RESEARCH ARTICLE

EFFECTS OF INDEPENDENT VARIABLES ON VARIOUS DEPENDENT FACTORS ON CORIANDER FLOWERS

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Abstract: A field experiment was undertaken to study the effect of weather parameters on the activity of various pollinators/visitors during 2018-19. Indian honey bee showed significant and negative correlation with minimum temperature (r= -0.750) and rock bee (r= -0.713) Italian bee (r= -0.715) whereas, the population of little bee showed significant positive correlation with maximum temperature (r= 0.764). The population of syrphid fly had exhibit significant and negative correlation with maximum temperature (r= -0.710). Evening relative humidity had positive and significant impact on the population of house fly (r= 0.739) and population of monarch butterfly exhibit significant and negative correlation with morning relative humidity (r= -0.757). Red cotton bug showed significant and negative correlation with maximum temperature (r= -0.738). The population of lady bird beetle exhibit significant and positive correlation with minimum temperature (r= 0.772).

Keywords: Coriander crop, Correlation, Independent and dependent variables, Pollinators/visitors, Weather parameter

INTRODUCTION

Coriander is an annual herb and, according to the climatic conditions, is cultivated as a summer or winter annual crop. At flowering, the glabrous plant can reach heights between 0.20 and 1.40 m. The germination is epigaeal and the plant has a tap root. The stem is more or less erect and sympodial, monochasial-branched, sometimes with several side branches at the basal node. Each branch finishes with an inflorescence. The color of the more or less ribbed stem is green and sometimes turns to red or violet during the flowering period. The stem of the adult plant is hollow, and its basal parts can reach a diameter of up to 2 cm. The leaves alternate, and the first ones are often gathered in a rosette. The plant is diversifolious . The blade shape of the basal leaves is usually either undivided with three lobes, or tripinnatifid, while the leaves of the nodes following are to a higher degree pinnatifid. The higher the leaves are inserted, the more pinnate they are. Thus, the upper leaves are deeply incised with narrow lance late or even filiform-shaped blades. The lower leaves are stalked, while the petiole of the upper leaves is reduced to a small, nearly amplexicaul leaf sheath. The leaves are green or light green and their underside often shiny waxy. During the flowering period the leaves sometimes turn red or violet. They wither before the first fruits are ripe starting from the basal leaves. The inflorescence is a compound umbel. Sometimes there are one or two linear bracts. The umbel has two to eight primary rays, which are of different length, in such a way that the umbel lets are located at the same level. Two, three or more bracteoles carry the umbel lets with five to twenty secondary rays.

The cultivation of coriander has increased slightly over a period of time in India. At present, however, it is cultivated in an area of 5. 46 lakh hectares with a total output of 2.90 tons and an average output of 531 kg per hectare. Rajasthan, Andhra Pradesh, Tamil Nadu, Gujarat, Madhya Pradesh and Karnataka. In Karnataka, coriander is grown in an area of 17,300 hectares with a total output of 2,900 tons and an average output of 168 kg / ha compared to the national average of 531 kg / ha (Sivaraman *et al*, 2001). Karnataka's low coriander productivity is primarily due to poor production technologies, lack of improved varieties, management of nutrients, and adequate pollination are the big rising coriander states.

In India this crop is being cultivated in an area of 583 thousand hectares with an annual production of 784 thousand tonnes (Anonymous, 2019). In India, Madhya Pradesh, Rajasthan, Gujarat, Tamil Nadu, U.P. are the major producing states. In India the domestic marketing centers of coriander is Jodhpur.

Coriander is the important vegetable, spice crop of the Chhattisgarh state with area of 20069 hectare an annual production 94730 metric tonnes (Anonymous, 2019).

Coriander's flowering phenology allows better cross-pollination. The inflorescence consists of a compound umbel, where the primary umbel is to bloom first, followed by the umbels of lower order. Therefore, pollination depends largely on various pollinating agents, including insects, especially honeybees, which are the cheapest and most environmentally friendly inputs to maximize yield in most cross-pollinated crops. Various insects such as honeybees *(Apis florea Apis cerana Trigona iridipennis* Smith.), solitary bees, butterflies and flies carry out cross pollination in coriander. Honey bees

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are among them the main coriander pollinators (80.30 percent). The bee pollination raised the yield in coriander by 49.86% (Anonymous, 2000).

Bee pollination not only helps to increase yield, but also improves the quality of different seed spices including uniformly mature coriander and early crop harvest. The provision of bee colonies during the crop's flowering cycle is very important for increasing coriander productivity. Coriander is a rich source of pollen and nectar, attracting many insect pollution species. A nationally organized bee pollination system contributes significantly to meeting global demand and foreign exchange even at the existing land-use level for coriander crop cultivation.

MATERIALS AND METHODS

The experiment was undertaken at Raj Mohini Devi College Agriculture and Research Station, Ajirma Fa rm, Ambikapur, District, Surguja (C.G.), during 2018 -19. This station is located It was upland single plot size 2x2 m, variety Chhattisgarh dhaniya-1 to study the diversity of pollinators/visitors for pollen, nectar or both collection was recorded in one square meter area for 5 minutes at 2 hourly intervals from 0900-1000, 1000-1300, 1500-1700 hours at 5 days interval initial to peak flowering period. Three spots were chosen in the crop field, each spot with a square meter for recording the diversity of pollinator/visitors and correlated with the weather parameters.

RESULTS AND DISCUSSION

The multiple independent factors had both positive and negative impacts on the activity of the multiple honeybees' population and pollinators. Correlation and regression studies were developed during the year (2018-19) to investigate the relation between the independent and dependent variables. The descriptions of the effect of different dependent variables on different independent factors on coriander flowers are as given below (Table 1):-

Indian honey bee

The findings indicated that the maximum temperature showed significant and negative correlation (r=-0.856) with Indian honey bee population. The regression equation being y = -1.554x + 28.85 indicated that within 1^0C increase in maximum temperature there will be decrease in population by 1.554 units. Whereas, Indian honey bee showed significant and negative correlation with minimum temperature (r= -0.750). The regression equation being y = -1.556x + 13.65 indicated that within increase in 1^0C minimum temperature there will be decreased in population by 1.556 units (Fig. 4.1 & 4.2). Earlier workers Painkra *et al*. (2015) who had worked on niger flowers of various pollinators/visitors and Das *et al*. (2011)who worked on apple.

Rock bee

The population of rock bee exhibit significant and negative correlation with maximum temperature (r= -0.835). The regression equation being y = -2.064x + 29.63 indicated that within 1^0C increase in maximum temperature there will be decrease in population by 29.74 units. Whereas, minimum temperature had significant and negative correlation (r= -0.713) with rock bee. The regression equation being y = -1.996x + 14.27 indicated that within increase in 1^0C minimum temperature there will be decrease in population by 1.996 units (Fig. 4.3 & 4.4). Earlier worker Kumar and Singh (2005) who recorded the abundance of various Apis sp.on rabi season sunflower.

Italian bee

Maximum temperature revealed significant negative correlation(r= -0.715) with the population of Italian bee. The regression equation being y = -1.528x + 11.91 states that within increase in 1^0C minimum temperature there will be decrease in population by 1.528 units (Fig. 4.5). The results are more or less similar with the earlier workers Chand *et al*. (1994) who recorded the pollinators on Indian mustard, Dash *et al*. (1988) on cashew crop, Bhambure (1958) on niger crop and Abrol (1992) on

Little bee

The population of little bee showed significant positive correlation with maximum temperature (r= 0.764). The regression equation being y = 8.463x + 20.80 states that within increase in 1% evening relative humidity there will be increased in population by 8.463 (Fig.4.7).

Syrphid fly

The population of syrphid fly had exhibit significant and negative correlation with maximum temperature (r= -0.710). The regression equation being y = -2.397x + 27.78 indicated that within increase in 1^0C maximum temperature there will be decrease in population by 2.397 units (Fig.4.8).

House fly

Evening relative humidity had positive and significant impact on the population of house fly (r= 0.739). The regression equation being y = 11.26x + 18.06 indicated that within increase in 1 % evening relative humidity there will be decrease in population by 11.26 units (Fig. 4.9).

Common crow (black)

The population of monarch butterfly exhibit significant and negative correlation with morning relative humidity (r= -0.757). The regression equation being y = -27.23x + 102.8 states that within increase in 1% morning relative humidity there will be decrease in population by 27.23 units (Fig. 4.10).

Red cotton bug

Red cotton bug showed significant and negative correlation with maximum temperature (r= -0.738). The regression equation being y = -4.793x + 27.65 indicated that within increase in 1^0C maximum temperature there will be decrease in population by 27.65 units (Fig. 4.11).

Lady bird beetle

The population of lady bird beetle exhibit significant and positive correlation with minimum temperature (r= 0.772). The regression equation being y = 4.892x + 5.103 indicated that within increase in 1^0C minimum temperature there will be increased in population by 4.892. Whereas, lady bird beetle revealed significant negative correlation with minimum temperature (r= -0.835). The regression equation being y = -35.45 x + 113.4 indicated that within increase in 1^0C minimum temperature there will be decrease in population by 35.45 units (Fig. 4.12 & 4. 13).

Blowfly

Evening relative humidity showed significant negative correlation (r= 0.753) with the population of blow fly. The regression equation being y = 16.65x + 18.14 indicated that within increase in 1 % evening relative humidity there will be decrease in population by 18.14 units (Fig. 4.13).

Table 1. Correlation between pollinator/visitors and weather parameters on coriander flowers

S.N.	Pollinators/visitors	Population of pollinators/visitors	Temperature (^{0}C)		Relative humidity (%)		Wind speed
			Maximum	Minimum	RH-I	RH-II	(km/h)
1	Indian honey bee	2.79	-0.856**	-0.750*	0.076	-0.156	-0.094
2	Rock bee	2.65	-0.835**	-0.713*	0.129	0.018	0.003
3	Italian bee	1.63	-0.696	-0.715*	0.125	0.003	-0.013
4	Little bee	1.22	0.041	-0.031	0.256	0.764*	0.332
5	Syrphid fly	1.46	-0.710*	-0.689	0.184	0.164	0.088
6	House fly	1.26	0.207	0.090	0.210	0.739*	0.207
7	Common crow	0.79	0.357	0.624	-0.757*	-0.273	-0.478
8	Red cotton bug	0.70	-0.738*	-0.664	0.016	-0.094	-0.111
9	Lady bird beetle	0.90	0.515	0.772*	-0.835**	-0.306	-0.654
10	Blow fly	0.85	0.173	0.107	0.242	0.753*	0.348

*Significant at 5% level of significance
** Significant at 1% level of significance

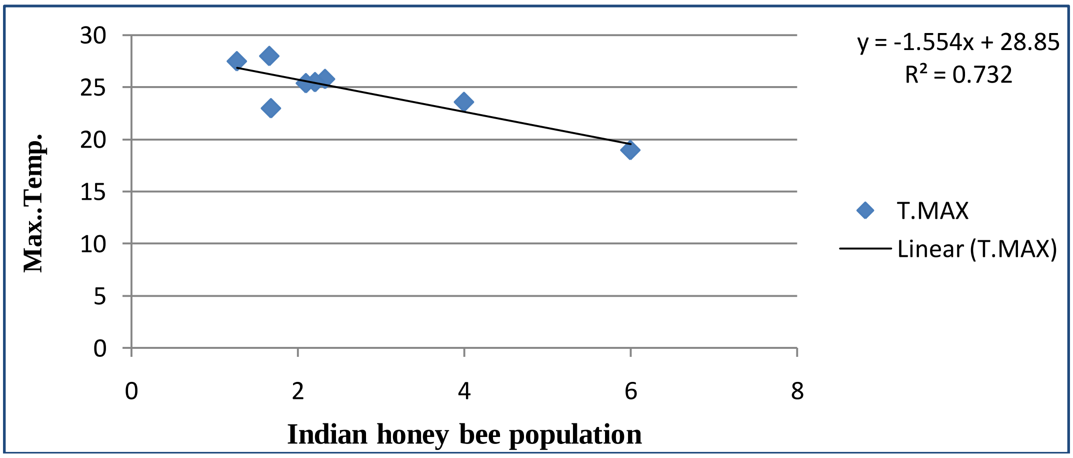

Fig. 1: Regression equation between max.temp. and population of Indian honeybee

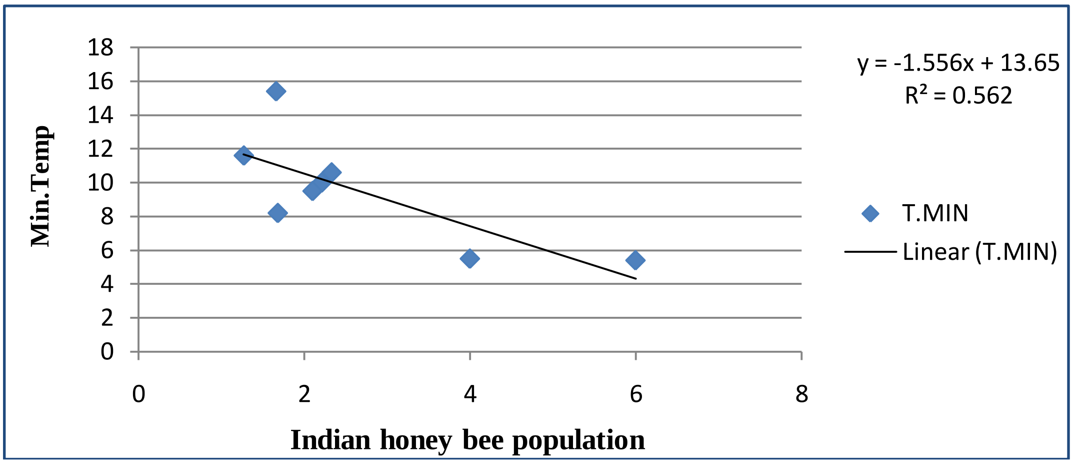

Fig. 2: Regression equation between min.temp. and population of Indian honey bee

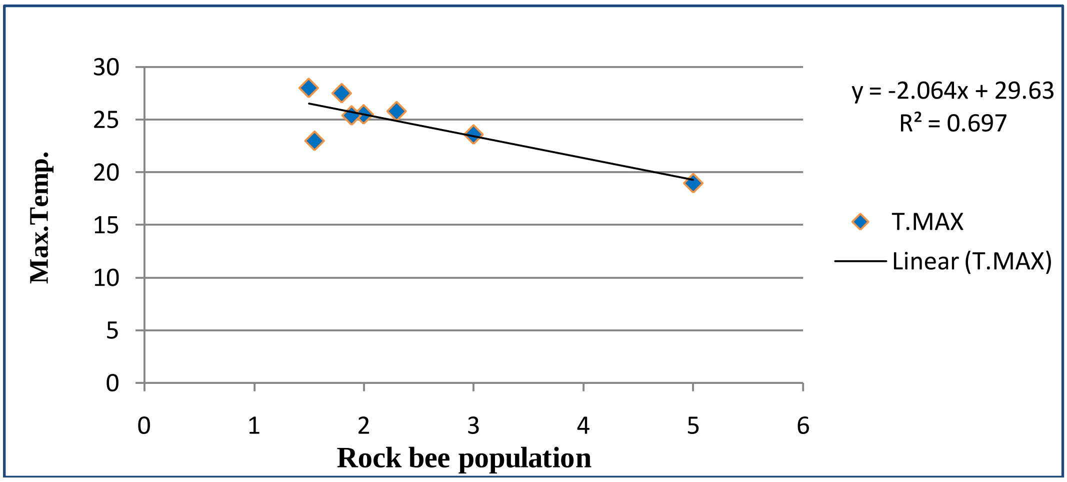

Fig. 3: Regression equation between maximum temperature and population of rock bee

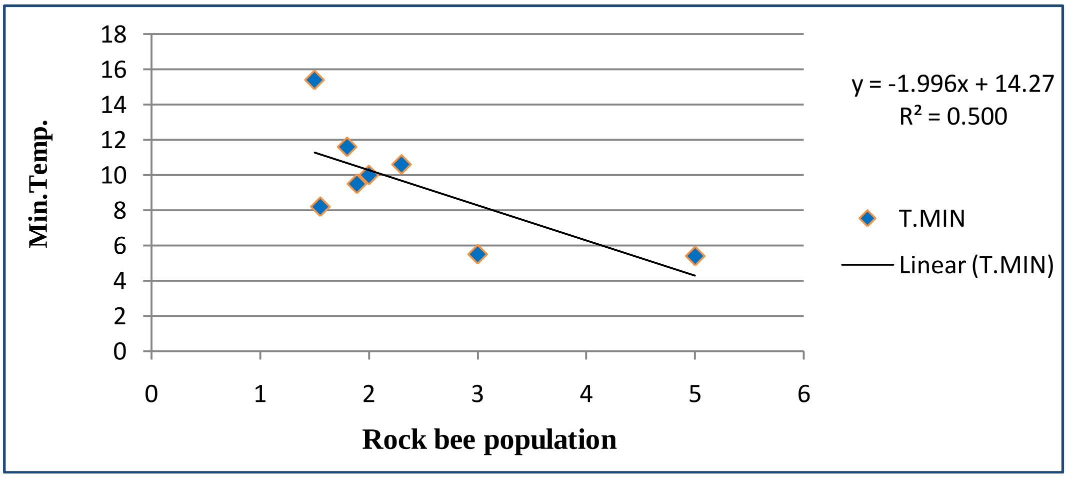

Fig. 4: Regression equation between minimum temperature and population of rock bee

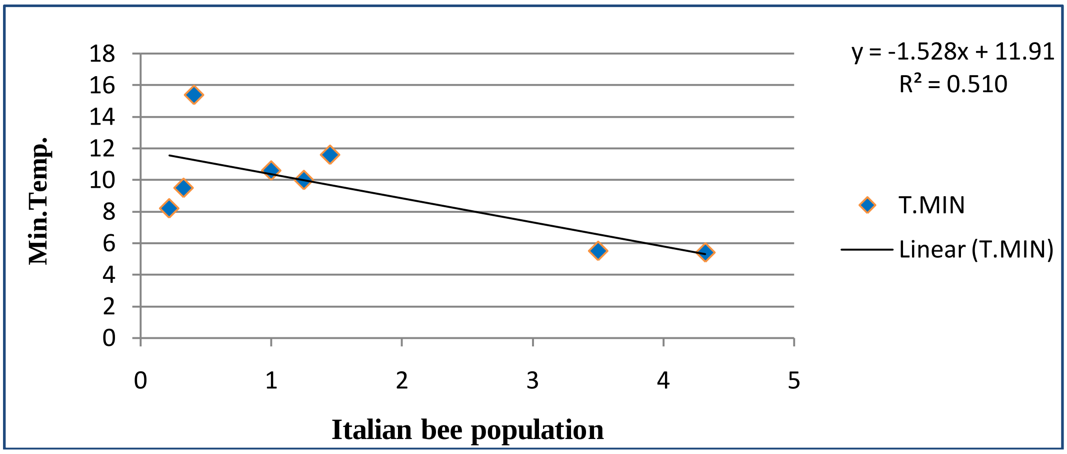

Fig. 5: Regression equation between minimum temperature and population of Italian bee

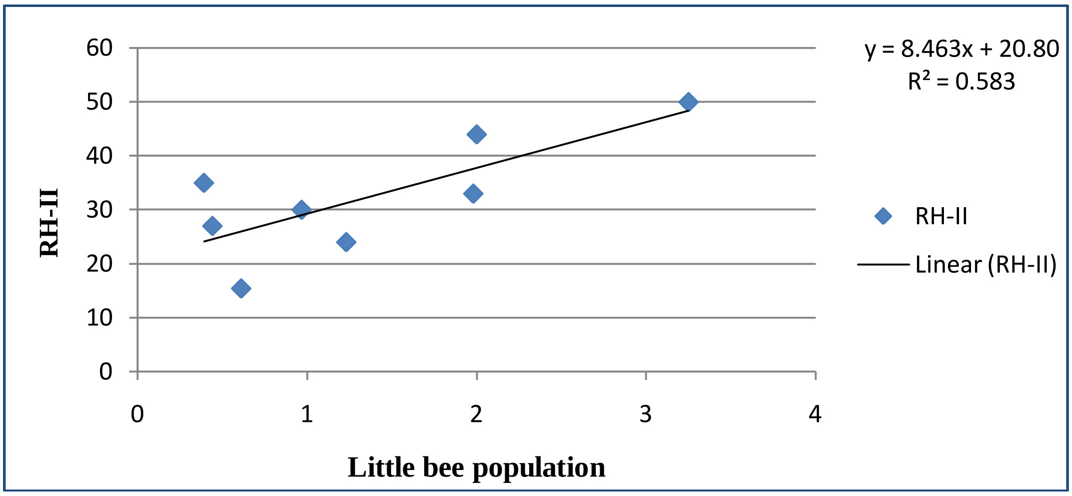

Fig. 6: Regression equation between evening relative humidity (%) and population of little bee

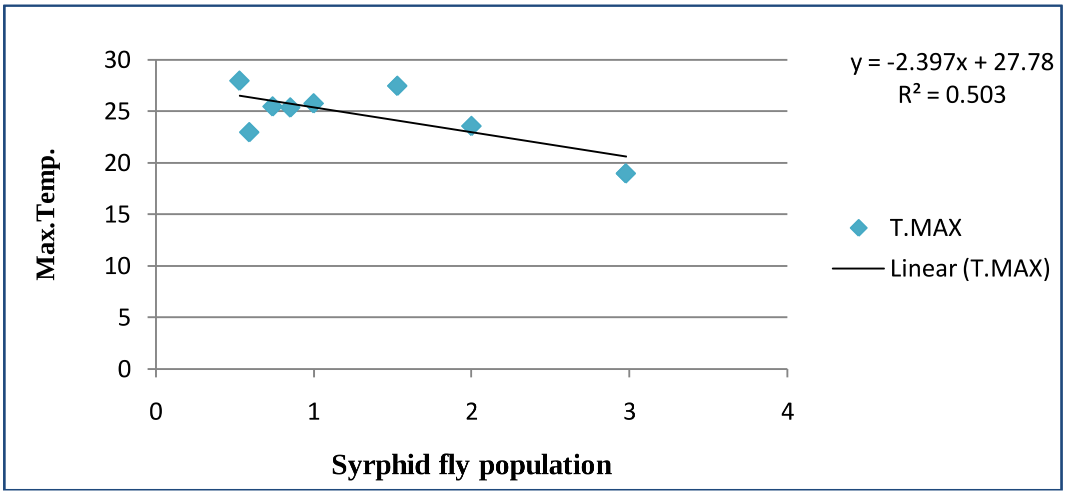

Fig. 7: Regression equation between maximum temperature and population of Syrphid fly

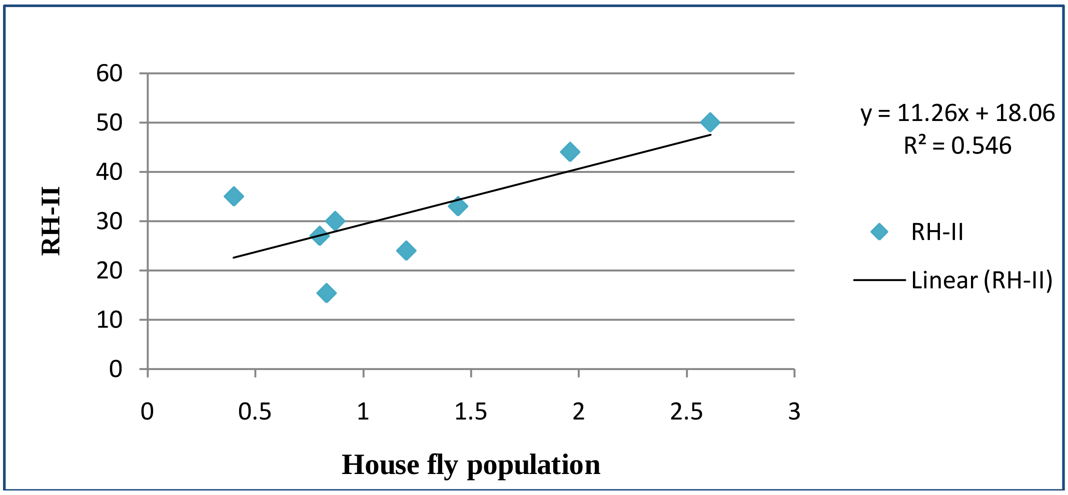

Fig. 8: Regression equation between evening relative humidity (%). and population of Housefly

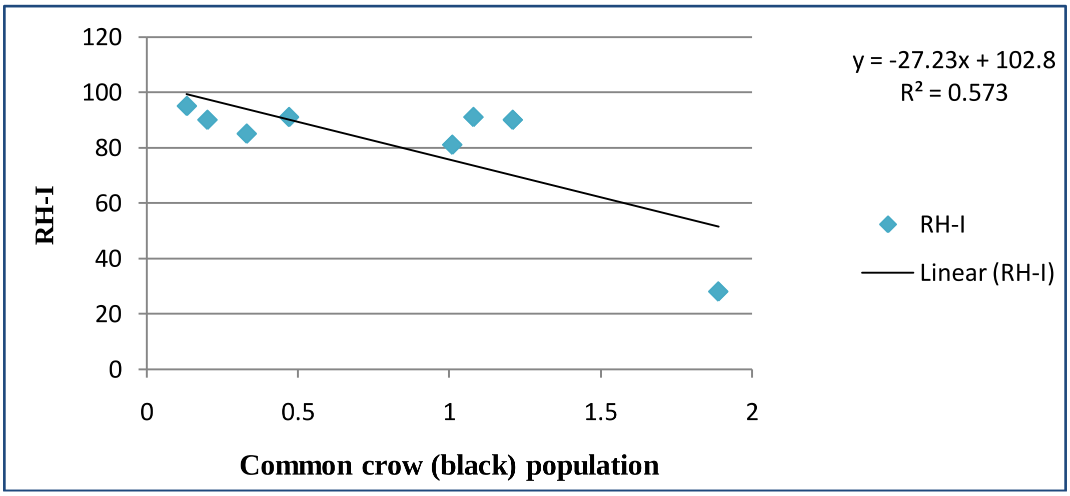

Fig. 9: Regression equation between morning relative humidity and population of common row

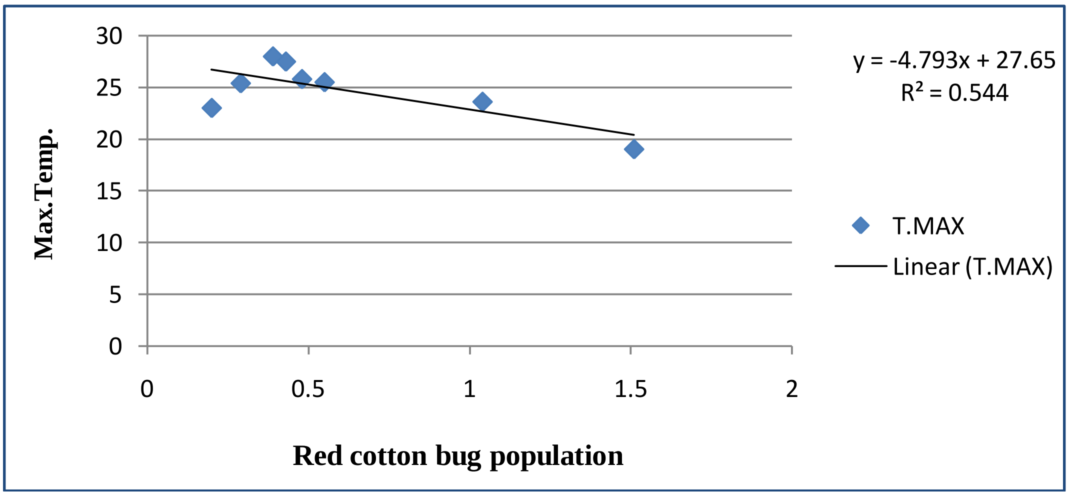

Fig. 10: Regression equation between maximum temperature and population of Red cotton bug/plant

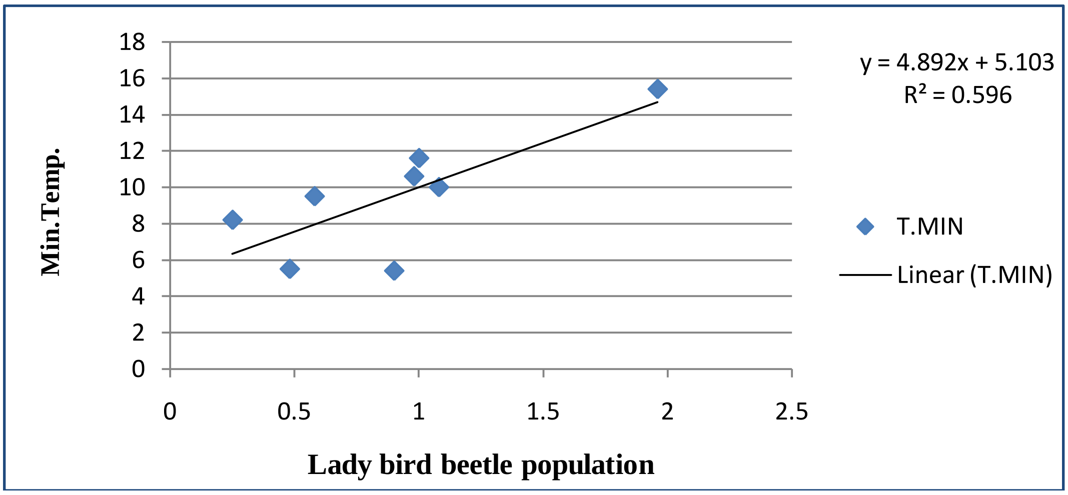

Fig. 11: Regression equation between minimum temperature and population of Lady Bird beetle

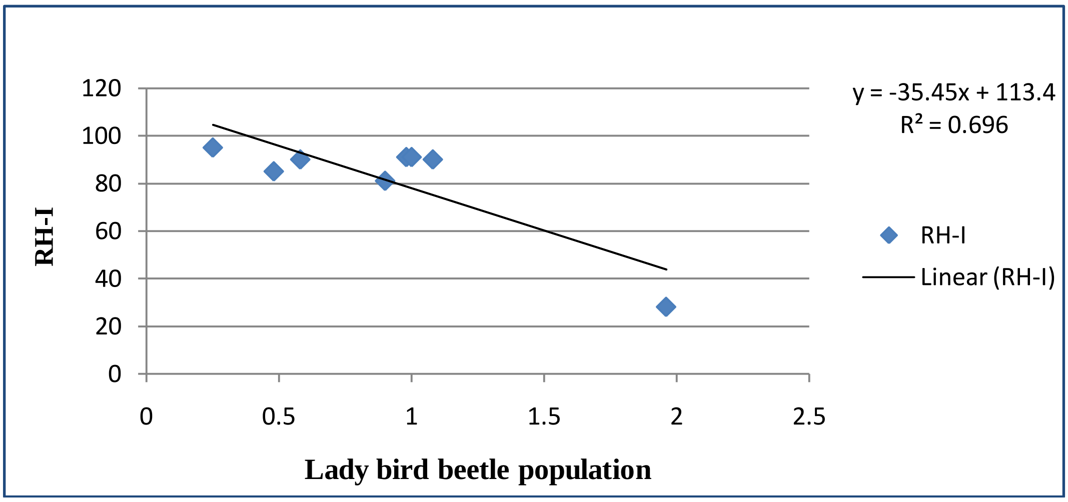

Fig. 12: Regression equation between morning relative humidity (%) and population of Lady Bird beetle

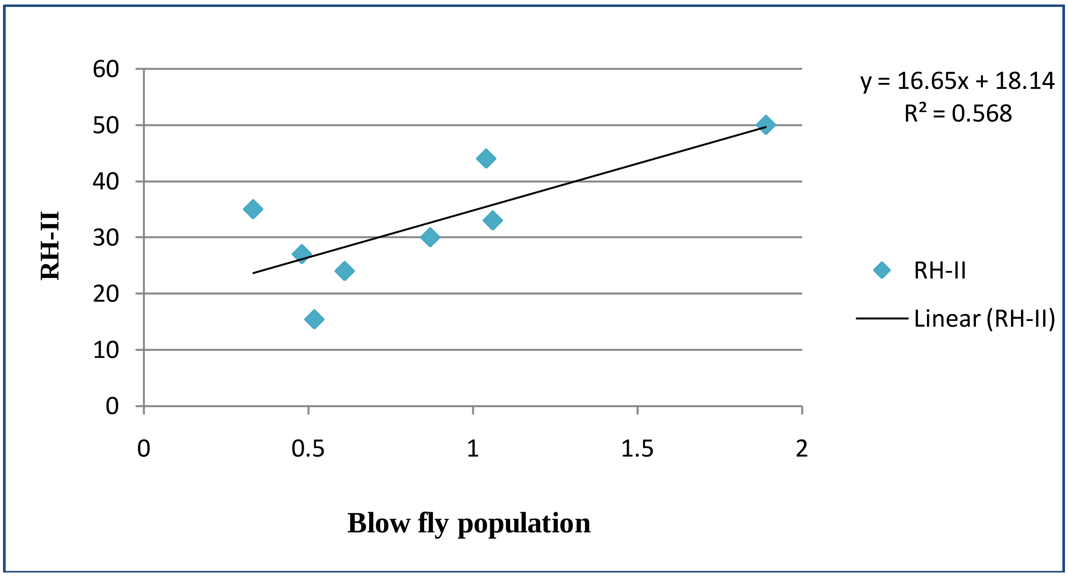

Fig. 13: Regression equation between evening relative humidity (%) and population of Blow fly

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CONCLUSION

It is concluded that the coriander flowers are visited by different pollinators/visitors like Indian honey bee and Italian honey bee showed significant and negative correlation with minimum temperature,little bee showed significant positive correlation with maximum temperature, syrphid fly showed significant negative correlation with maximum temperature, monarch butterfly exhibits the significant negative correlation with morning relative humidity, Red cotton bug showed significant and negative correlation with maximum temperature. Whereas, lady bird beetle exhibit significant and positive correlation with minimum temperature.

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