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Insect pollinators and their relative abundance on black cumin (*Nigella sativa* L.) At Dera Ismail Khan

Muhammad Abrar, Sajjad Ahmad, Saboor Naem and Spogmay Naem

Abstract

The current study was conducted at Agriculture Research Institute Ratha Kulachi, Dera Ismail Khan, to study the population dynamics of insect pollinators on Black Cumin during 2014. A 100m² plot was selected for research purpose. The Insects were observed twice a day i.e. from 9:30-10:30 am and 2:30-3:30 pm from the beginning of flowering stage up to the crop maturity i.e. 7 February to 7 March. Nine species of pollinators belonging to class Insecta were recorded, in which four were Dipterous (Syrphid fly) that is *Episyrphus balteatus* De., *Melanostoma orientale* Wied., *Eupeodes bucculatus* Rond. and *Eristalis tenax* L. Three belonging to order Hymenoptera (two were honey bees i.e. *Apis dorsata* Fabr. and *Apis florea* Fabra., while one was small carpenter bee i.e. *Ceratina spp* Latr.) and two belonging to order Lepidoptera i.e. Cabbage Butterfly (*Pieris brassicae* L.) and Monarch Butterfly (*Danaus chrysippus* L.). *Apis florea* was recorded very high with a percent value of 36.79% as compare to other species, followed by *Pieris brassicae* and *Apis dorsata* with values of 14.5% and 12.5% respectively, while *Eristalis tenax* and *Danaus chrysippus* were reported to have the lowest population of similar values of 3.53%. The population of *Apis florea*, *Apis dorsata*, *Ceratina spp*, *Pieris brassicae* and *Melanostoma orientale* were more with values of 57%, 54.7%, 60%, 51.30% and 52% respectively at 2:30-3:30 pm than morning. On the other hand the population of *Danaus chrysippus* was equal at both the time intervals during the research period.

Keywords: Black cumin, flowering stage, Insect pollinators, Population dynamics

Introduction

Black cumin (*Nigella sativa* L.) belongs to family Ranunculaceae and originated from South West Asia and now grown in many countries of the world like Egypt, India, Pakistan, Saudi Arabia, Syria and Turkey [1]. *Nigella sativa* L. is an important medicinal plant and use in the cure of many diseases. It is also used in bakery food products as a flavouring agent. It is a rich source of proteins, amino acids, carbohydrates, calcium, potassium, sodium, and iron [2]. In the Muslim world it has earned a valuable and significant medicinal value due to the hadith of Hazrat Muhammad (SAW), One day he said: "Black cumin is a remedy for all diseases except death" [3].

Plants were used in every era for the cure of different diseases and day by day its medicinal importance is increasing. Similarly, *Nigella sativa* has a key role in the control of different diseases such as throat infections and liver cancer. The seed and oil of Black cumin was tested as treatment for different patients by the doctors for the control of numerous diseases. Positive results were obtained by scientists and thus regarded it as a significant medicinal plant for the cure of many diseases [4].

Every plant species need pollination and fertilization to produce seeds and fruits and pollinators play a key role in pollination. In plants the process of pollination starts from flowering stage in which pollen transfer from the anther to the stigma by different means. It was claimed and proved experimentally by researchers that 80% of pollination takes place by insects in which 80% is done by honey bees [5]. Many insect pollinators visit flowers and generate the process of pollination. Honeybees as compared to other are the best pollinators, their visit time per minute was recorded more than other insects, and their presence in the nearby area of the crop during the flowering stage is helpful for pollination [6].

Pakistan is an agricultural country and along with cash crops, fruits, and vegetables the need and use of medicinal plants is also raising up now a days. On the other hand the growers do not give importance to insect pollinators because they have no knowledge and information

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about the pollinators and pollination and their impact on yield and quality. Therefore to identify insect pollinators and to know their abundance at different time intervals the present study was conducted.

Materials and methods

The current study was conducted at Agriculture Research Institute Ratha Kulachi Dera Ismail Khan to study the population dynamics of insect pollinators on Black cumin at morning i.e. 9:30-10:30 am and afternoon i.e. 2:30-3:30 pm during 2014. A 100 m² plot was prepared to conduct a research.

Data Collection

The data was recorded twice a day that is from 9:30-10:30am and 2:30-3:30pm from the beginning of flowering stage up to the crop maturity. Black cumin plants during each observation were given a time of 40 minutes from different angles in the experimental plot. The species and number of insect pollinators visited were carefully noted. The relative abundance of insect pollinators was determined by using the formula;

$$\text{Relative abundance of species} = \frac{\text{Number of individuals visit flowers}}{\text{Total number of pollinators}} \times 100$$

Collection of insect pollinators visiting Black cumin flowers

At the flowers blooming stage various species of insect pollinators were collected for further study. Hand net was used for the collection of insect pollinators. The collected

specimens with the help of available literature were identified up to the species level, properly labelled, preserved and were submitted to the research laboratory of the Entomology department, The University of Agriculture, Peshawar. For identification of specimens belonging to the families of Syrphidae [7], Apidae [8] and Pieridae [9] different keys were used.

Results and discussion

Various insect pollinator species recorded on Black cumin

The data showed that nine different pollinators were observed during the flowering season of Black cumin. The pollinators are listed and classified in Table 1. Out of these nine species four were Dipterous, three Hymenopterous and two pollinators were Lepidopterous. Four species of order Diptera contain syrphid flies (*Episyrphus balteatus* De., *Melanostoma orientale* Wied., *Eupeodes bucculatus* Rond. and *Eristalis tenax* L.) while three Hymenopterans in which two were honey bees (*Apis dorsata* Fabr., *Apis florea* Fabr.) and one was small carpenter bee (*Ceratina spp* Latr.). The other two Lepidopterous species were cabbage butterfly (*Pieris brassicae* L.) and monarch butterfly (*Danaus chrysippus* L.) on Black cumin. Munawar *et al.*, (2009) [10] also found honey bees, syrphid flies and butterflies in pollination activities on Black cumin. Mukherjee *et al.*, (2013) [11] recorded honey bees and butterflies as pollinating agents on Black cumin. Kant *et al.*, (2013) [12] observed that honey bees played an important role in pollination of Black cumin and some other minor seed spice crops. Zaitoun *et al.*, (2008) [13] studied different species of honey bees from flowering stage up to mature stage of on Black cumin.

Table 1: Various species of insect pollinators recorded on Black cumin.

Common name	Technical name	Order/ Family
1- Syrphid fly 1	<i>Episyrphus balteatus</i> De.	Diptera (Syrphidae)
2- Syrphid fly 2	<i>Melanostoma orientale</i> Wied.	Diptera (Syrphidae)
3- Syrphid fly 3	<i>Eupeodes bucculatus</i> Rond.	Diptera (Syrphidae)
4- Syrphid fly 4	<i>Eristalis tenax</i> L.	Diptera (Syrphidae)
5- Gaint Honey bee	<i>Apis dorsata</i> Fabr.	Hymenoptera (Apidae)
6- Small Honey bee	<i>Apis florea</i> Fabr.	Hymenoptera (Apidae)
7- Small carpenter bee	<i>Ceratina spp</i> Latr.	Hymenoptera (Apidae)
8- Cabbage Butterfly	<i>Pieris brassicae</i> L.	Lepidoptera (Pieridae)
9- Monarch Butterfly	<i>Danaus chrysippus</i> L.	Lepidoptera (Pieridae)

Relative abundance (%) of insect pollinator of same species at 9:30-10:30am and 2:30-3:30pm on Black cumin

Fig.1 shows the relative abundance (%) of insect pollinator species recorded at 9:30-10:30am and 2:30-3:30pm on Black cumin. According to the figure 1 the bars indicate that the relative abundance of *E. balteatus* was recorded more (60.80%) at 9:30-10:30am but less (39.13%) at 2:30-3:30pm, while in *M. orientale* it was less (48.00%) at 9:30-10:30am but more (52%) at 2:30-3:30pm. The relative abundance of both *E. bucculatus* and *E. tenax* was more (53% and 53.30%) at 9:30-10:30am and less (47% and 46.66%) at 2:30-3:30pm respectively, while the bars of *A. florea* and *A. dorsata* shows that it was reported less (43% and 45.20%) in both species at 9:30-10:30am but more (57% and 54.7%) at 2:30-3:30pm respectively. On the other hand the bars of *Ceratina spp* also indicate same result i.e. less (40%) at 9:30-10:30am but more (60%) at 2:30-3:30pm respectively. The relative abundance of *P. brassicae* was less at 9:30-10:30am (48.60%) and more at 2:30-3:30pm (51.30%). *D. chrysippus* shows same (50%, 50%) relative abundance at both 9:30-10:30am and 2:30-3:30pm respectively.

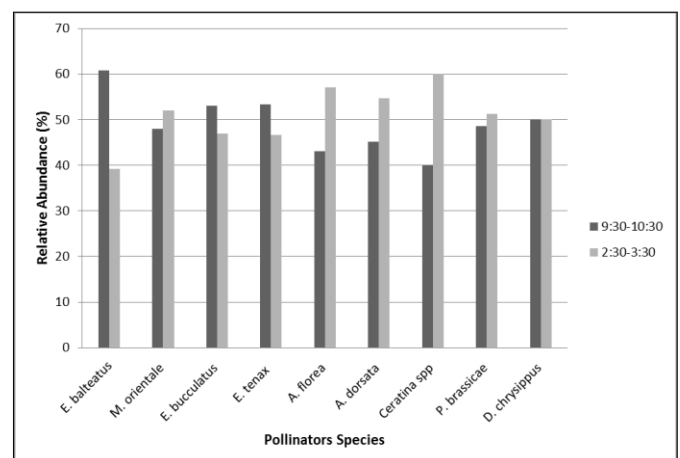


Fig 1: Relative abundance (%) of insect pollinator of same species at 9:30-10:30am and 2:30-3:30pm on Black cumin.

Average Relative abundance (%) of insect pollinators on Black cumin

Fig.2 indicates the data about the average relative abundance of nine different insect pollinator species recorded on Black cumin. In all of these nine species the average relative abundance of *E. balteatus*, *M. orientale*, *E. bucculatus* and *E. tenax* were 4.9%, 5.89%, 4.0% and 3.53% respectively. On other hand *A. florea*, *A. dorsata* and *Ceratina spp* were 36.79%, 12.5% and 10.61% respectively while 14.5% and

3.53% was of *P. brassicae* and *D. chrysippus* respectively observed on Black cumin. On over all bases among these pollinators the relative abundance of *A. florea* was recorded very high as compare to other species and followed by *P. brassicae*, *A. dorsata*, *Ceratina spp*, *M. orientale*, *E. balteatus*, and *E. bucculatus* in descending order whiles *E. tenax* and *D. chrysippus* was reported same and low relative abundance in all insect pollinators.

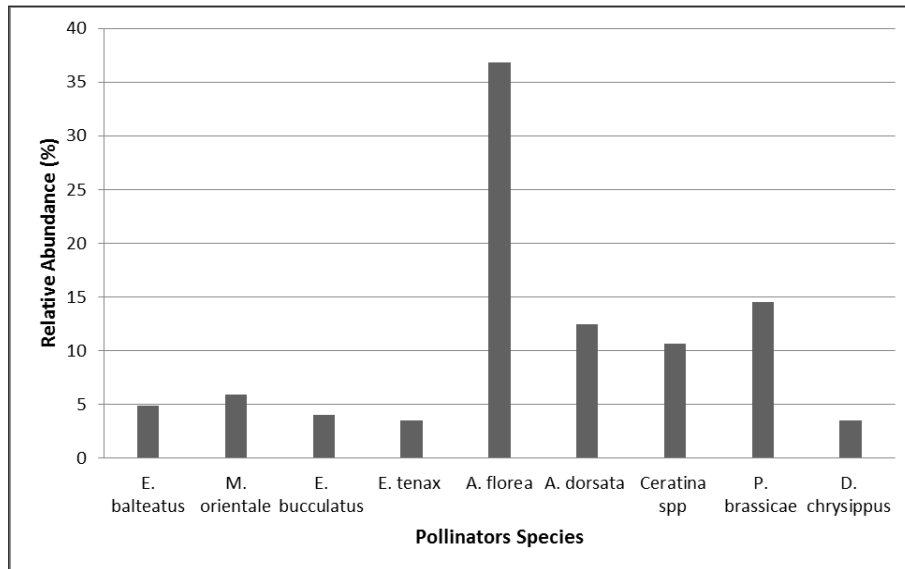


Fig 2: Average Relative abundance (%) of different insect pollinators on Black cumin.

Population dynamics of insect pollinators at 9:30-10:30am and 2:30-3:30pm on Black cumin.

***Episyrphus balteatus* De.**

Fig.3 shows the population dynamics of *E. balteatus*. According to the fig.3 the population was started from 7th February which was increased on 14th February and reached

to its peak on 21st February. The population trend declined on 28th February and reached to lowest level on 7 March at both 9:30-10:30am and 2:30-3:30pm. The population dynamics was reported maximum at 9:30-10:30 as compared to 2:30-3:30pm.

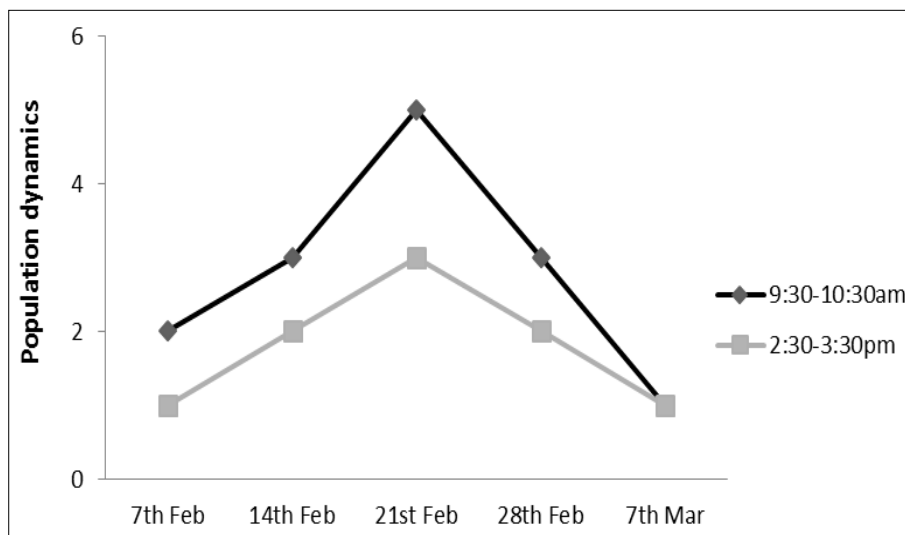


Fig 3: Population dynamics of *Episyrphus balteatus* on Black cumin.

***Melanostoma orientale* Wied.**

Fig. 4 indicates the population dynamics of *M. orientale*. The figure shows that the population of *M. orientale* was started from 7th February, which increased on 14th Feb and on 21st February it was reached to its peak at the morning. The population was then declined on 28th February and on 7th March it reached to its lowest level at 9:30-10:30am. On 7th

February at 2:30-3:30pm, the population was very low and remains in same condition on 14th February, but it has achieved its peak on 21st February and was remained same on 28th February and 7 March. In overall, the population dynamics was noted higher at 2:30-3:30pm as compared to 9:30-10:30am.

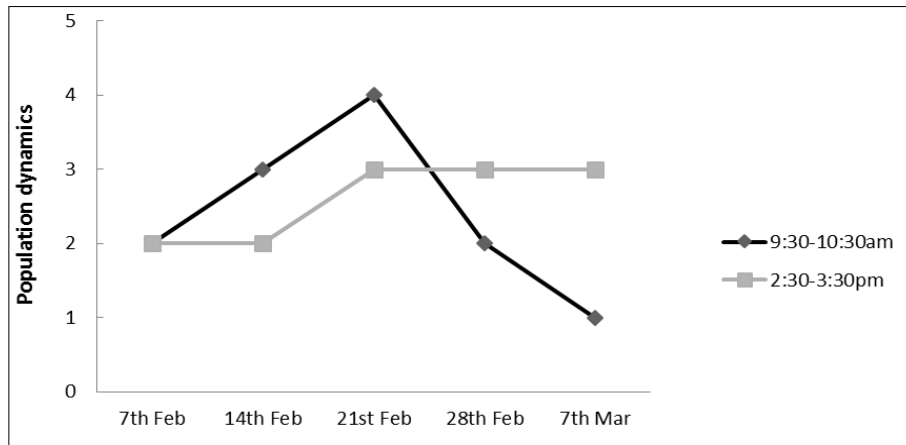


Fig 4: Population dynamics of *Melanostoma orientale* on Black cumin.

***Eupeodes bucculatus* Rond.**

Fig.5 shows the population dynamics of *E. bucculatus*. At 9:30-10:30am the population was founded minimum on 7thFebruary, which increased on 14th February and reached to maximum on 21st February. The number of insect pollinators declined on 28th February. The decreasing trend tends to continued as the population density reached to its minimum

on 7th March. At 2:30-3:30pm the population was on its lowest level on 7th and 14th February. The population increased on 21st February and remained same till the observations lasted i.e. 28th February and 7th March. The population dynamics was noticed minimum at 2:30-3:30pm as compared to 9:30-10:30am.

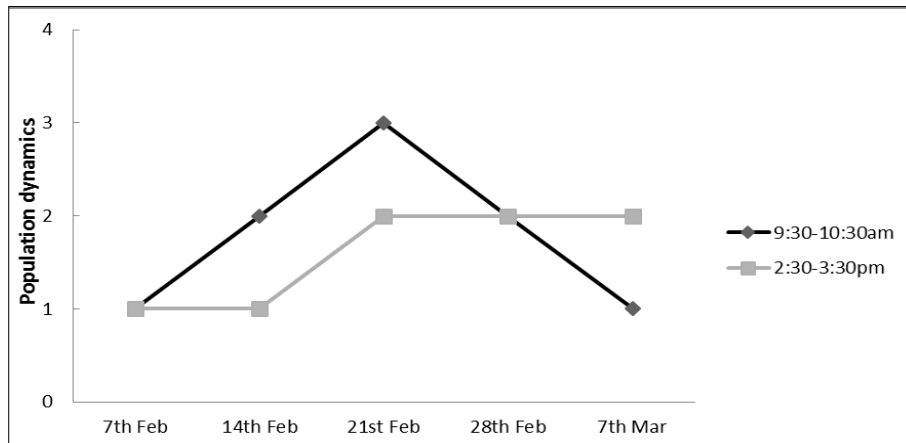


Fig 5: Population dynamics of *Eupeodes bucculatus* on Black cumin.

***Eristalis tenax* L.**

Fig.6 indicates the population dynamics of *E. tenax*. According to the Figure the population was minimum on 7th February at both the time intervals i.e. 9:30-10:30am and 2:30-3:30pm, while in the morning on 14th February it was increased and reached to peak on 21st February, while on 28th February and 7th March the population again came down to a

minimum value. On the other hand the number of pollinator at the afternoon on 14th February remained same to that on 7th February, while on 21st and 28th February the values of population of *E.tenax* as pollinator were also same as shown in figure 6, but decreased to least on 7th March. The population dynamics was observed maximum at 9:30-10:30am as compared to 2:30-3:30pm.

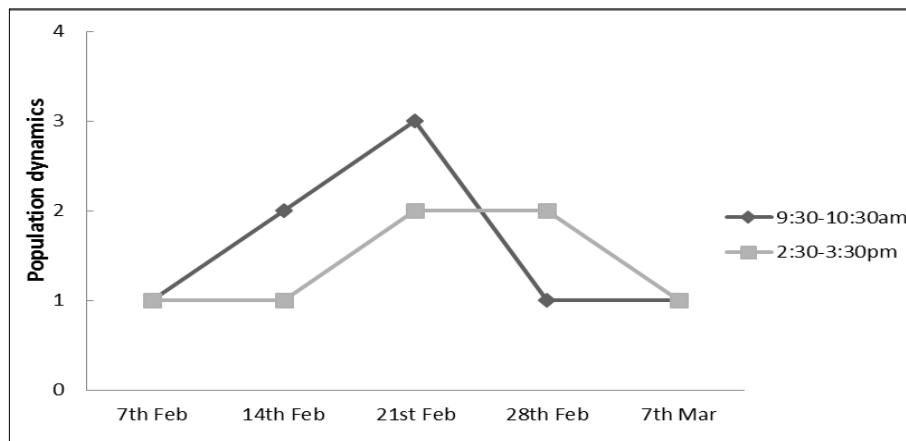


Fig 6: Population dynamics of *Eristalis tenax* on Black cumin.

***Apis florea* Fabr.**

The population dynamics of *A. florea* is given in figure 7 and tells us that the population of this small bee was started from 7th February and was recorded minimum during the observations at both the time intervals (morning and afternoon) but on 14th February it was increased at both the observation times. The number of pollinator continued to

increase and gained its peak on 21st of February during 9:30-10:30am and 2:30-3:30pm separately. The values of the population then decreased at both the time intervals on 28th February. The figures of population of the pollinator went down further during the morning and afternoon on 7th March. At 2:30-3:30pm the population dynamics was reported maximum as compared to 9:30-10:30am.

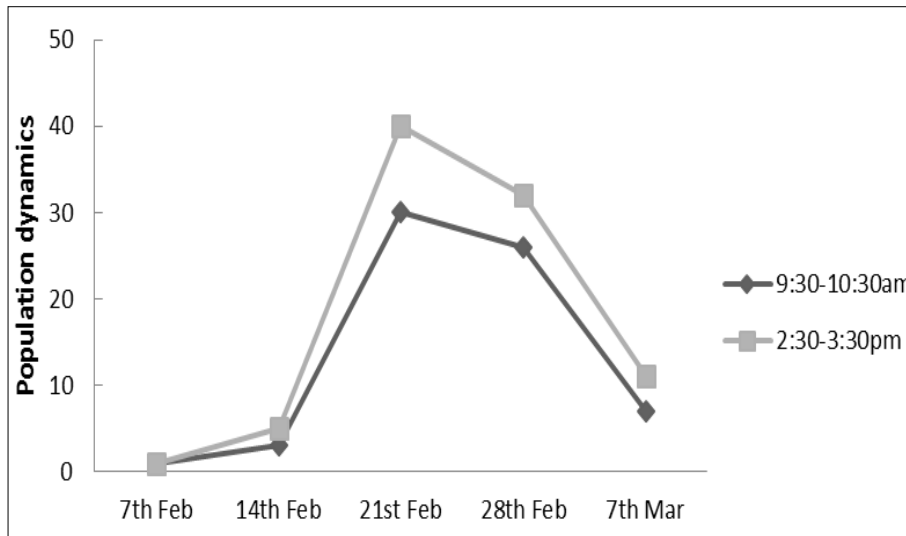


Fig 7: Population dynamics of *Apis florea* on Black cumin.

***Apis dorsata* Fabr**

Fig.8 indicates the population dynamics of *A. dorsata*. According to the figure 8 at 9:30-10:30am and 2:30-3:30pm on 7th February minimum population of the pollinators were reported. On 14th February at both the time intervals the number of pollinators increased very little. The figures of

population achieved its highest point on 21st February at the morning and afternoon. The population decreased on 28th of February during both the observation periods, the decreasing trend tends to continued on 7th March also, at morning and afternoon as shown in figure 8. The population of *A.dorsata* was higher at the afternoon than the morning.

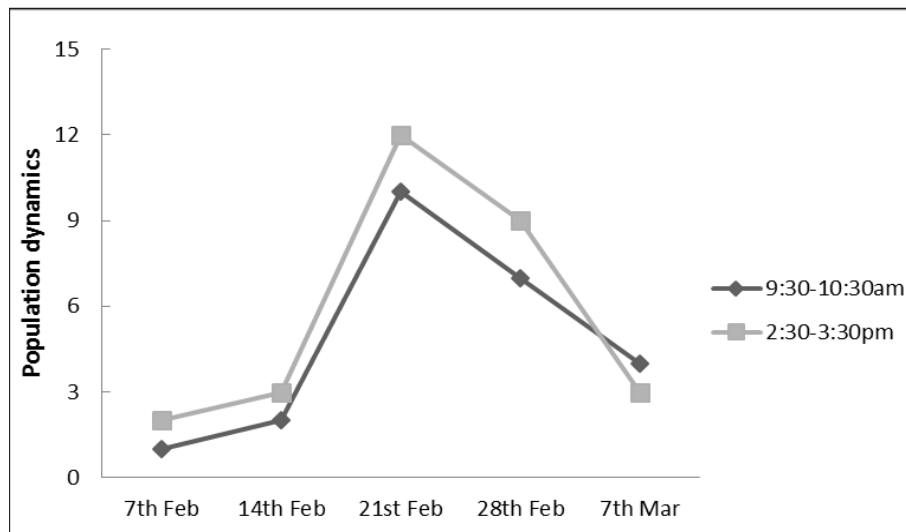


Fig 8: Population dynamics of *Apis dorsata* on Black cumin.

***Ceratina spp* Latr**

Fig.9 shows the population dynamics of *Ceratina spp*. The data infers that the population of *Ceratina spp* was recorded from 7th February at 9:30-10:30am and 2:30-3:30pm. The figure shows increase of population at the mornings of 14th and 21st February, while on 14th of February during 2:30-3:30pm a high increasing jump in population can be noticed which is followed by a little increase of pollinator's number

on 21st February. The figure 9 indicates decrease in population on 28th February and least population on 7th March at the morning. At afternoon a big decreasing jump can be observed on 28th of February, while on 7th March the population further decreased at 2:30-3:30pm. At 2:30-3:30pm the population dynamics was reported maximum as compared to 9:30-10:30am.

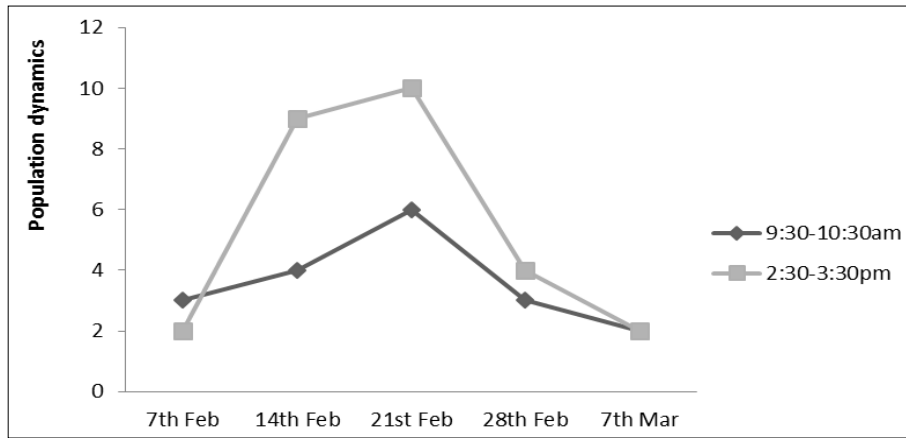


Fig 9: Population dynamics of *Ceratina spp* on Black cumin.

***Pieris brassicae* L.**

Fig.10 indicates the population dynamics of *P. brassicae*. The population was reported lowest at the morning on 7th February as compared to the mornings of other observation dates. The population figure raised on 14th February and then attained its peak on 21st February during morning. The population was decreased on 28th February, and continued to decrease up to

7th March as shown in figure 10. At the afternoon i.e. 2:30-3:30pm the value of population was recorded lowest on 7th February. The population increased gradually on 14th and 21st February and reached to its maximum value on 28th February, which is then declined greatly on 7th March. The population dynamics was noticed minimum at 9:30-10:30am as compared to 2:30-3:30pm.

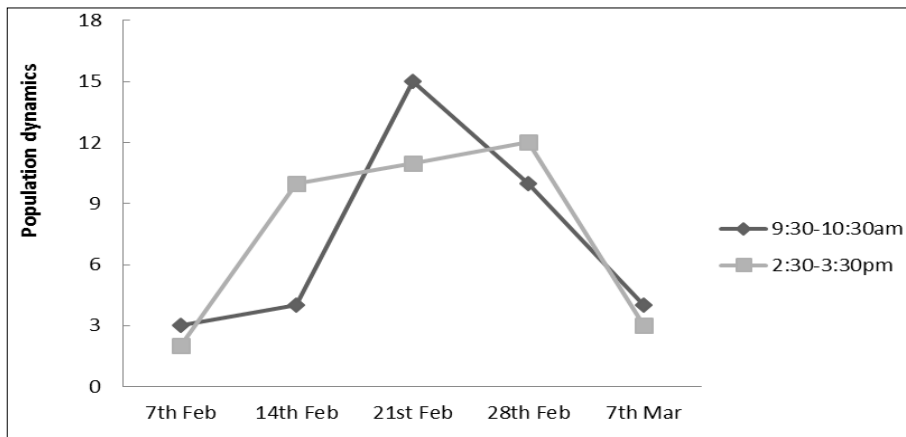


Fig 10: Population dynamics of *Pieris brassicae* on Black cumin.

***Danaus chrysippus* L.**

Fig.11 shows the population dynamics of *D. chrysippus*. According to the figure 11 the population was started from 7th February and reported minimum during 9:30-10:30am and 2:30-3:30pm both. The number of *D.chrysippus* remained same during 9:30-10:30am on 14th and 21st February. The population came back to its lowest density during the morning of 28th February and then again increased on 7th March. At

2:30-3:30pm on 14th February the pollinator number was similar to that of 7th February, while on 21st February during same time interval the number of pollinator gained its peak. The population decreased on 28th February and continued to decline on 7th March at the afternoon. In overall, the population dynamics was noted higher at 2:30-3:30pm as compared to 9:30-10:30am.

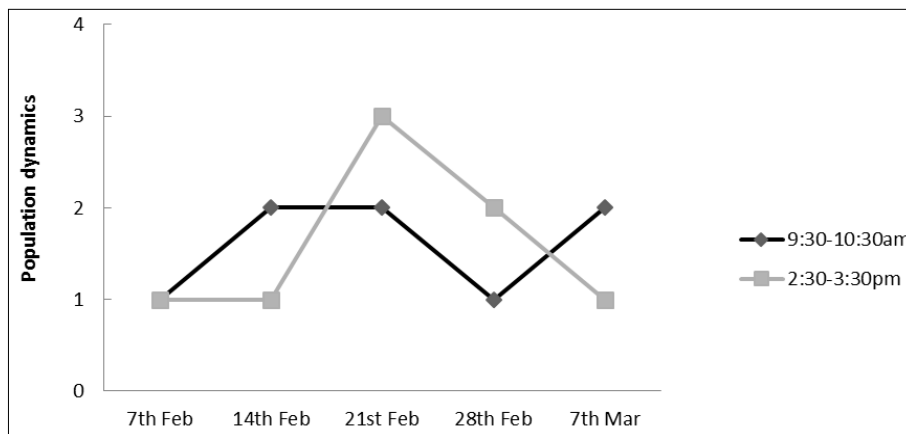


Fig 11: Population dynamics of *Danaus chrysippus* on Black cumin.

Results of Ali and Ali (1989) ^[14] show concurrence with our findings, as they noticed *Apis florea* prevalence up to some extent. Munawar *et al.*, (2009) ^[10] examined role of pollinators in the production of *Nigella saiva* and found different species at two time intervals in which honeybees were found densely. Kant *et al.*, (2013) ^[12] also recorded *Apis florea* and *Apis mellifera* abundantly at two time intervals. Zaitoun *et al.*, (2008) ^[13] worked on the effect on yield by pollinating bees and reported honeybees more in number on Black cumin. Our results are at par with the conclusions made by Douka and Fohouo (2013) ^[15] from their research. They found that a single honey bee of specie *Apis mellifera* in a minute visits 27.98 flowers. Meena *et al.*, in 2015 did research in Rajasthan on pollinators of seed spices from the initial flowering stages till crop harvest. They concluded that *Apis florea* have the highest percentage among other pollinators, followed by *Apis dorsata* and *Apis mellifera* ^[16].

Conclusion and recommendations

The current experimental work indicated that *Apis florea*, *Pieris brassicae* and *Apis dorsata* were the major pollinators of Black cumin in Dera Ismail Khan. Insects pollinators belongs to family Syrphidae of order Diptera also played its role in pollination. Most of the pollinators were having higher population in the afternoon than morning Number of population of pollinators were highest on 21st February followed by 28th February both in the morning and afternoon. Farmers and nursery owners are advised not to apply insecticide during the last days of February when Black cumin plants are at their peak blossoming stage as it would adversely affect the pollinators. Farmers should concern honeybee keepers in order to place bee colonies in their field, so that pollination is enhanced. All those practices should be adopted that could make the environment favourable for Honeybees, Butterflies and Syrphid flies as these are the most prevalent pollinators of Black cumin in Dera Ismail Khan.

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