by three standardized methods i.e. Aerial netting through insect hand net, Yellow pan water trap and Malaise trap following Namaghi and Husseini (2009), while larvae were directly picked/sampled from leaves, stem, growing points and inflorescence of *Brassica* plant.

Data analysis: The collected data was subjected to Pearson's correlation analysis following Panse and Sukhatme (1985) in order to measure the strength of linear relationship of weather variables with population densities of predator as well as prey. In addition regression analysis was also employed to spot the effect of alteration in independent variables (x) on the outcome of dependent variable (y), using SPSS software version 22.

RESULTS AND DISCUSSION

This study was carried out to explore the monthly prevalence of *Episurphus balteatus* and its prey aphid *Myzus persicae* on *Brassica campestris* L. during Rabi season (November, 2015-March, 2016). It was found that the occurrence of *Episurphus balteatus* (larvae and adults) started from 3rd week of November and continued till the end of March (harvesting time), while the occurrence of its prey aphid started from 1st week of November and continued till March. In the beginning the density of *Episurphus balteatus* as well as aphid was very low (3.2 predators/ sample and 3.1 aphids/sample) and attended their peak density in the month of February (27.3 predators/sample and 102.2 aphids/sample respectively) (Table 1).

This was due to the fact that during February *Brassica* crop reached to full flowering and pod formation stage and at this stage it was found severely infested by green peach aphids *Myzus persicae*, although branches, stems and leaves were found infested but inflorescence was the most affected part (Figure 1 and 2). In addition this period was found to be the most suitable for predator density, as female *E. balteatus* lay their eggs inside large aphid colonies. During this high population density period an average relative humidity and temperature were 58.8% and 20.4^{0}C respectively with no rainfall. The population density of *E. balteatus* (adult and larvae) as well as aphids showed declining drifts after February due to gradual rise in temperature and incidence of rainfall.

Pearson's correlation analysis revealed a strong and significant positive correlation i.e. r= 0.895 (p=0.01) between *E. balteatus* and *Myzus persicae* aphid, this shows the predator's positive role in suppressing the *Myzus persicae* aphid's population in the field, while there was a significant negative correlation of predator and aphid with temperature and rainfall, the values being r= -0.647*, r= -0.827** (with temperature) and r= -0.597, r=- .0748** with rainfall and a significant positive correlation of humidity was recorded with predator and prey, the values being, r= 0.562*, r= 0.718** (p=0.05) (Table 2). The essence of this study was to investigate if density of aphids and weather factors i.e. temperature; rainfall and relative humidity have significant effect on population density of predator? To evaluate these facts, regression analysis was run using SPSS software version 22, the results are summarized in table 3 (a, b and c). Table 3 (a) showed that R (degree of correlation) was .903 which is > 0.6 and considered as very high correlation, while the R^2 was .816 which means 81.6% variance can be explained in predictor variables (independent variables) (R^2 .816 x 100 = 81.6; 18.4 + 81.6 = 100%) These results suggest that aphid and weather factors (overall) affected 81.6% on population density of *E. Balteatus*. Table 3 (b) revealed the significance value (p=0.001) which is less < 0.005 and 0.05, this means that the overall regression module is highly significant, while table 3 (c) illustrates Beta coefficient values which suggests the effect of all independent variables i.e. aphid, temperature, rainfall and relative humidity on density of predator, the values being 0.583, -0.320, -0.151, 0.093 respectively. This means that aphids had 58.3% effect, temperature -32.0%, rainfall -.15.1 % and relative humidity had 9.3% effect on

population density of *Episurphus balteatus* predator in brassica fields. These results indicate that there is high effect of aphid density on predator, whereas the temperature and rainfall show a moderate and low negative effect on predator respectively, while relative humidity shows very low effect on predator population.Observations of Butani and Kapadia (1997), Manzar *et al.* (1998), Bijiya *et al.* (2001) and Konar and Paul (2003) are also similar, they reported negative correlation of predator and aphid with temperature and rainfall. Singh *et al.* (1993) recorded density reliant relationship of predator with aphid population. They reported that adults and larvae of *E. balteatus* were found in high numbers when prey aphid, *Myzus persicae* were plentiful in the field. The results of this study are in compliance with that of Bilashini *et al.* (2007) who also described positive correlation between predator and aphids in their experimental study. Hoverflies are of dual importance i.e. bio-control agents against different pests and pollinators, this provided a strong motive to preserve and protect these natural opponents and their extended use in agriculture ecosystem (Burgio and Sommaggio 2014).

Fig. 1. *Myzus persicae* (green peach aphids) (Nymph) on Brassica leaf

Fig. 2. Infested brassica inflorescence (flower) with *Myzus persicae* aphids

Fig. 3. Adult *Episrphus baltatus* (Female)

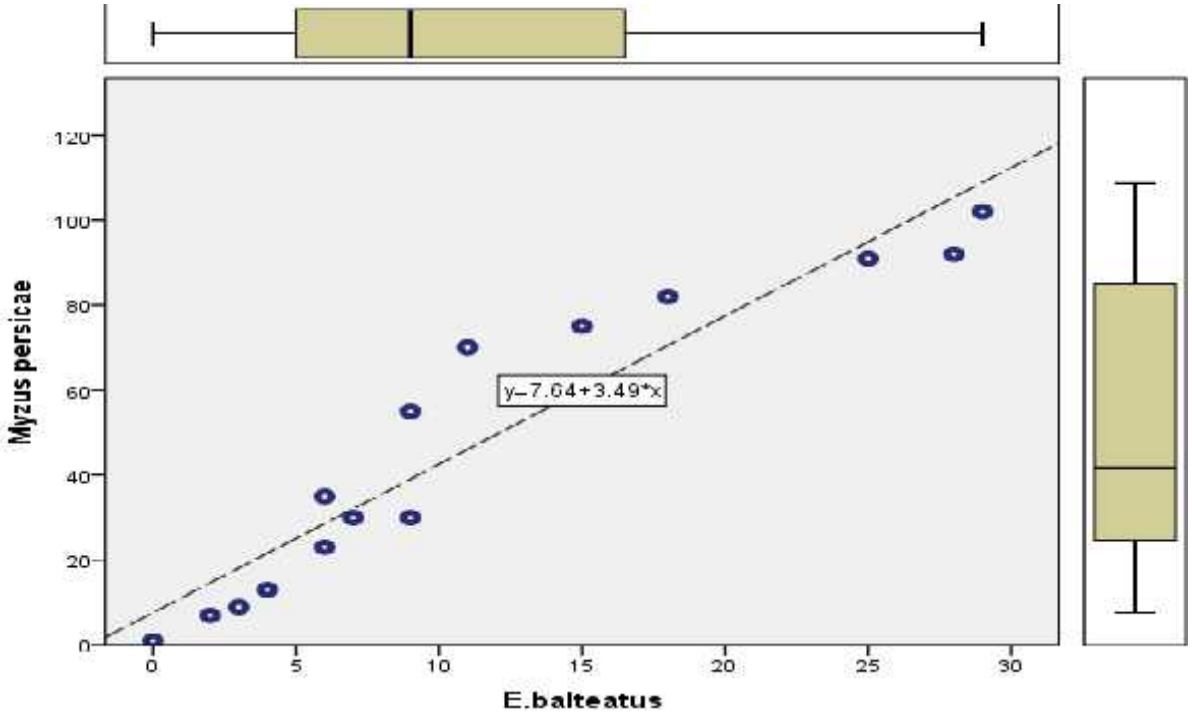

Fig 04. Strong positive correlation between *Episurphus balteatus* with green peach aphid.

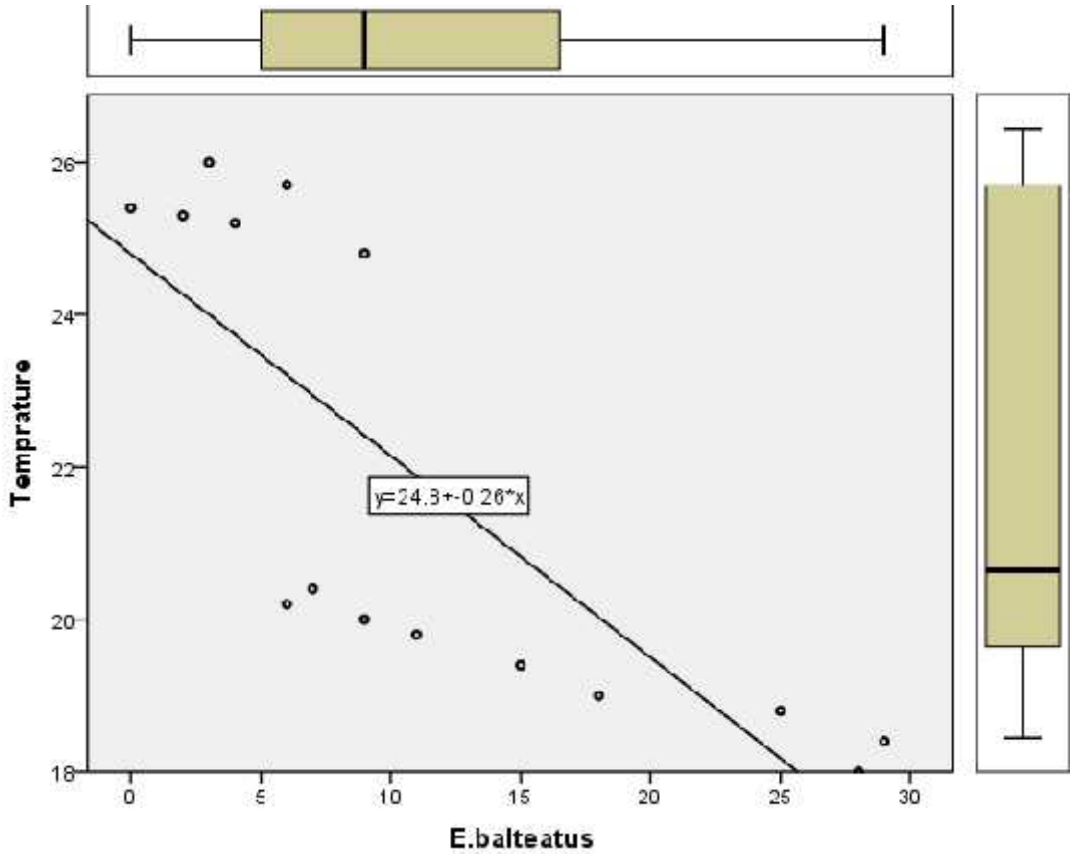

Fig 05. Negative correlation between *Episurphus balteatus* with temperature

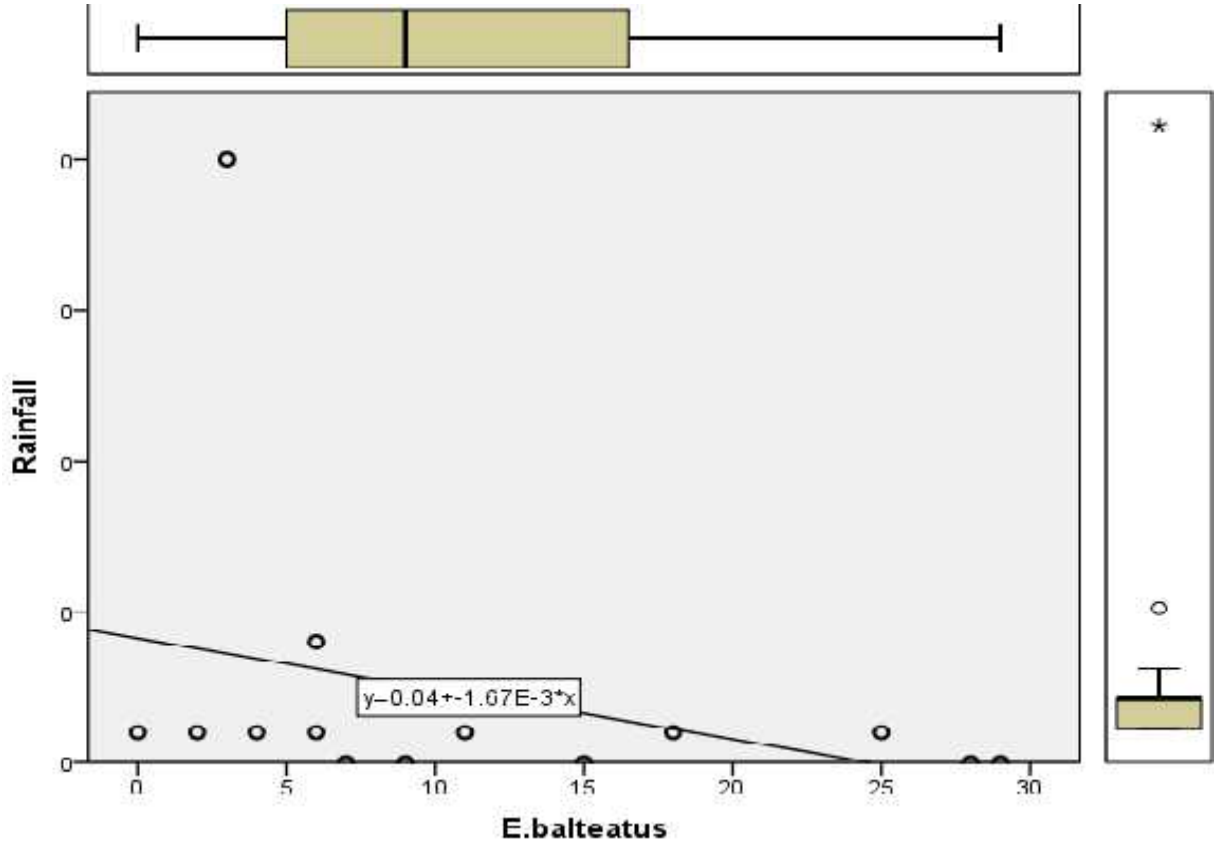

Fig 06. Negative correlation between *Episurphus balteatus* with rainfall

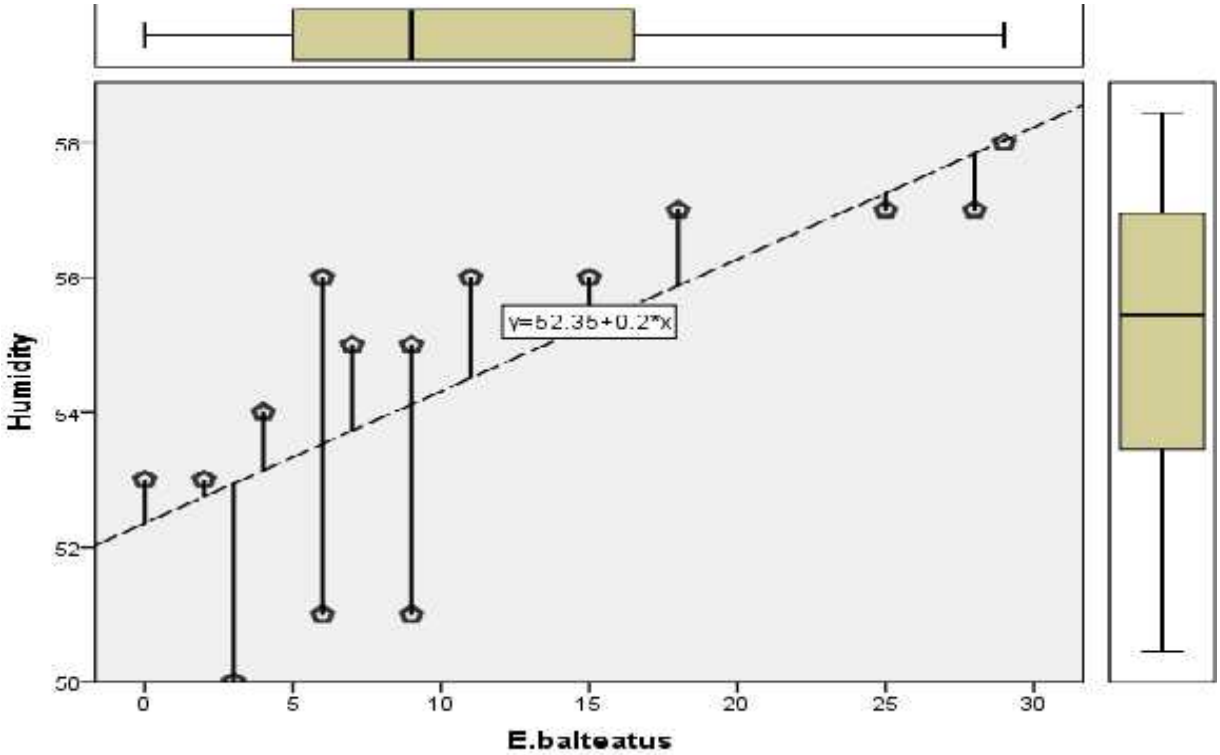

Fig 07. Positive correlation between *Episurphus balteatus* with relative humidity (RH).

Table 1. Population incidence of Episyrphus balteatus predator with prey and abiotic factors on *B. campestris* L. during November 2015-March 2016

Month/duration	Prey	Predator	Temperature (°C)	Rainfall (mm)	Relative Humidity
N 1	3.1	0	25.4	0	55
N2	7.2	0	25.3	0.03	55
N3	13.7	3.2	25.2	0	57
D1	30.6	8.4	20.4	1.01	54
D2	35.3	6.9	20.2	0.09	55
D3	55.5	6.5	20.1	0.08	56
J1	70.8	10.1	19.8	0	58
J2	75.1	12.9	19.4	0.08	57
J3	82.3	10.3	19.9	0.01	58
F1	91.1	16.2	19.7	0	58
F2	102.2	27.3	20.4	0	59
F3	92.5	26.7	20.2	0	57
M1	30.4	9.2	24.8	0.5	52
M2	23.7	4.4	25.7	2.19	51
M3	9.1	3.2	26.6	2.24	51

Table 2. Pearson correlation coefficient analysis of predator with prey and environmental factors

Correlations						
		Predator	**Prey**	**Temperature**	**Rainfall**	**RH**
Predator	Pearson Correlation	1	.882**	-.631*	-.614*	.550*
	Sig. (2-tailed)		.000	.012	.015	.034
	N	15	15	15	15	15
Prey	Pearson Correlation	.882**	1	-.827**	-.769**	.718**
	Sig. (2-tailed)	.000		.000	.001	.003
	N	15	15	15	15	15
Temperature	Pearson Correlation	-.631*	-.827**	1	.833**	-.701**
	Sig. (2-tailed)	.012	.000		.000	.004
	N	15	15	15	15	15
Rainfall	Pearson Correlation	-.614*	-.769**	.833**	1	-.810**
	Sig. (2-tailed)	.015	.001	.000		.000
	N	15	15	15	15	15
RH	Pearson Correlation	.550*	.718**	-.701**	-.810**	1
	Sig. (2-tailed)	.034	.003	.004	.000	
	N	15	15	15	15	15

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 3. Regression analysis of predator with *Myzus persicae* aphid and environmental factors

(a) Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.903[a]	.816	.742	4.2299

a. Predictors: (Constant), RH, Temperature, Prey, Rainfall

(b) ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	793.633	4	198.408	11.089	.001[b]
	Residual	178.924	10	17.892		
	Total	972.557	14			

a. Dependent Variable: Predator

b. Predictors: (Constant), RH, Temperature, Prey, Rainfall

(c) Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.944	46.858		.063	.951
	Prey	.283	.062	.583	4.586	.001
	Temperature	.945	.856	-.320	1.104	.296
	Rainfall	-1.011	3.269	-.151	-.629	.764
	RH	.491	.781	.093	.293	.543

a. Dependent Variable: Predator

Conclusion: Based on findings of this study it is concluded that population density of *Episurphus balteatus* (larvae and adults) is highly increased in response to abundance of *Myzuspersicae* aphids of *Brassica campestris* L. in the field, so it can be employed in biological control and in integrated management program of aphid species.

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