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Effect of weather parameters on population abundance of *Apis* species on coriander

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Abstract

The experiment was conducted at University Apiary, RPCAU, Pusa (Samastipur) and Beekeeping Unit, TCA, Dholi (Muzaffarpur) in 'Rabi 2021-22' on Rajendra Dhanian-2 variety of coriander. Several recordings were taken in order to calculate the impact of temperature and relative humidity on honey bee species abundance. Study showed that population of *Apis mellifera* and *Apis dorsata* increased with increase in temperature while population reduced with increasing relative humidity, whereas *Apis florea* and *Apis cerana indica* showed exactly opposite pattern.

Keywords: *Apis* sp., temperature, relative humidity and correlation

Introduction

India is endowed with 63 distinct types of spice crops, 20 of which are seed spices that grow on 35.41 lakh hectares and yield 6.32 million tonne of seeds (Shivashankara *et al.*, 2016) [6]. Important tropical spice crop coriander (*Coriandrum sativum* L.) belongs to the Apiaceae family (Umbelliferae). One of the first spices utilised by humans as flavouring agents was coriander. All plant parts are edible, however the dried seeds and fresh leaves are the ones that are most usually used as seasonings in food. Coriander's protandrous state, which results from cross pollination is caused by the blooming phenology of the plant. Research on coriander in Russia in 1950 revealed a 49% to 68% drop in seed set as a result of pollinator exclusion (Glukhov, 1955) [3]. Due to its fragrance, coriander flowers are particularly attracting to many insects including Coleopterans, Dipterans and Hymenopterans. However, bees are one of them that most effectively pollinate this crop. The *Apis* genus predominates among pollinating bee species in India (Baswana, 1982) [1].

The importance of honey bees among all other pollinators can't be overstated. In the lack of better sources, they not only visit for nectar but also for pollen. To increase coriander productivity, bee colonies must be available throughout the crop flowering season. Bees are excellent pollinators as they collect pollen from flowers for their nutrition. Honey bees are extremely sensitive to changes in the weather (Shrestha, 2019) [7]. In this experiment, the precise effects of temperature and relative humidity on bee abundance are investigated.

Methodology

The experiment was conducted at University Apiary, RPCAU, Pusa (Samastipur) and Beekeeping Unit, TCA, Dholi (Muzaffarpur) in 'Rabi 2021-22' on Rajendra Dhanian-2 variety of coriander during the year 2022. At the Pusa apiary, the abundance of *Apis mellifera*, *Apis cerana indica*, *Apis florea* and *Apis dorsata* was assessed by counting the number of individuals per square metre for five minutes. The number of foragers were recorded during flowering period at different time intervals, i.e. 07:00, 09:00, 11:00, 13:00, 15:00 and 17:00 hours of the day at alternate day for ten minute from 01.03.2022 to 17.03.2022. Observations regarding the temperature and relative humidity were also recorded at the same time interval. After an experiment, analytical methods were used to assess the relationship between species abundance and weather parameters.

Results and discussion

Experimental trials in Pusa location and Dholi location showed (Table: 1.) that the population of *Apis mellifera* on different hours of the day was found to had a positive and significant correlation with temperature whereas had a negative and significant relationship with relative

humidity for *Apis cerana indica* at both Pusa (0.326 and -0.322) and Dholi (0.090 and -0.070). In *Apis dorsata*, temperature had positive and relative humidity had negative correlation but it was significant at Pusa (0.763** and -0.731) whereas non-significant at Dholi (-0.648 and -0.583). There

exist a negative non-significant relationship with temperature and positive non-significant relation with relative humidity for *Apis florea* at both Pusa location (-0.497 and 0.495) and Dholi location (-0.489 and 0.503).

Table 1: Correlation coefficient between mean population of honey bee species on different hours of the day and weather parameters at Pusa and Dholi during 2021-22

Correlation Coefficient					
Factors	Independent Variables (X)	Dependent Variables (Y)			
	Weather Parameters (X ₁ & X ₂)	<i>Apis mellifera</i> (Y ₁)	<i>Apis cerana indica</i> (Y ₂)	<i>Apis dorsata</i> (Y ₃)	<i>Apis florea</i> (Y ₄)
Pusa	Temp. (°C)	0.862**	0.326	0.763**	-0.497
	RH (%)	-0.830**	-0.322	-0.731*	0.495
Dholi	Temp. (°C)	0.842**	0.091	0.668*	-0.489
	RH (%)	-0.820**	-0.070	-0.683*	0.503

Table 2: Correlation coefficient between mean population of honey bee species on different dates and weather parameters at Pusa and Dholi during 2021-22

Correlation Coefficient					
Factors	Independent Variables (X)	Dependent Variables (Y)			
	Weather Parameters (X ₁ & X ₂)	<i>Apis mellifera</i> (Y ₁)	<i>Apis cerana indica</i> (Y ₂)	<i>Apis dorsata</i> (Y ₃)	<i>Apis florea</i> (Y ₄)
Pusa	Temp. (°C)	0.715*	-0.534	0.919**	-0.823**
	RH (%)	-0.722*	0.606	-0.927**	0.837**
Dholi	Temp. (°C)	0.851**	-0.454	0.924**	-0.944**
	RH (%)	-0.840**	0.545	-0.923**	0.947**

Table: 2. showed that the population of *Apis mellifera* on different dates during whole flowering period was found to had a positive and significant correlation with temperature, whereas had a negative and significant relationship with relative humidity at both Pusa location (0.715* and -0.722*) and Dholi location (0.851* and -0.840*). There exist a positive non-significant relationship with temperature and negative non-significant relation with relative humidity for *Apis cerana indica* at both Pusa location (0.534 and -0.606) and Dholi location (0.454 and -0.545). In *Apis dorsata*, temperature had positive and relative humidity had negative correlation with high significance at Pusa (0.919** and -0.927**) whereas non-significant at Dholi (-0.924** and -0.923**). There exist a negative significant relationship with temperature and positive significant relation with relative humidity for *Apis florea* at both Pusa (-0.823** and 0.837**)

and Dholi (-0.944** and 0.947).

Apis florea and *Apis cerana* are more sensitive to temperature factor due to their relatively small size as compared to other two species. Peak foraging behaviour of *Apis florea* was observed during morning hours when flowers partially opened and favourable weather conditions *i.e.* low temperature and relative high humidity.

Kumar *et al.* (2012) [4] reported that activity of pollinators was lowered down after 15.00 hours, when temperature decreased to 23 to 24 °C and relative humidity increased to 69 to 78%. Sarviva (1985) [5] concluded that the foraging activity of *Apis mellifera* was depending on weather parameters. Burril and Dietz (1981) [2] observed that population and foraging activity of *Apis mellifera* was highly positively significant with increasing air temperature while negatively significant to relative humidity.

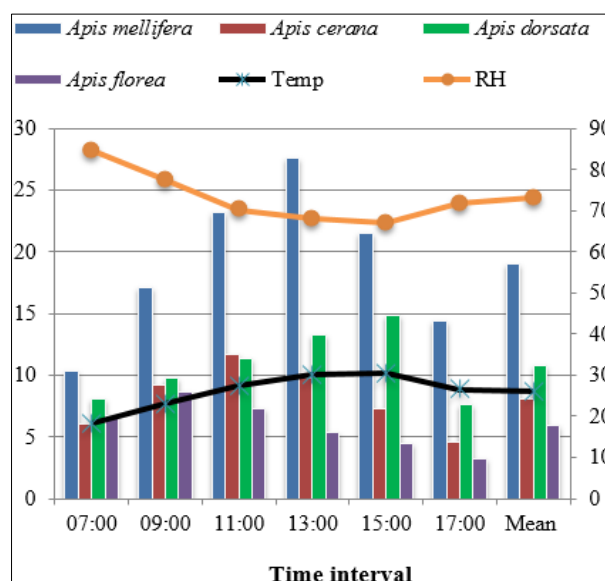


Fig 1: Abundance (No. of honey bee species/m²/10 minute) of honey bee species on coriander flowers and weather parameters on different hours of the day at Pusa

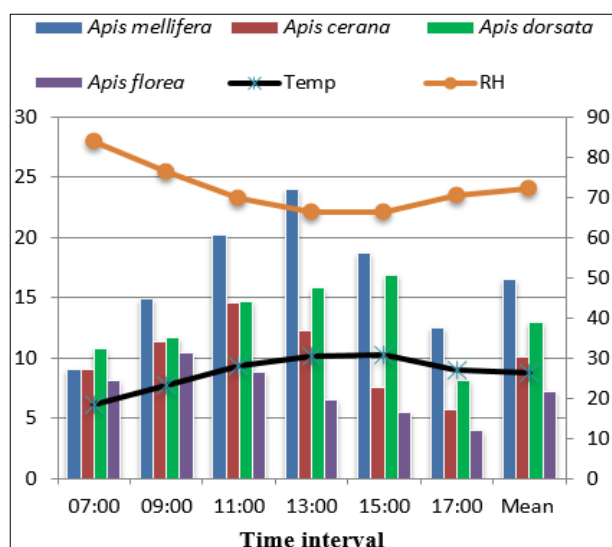


Fig 2: Abundance (No. of honey bee species/m²/10 minute) of honey bee species on coriander flowers and weather parameters on different hours of the day at Dholi

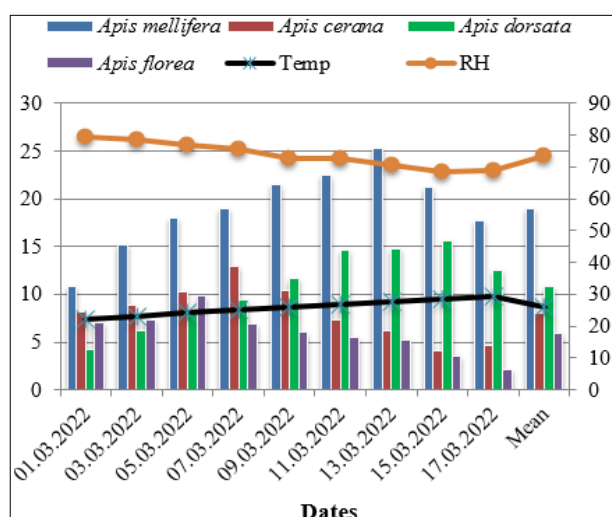


Fig 3: Abundance (No. of honey bee species/m²/10 minute) of honey bee species on coriander flowers and weather parameters on different dates at Pusa

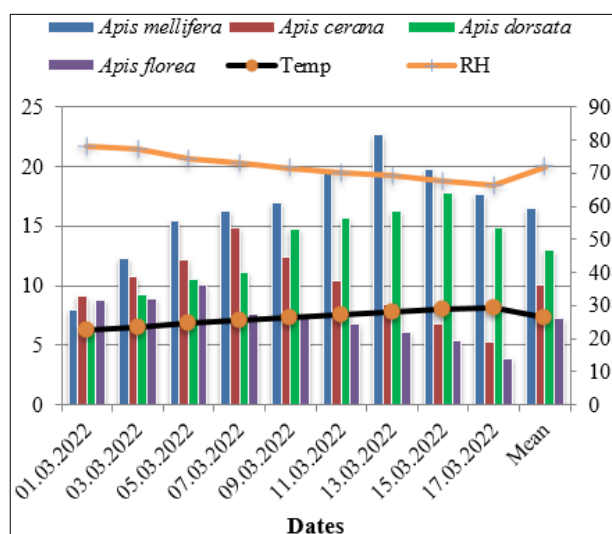


Fig 4: Abundance (No. of honey bee species/m²/10 minute) of honey bee species on coriander flowers and weather parameters on different dates at Dholi

Conclusion

Influence of weather parameters on population of *Apis mellifera* and *Apis dorsata* was significant. Population of these two species increased with increase in temperature while population reduced with increasing relative humidity, whereas *Apis florea* and *Apis cerana indica* showed exactly opposite pattern.

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