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POLLINATORS (APIS AND NON-APIS) ON SUNFLOWER AND ONION CROP FIELDS IN KALABURAGI DISTRICT, KARNATAKA, INDIA.

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***Abstract*:** Honeybees plays an important ecological role as pollinators of many plant species. Honeybees and their products are the basics for a multi-million dollar commercial industry around the world. They are major agricultural pollinators around the world and are keystone pollinators in the tropical ecosystem. Pollination has been considered as a crusial process to ecosystem functioning through the facilitation of both plant and animal diversity. The study site was selected in the crop land area in Kalaburagi district, Karnataka State, India. The observation was done in the Sunflower *(Helianthus annuus*) field and Onion (*Allium cepa*) field at different time intervals, to record the pollination potential of *Apis* and non-*Apis* species by taking 10-15 minutes observation time. During the entire observation both *Apis*, non-*Apis* pollinators and other pollinators like butterflies and birds were also observed. Among all these pollinators the major pollinators in the sunflower field and onion field were non-*Apis* species.

Keywords: *Apis* and non-*Apis* pollinators, pollination, sunflower and onion fields

I. INTRODUCTION

Pollination is caused by a simple process of transfer of a compatible pollen grain to the stigma of ovary. If there is no pollination the flowers wither and produce no seed. The factors that govern pollination are so diverse and the environmental influences are so complex, that the ecological relationships have not been fully understood even in case of the most commonly cultivated crops.

Bees are dependent on flowers for their food. There exists a close association and mutually beneficial relationship through their evolution together since 60-100 million years ago. Bees not only aid in self - pollination within a flower, they also bring pollen from other plants for cross pollination, thus winding the scope of gene pool and increasing biodiversity among the plants visited by them (Atwal, 1992).

It is estimated that there are 15-20 thousand species of bees in the world and no less than 4000 species exist in USA and Canada (Hoopingarner and Waller, 1992). In the Indian subcontinent there are perhaps few number of species of bees visiting flowers. Hambelton (1944) prepared a list of 50 agricultural crops which are either dependent upon honeybees for pollination and production or they yield more when bees are abundant in that area. Current understanding of the pollination process shows that, while interesting specialized relationships exist between plants and their pollinators, healthy pollination services are best ensured by an abundance and diversity of pollinators. This is because the flowering plant species only produce seeds if animal pollinators move pollen from the anthers to the stigmas of their flowers. Without this service, delicate interconnected species and processes functioning within an ecosystem would collapse (Suwannapong et al. 2012).

In sunflower 2-4 rows of florets open on periphery every day and the structure of flower prevents self – pollination. Fertilization takes place through cross pollination with pollen from other florets of the same flower or preferably from another flower head. The role of bees in sunflower pollination is so important that 50-100% increase in yield is expected simply by bringing honeybees to the field at the rate of 2-5 colonies per hectare. The bee activity enhances sunflower yield to the extent of 20-30% through increasing pollination and also seed weight and oil content (Hegde, 2003). The Honey bees are the most important insects in the sunflower pollination process. Unlike other insects that visit flowers only for their own food, bees visit a greater number of flowers to fulfill the needs of their colony (Müller et al. 2006). The foraging pattern of bees on sunflower flowers is a key issue in studies of pollination.

Onion is the second most cultivated vegetable crop in the world. Honeybees are the main pollinators of onion seed production, but owning to low attractiveness of flowers, pollination is often inadequate. Nectar is the most important floral reward offered by plants. Floral nectar composition has been studied as the potential cause of bee preferences in many species, among them onion (Soto et al. 2015).

II. RESEARCH METHODOLOGY

The study area was selected in Kalaburagi district and it lies in between 17.3297°N and 76.8343°E, in the northern hemisphere. The study sites were selected in the crop field of sunflower (*Helianthus annuus*) and onion (*Allium cepa*).The study sites were enmarked by plotting A, B, C, D in both the fields the area measured around 700 sq ft. The observation was done at different time intervals such as, morning (7 AM to 8 AM), afternoon (1 PM to 2 PM) and evening (4 PM to 5 PM). Monthly 2 observations were made in each plot by observing the pollinators for 15 minutes in different season. These observations were done to record the *Apis* and non-*Apis* species visiting the flowers at different hours in a day.

III. RESULT AND DISCUSSION

The observations of sunflower field were done in the month of September (post monsoon season), October (winter season) and November (winter season) and the observations of onion field were done in the month of January (winter season), February (pre-summer season) and March (summer season).

Sunflower field: According to the observation in plot A,B,C,D, the bees were seen foraging for nectar and pollen starting from the time 7:45 AM. At each florets of the sunflower *Tetragonula irridipennis* were found large in number. *Apis florea, Apis dorsata* and around 6 species of non-*Apis* were recorded. The activity of the honeybees were found high during the morning hours and low in afternoon hours compared to evening. The major pollinators seen in all the plots were *Tetragonula irridipennis* and *Apis dorsata.* Comparatively the pollinators were found large in number during October and November, 2019 and less during the month of September 2019, as there was acute rainfall. According to the study plots A,B,C,D , the pollinators were recorded high in D plot.

In Kalaburagi district the study site was selected in oilseed field i.e, Sunflower. The sunflower field was of 2 acre land, in that 700 sq ft area was selected and the plots A, B,C,D were marked, in which each plot measured around 175 sq ft area. The observations were recorded in the month of September, October and November and monthly twice the pollinators were recorded to check the pollination potential of the sunflower field. The observation was carried out in morning hours, afternoon hours and evening hours, by observing the bees in every plot for about 15 minutes and in each plot the *Apis florea* were observed 5 minutes, *Apis dorsata* was observed for 5 minutes and other non-*Apis* bees were observed for 5 minutes. The majority of the pollinators were *Tetragonulla irridepennis* and *Apis dorsata.* During the month of October the activity of pollinators were high in number compared to September and November.

Onion field: According to the observation in plot A,B,C,D, the bees were seen foraging for nectar and pollen starting from the time 7:45 AM. At each florets of the onion flower *Tetragonula irridipennis* and *Apis florea* were found large in number. *Apis florea, Apis dorsata* and around 3 - 4 species of non-*Apis* were recorded. The activity of the honeybees were found high during the afternoon hours and low in morning hours compared to evening. The major pollinators seen in all the plots were *Tetragonula irridipennis* and *Apis florea.* Comparatively the pollinators were found large in number during February 2019 and less during the month of January 2019. According to the study plots A,B,C,D , the pollinators were recorded high in D plot.

In Kalaburagi district the study site was selected in onion field. The onion field was of 700 sq ft area and the plots A, B,C,D were marked and each plot measured around 175 sq ft area. The observations were recorded in the month of January, February and March and monthly twice the pollinators were recorded to check the pollination potential of the onion field. The observation was carried out in morning hours, afternoon hours and evening hours, by observing the bees in every plot for about 15 minutes and in each plot the *Apis florea* were observed 5 minutes, *Apis dorsata* was observed for 5 minutes and other non-*Apis* bees were observed for 5 minutes. The majority of the pollinators were *Tetragonulla irridepennis* and *Apis florea.* During the month of February the activity of pollinators were high in number.

Figures and tables

Months	Morning			Afternoon			Evening		
	Apis florea	*Apis dorsata*	Non-*Apis*	*Apis florea*	*Apis dorsata*	Non-*Apis*	*Apis florea*	*Apis dorsata*	Non-*Apis*
September	**0**	**3**	**22**	**1**	**2**	**20**	**1**	**5**	**21**
October	**1**	**1**	**38**	**7**	**6**	**25**	**6**	**10**	**24**
November	**5**	**8**	**26**	**2**	**7**	**27**	**2**	**9**	**34**
Mean	**2**	**4**	**28.66**	**3.33**	**5**	**24**	**3**	**8**	**26.33**
Variance	**7**	**13**	**69.33**	**10.33**	**7**	**13**	**7**	**7**	**46.33**
S.D±	**2.64**	**3.60**	**8.32**	**3.21**	**2.64**	**3.60**	**2.64**	**2.64**	**6.80**

Table No. 1: *Apis* and non-*Apis* pollinators recorded in PLOT – A in sunflower field

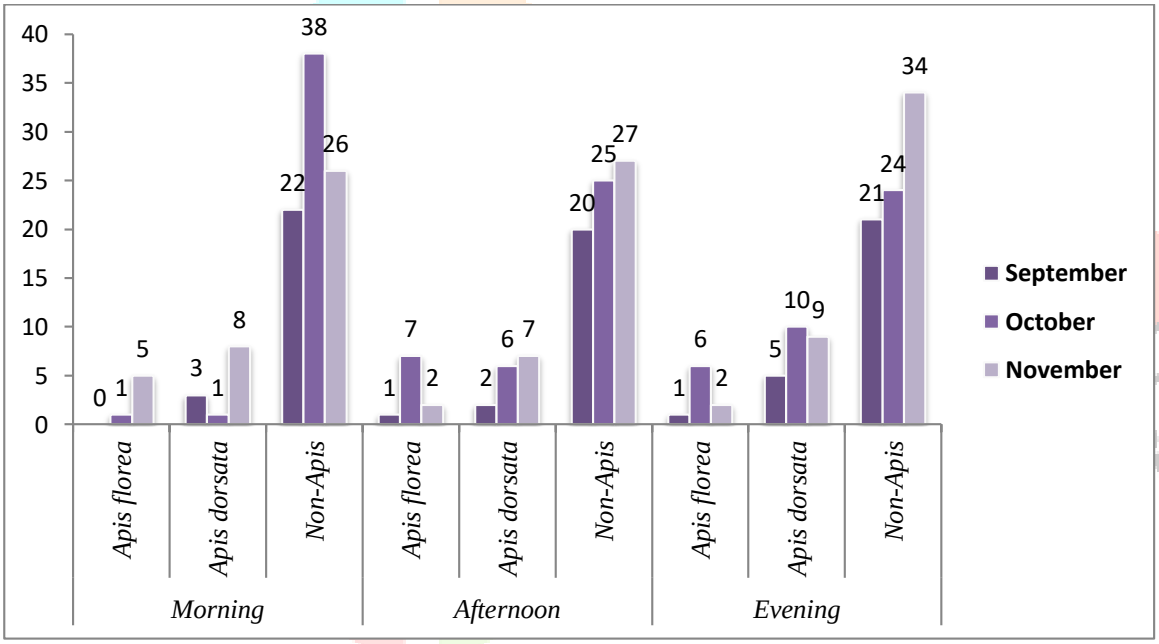

Fig No. 1: Graph showing the *Apis* and non-*Apis* pollinators in PLOT-A in sunflower field

Months	Morning			Afternoon			Evening		
	Apis florea	*Apis dorsata*	Non-*Apis*	*Apis florea*	*Apis dorsata*	Non-*Apis*	*Apis florea*	*Apis dorsata*	Non-*Apis*
September	**2**	**4**	**18**	**4**	**6**	**18**	**1**	**5**	**18**
October	**3**	**7**	**31**	**7**	**6**	**20**	**5**	**5**	**26**
November	**7**	**10**	**20**	**5**	**9**	**27**	**5**	**9**	**33**
Mean	**4**	**7**	**23**	**5.33**	**7**	**21.66**	**3.66**	**6.33**	**25.66**
Variance	**7**	**9**	**49**	**2.33**	**3**	**22.33**	**5.33**	**5.33**	**56.33**
S.D±	**2.64**	**3**	**7**	**1.53**	**1.73**	**4.72**	**2.30**	**2.30**	**7.50**

Table No. 2: *Apis* and non-*Apis* pollinators recorded in PLOT- B in sunflower field

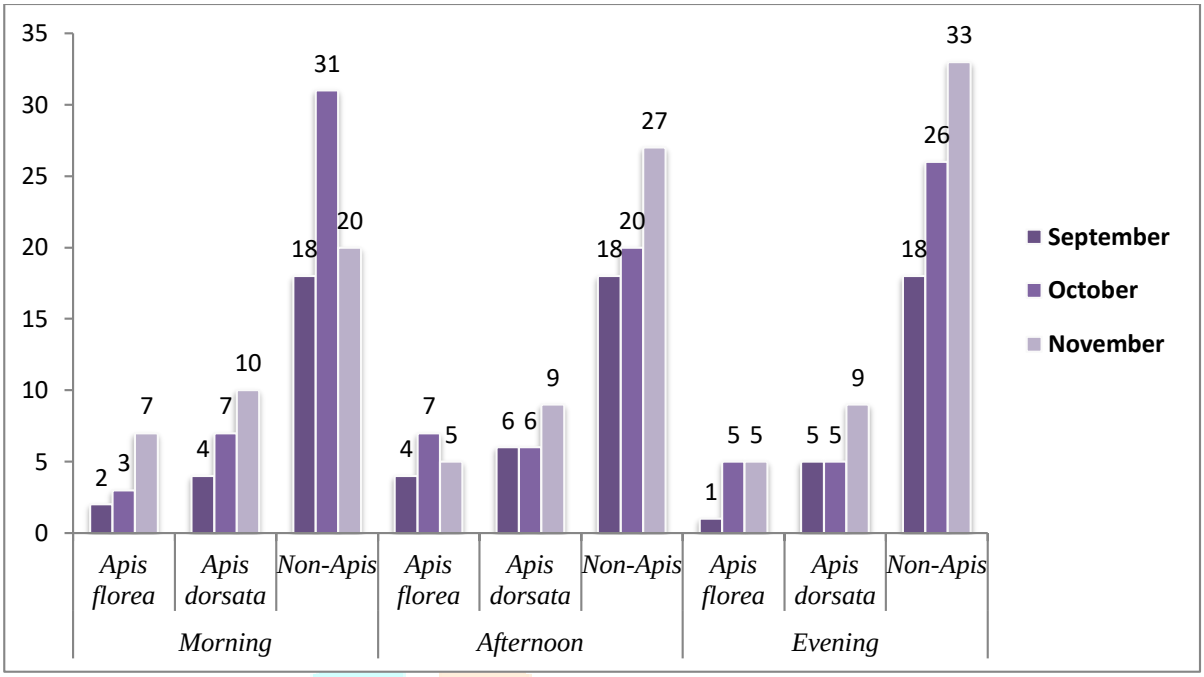

Fig No. 2: Graph showing the *Apis* and non-*Apis* pollinators in PLOT-B in sunflower field

Months	Morning			Afternoon			Evening		
	Apis florea	***Apis dorsata***	**Non-*Apis***	***Apis florea***	***Apis dorsata***	**Non-*Apis***	***Apis florea***	***Apis dorsata***	**Non-*Apis***
September	**1**	**3**	**16**	**3**	**7**	**18**	**1**	**5**	**20**
October	**1**	**6**	**28**	**7**	**5**	**17**	**6**	**5**	**27**
November	**3**	**9**	**25**	**6**	**7**	**22**	**3**	**8**	**29**
Mean	**1.66**	**6**	**23**	**5.33**	**6.33**	**19**	**3.33**	**6**	**25.33**
Variance	**1.33**	**9**	**39**	**4.33**	**1.33**	**7**	**6.33**	**3**	**22.33**
S.D±	**1.15**	**3**	**6.24**	**2.08**	**1.15**	**2.64**	**2.51**	**1.73**	**4.72**

Table No. 3: *Apis* and non-*Apis* pollinators recorded in PLOT- C in sunflower field

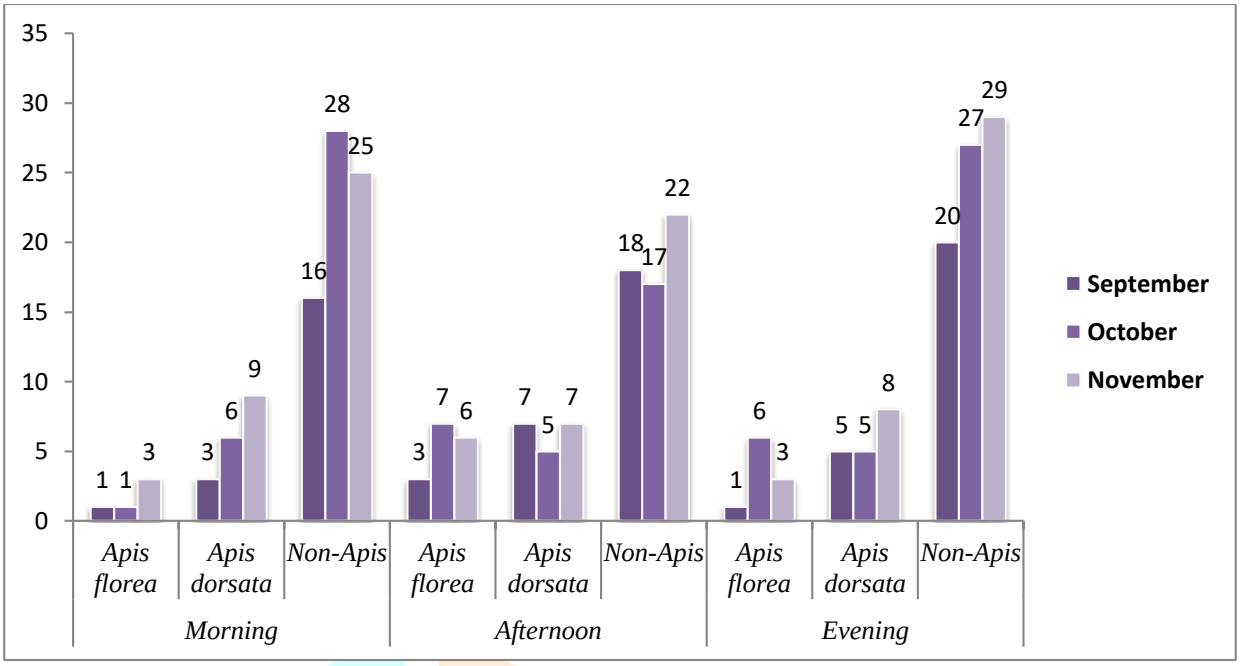

Fig No. 3: Graph showing the *Apis* and non-*Apis* pollinators in PLOT-C in sunflower field

Months	Morning			Afternoon			Evening		
	Apis florea	*Apis dorsata*	Non-*Apis*	*Apis florea*	*Apis dorsata*	Non-*Apis*	*Apis florea*	*Apis dorsata*	Non-*Apis*
September	**1**	**6**	**17**	**3**	**6**	**17**	**1**	**6**	**19**
October	**1**	**6**	**28**	**5**	**6**	**20**	**7**	**10**	**30**
November	**5**	**7**	**25**	**3**	**7**	**36**	**5**	**8**	**29**
Mean	**2.33**	**6.33**	**23.33**	**6.33**	**3.66**	**24.33**	**4.33**	**8**	**26**
Variance	**5.33**	**0.33**	**32.33**	**0.33**	**1.33**	**104.3**	**9.33**	**4**	**37**
S.D±	**2.30**	**0.57**	**5.68**	**0.57**	**1.15**	**10.21**	**3.05**	**2**	**6.08**

Table No. 4: *Apis* and non-*Apis* pollinators recorded in PLOT- D in sunflower field

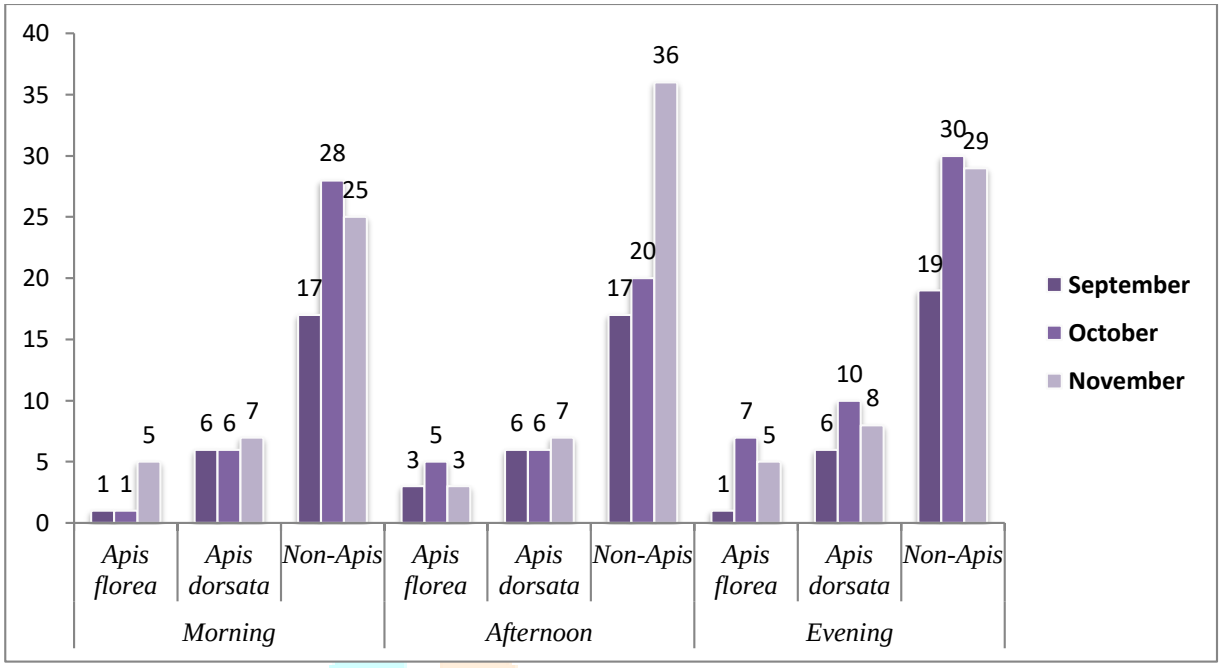

Fig No. 4: Graph showing the *Apis* and non-*Apis* pollinators in PLOT-D in sunflower field

Months	Morning			Afternoon			Evening		
	Apis florea	***Apis dorsata***	**Non-*Apis***	***Apis florea***	***Apis dorsata***	**Non-*Apis***	***Apis florea***	***Apis dorsata***	**Non-*Apis***
January	**9**	**0**	**8**	**45**	**0**	**58**	**51**	**0**	**42**
February	**7**	**0**	**6**	**42**	**0**	**48**	**40**	**0**	**32**
March	**13**	**0**	**14**	**62**	**0**	**95**	**32**	**0**	**43**
Mean	**9.66**	**0**	**9.33**	**49.66**	**0**	**67**	**41**	**0**	**39**
Variance	**9.33**	**0**	**17.33**	**116.33**	**0**	**613**	**91**	**0**	**37**
S.D±	**3.05**	**0**	**4.16**	**10.78**	**0**	**24.75**	**9.53**	**0**	**6.08**

Table No. 5: *Apis* and non-*Apis* pollinators recorded in PLOT-A in Onion field.

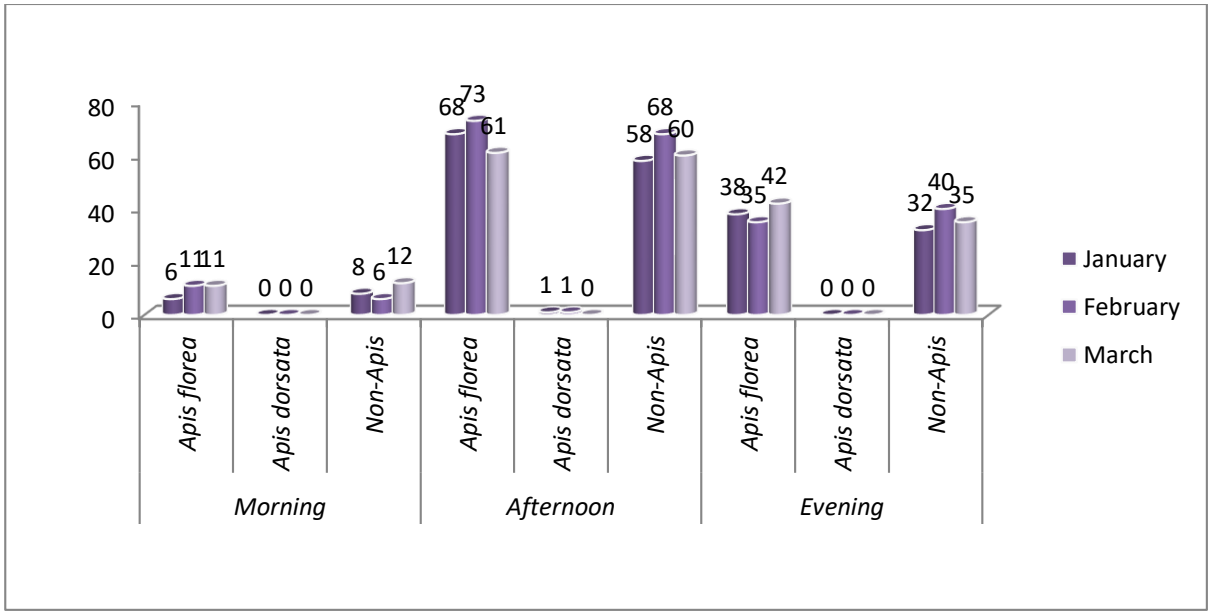

Fig No. 5: Graph showing *Apis* and non-*Apis* pollinators in PLOT-A in Onion field

Months	Morning			Afternoon			Evening		
	Apis florea	*Apis dorsata*	Non-*Apis*	*Apis florea*	*Apis dorsata*	Non-*Apis*	*Apis florea*	*Apis dorsata*	Non-*Apis*
January	**8**	**0**	**8**	**55**	**1**	**62**	**50**	**1**	**30**
February	**12**	**0**	**12**	**58**	**0**	**60**	**60**	**0**	**22**
March	**24**	**1**	**34**	**58**	**1**	**45**	**31**	**0**	**18**
Mean	**14.66**	**0.33**	**18**	**57**	**0.66**	**55.66**	**47**	**0.33**	**23.33**
Variance	**69.33**	**0.33**	**196**	**3**	**0.33**	**86.33**	**217**	**0.33**	**37.33**
S.D±	**8.32**	**0.577**	**14**	**`1.73**	**0.57**	**9.29**	**14.73**	**0.57**	**6.11**

Table No. 6: *Apis* and non-*Apis* pollinators recorded in PLOT-B in Onion field.

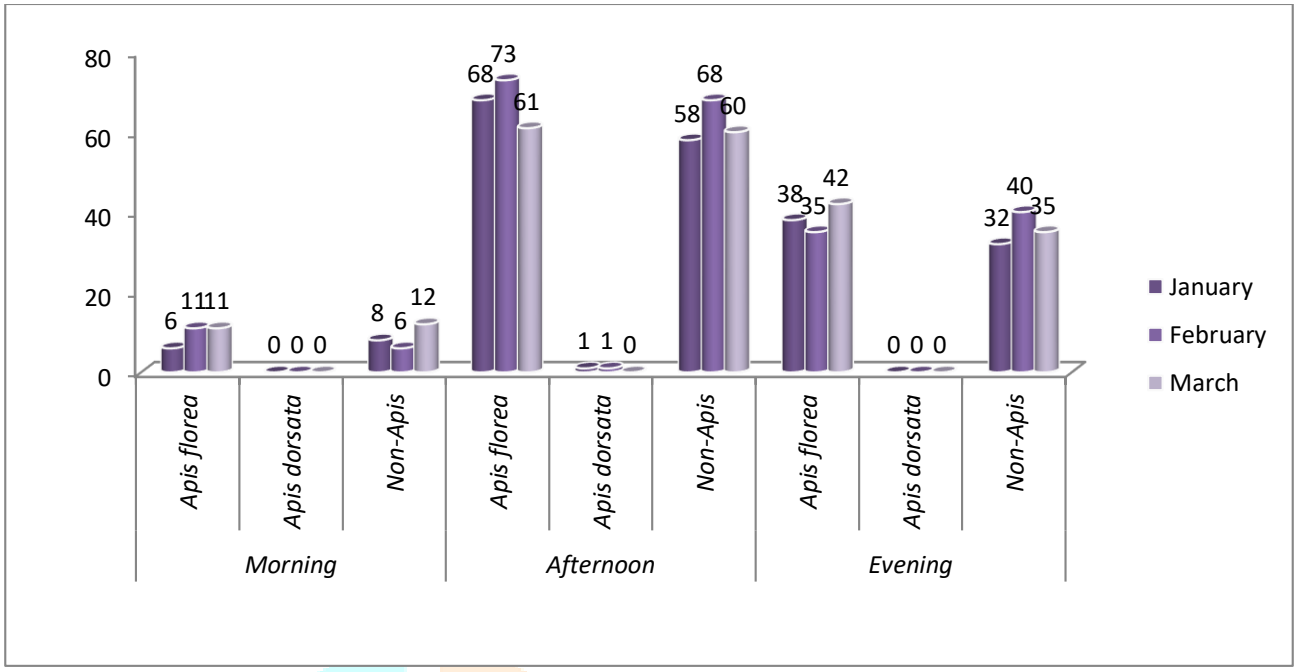

Fig No. 6: Graph showing the *Apis* and non-*Apis* pollinators in PLOT-B in onion field.

Months	Morning			Afternoon			Evening		
	Apis florea	*Apis dorsata*	Non-*Apis*	*Apis florea*	*Apis dorsata*	Non-*Apis*	*Apis florea*	*Apis dorsata*	Non-*Apes*
January	**9**	**0**	**11**	**45**	**1**	**62**	**40**	**1**	**30**
February	**9**	**0**	**6**	**60**	**0**	**74**	**37**	**0**	**30**
March	**13**	**0**	**11**	**79**	**0**	**90**	**38**	**0**	**34**
Mean	**10.33**	**0**	**9.33**	**61.33**	**0.33**	**75.33**	**38.33**	**0.33**	**31.33**
Variance	**5.33**	**0**	**8.33**	**290.33**	**0.33**	**197.33**	**2.33**	**0.33**	**5.33**
S.D±	**2.30**	**0**	**2.88**	**17.03**	**0.57**	**14.04**	**1.52**	**0.57**	**2.30**

Table No. 7: *Apis* and non-*Apis* pollinators recorded in PLOT-C in Onion field.

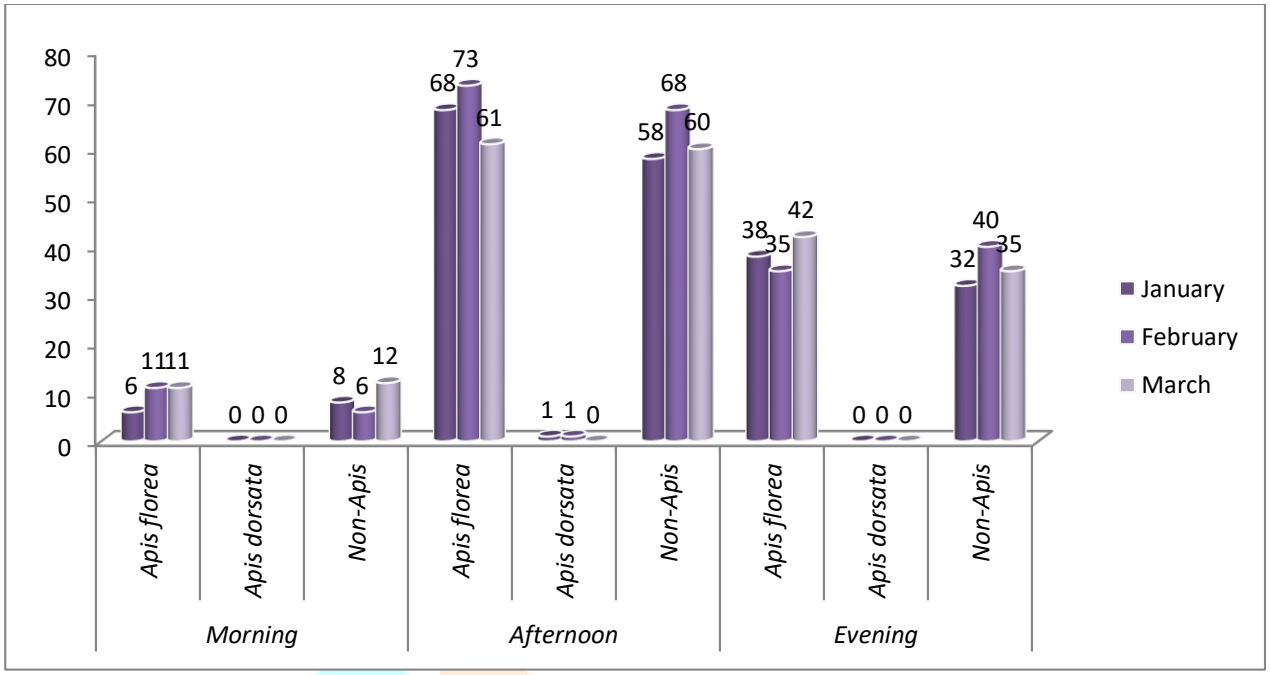

Fig No. 7: Graph showing the *Apis* and non-*Apis* pollinators in PLOT-C onion field.

Months	Morning			Afternoon			Evening		
	Apis florea	*Apis dorsata*	Non-*Apis*	*Apis florea*	*Apis dorsata*	Non-*Apis*	*Apis florea*	*Apis dorsata*	Non-*Apis*
January	**6**	**0**	**8**	**68**	**1**	**58**	**38**	**0**	**32**
February	**11**	**0**	**6**	**73**	**1**	**68**	**35**	**0**	**40**
March	**11**	**0**	**12**	**61**	**0**	**60**	**42**	**0**	**35**
Mean	**9.33**	**0**	**8.66**	**67.33**	**0.66**	**62**	**38.33**	**0**	**35.66**
Variance	**8.33**	**0**	**9.33**	**36.33**	**0.33**	**28**	**12.33**	**0**	**16.33**
S.D±	**2.88**	**0**	**3.05**	**6.02**	**0.57**	**5.29**	**3.51**	**0**	**4.04**

Table No. 8: *Apis* and non-*Apis* pollinators recorded in PLOT-D in Onion field.

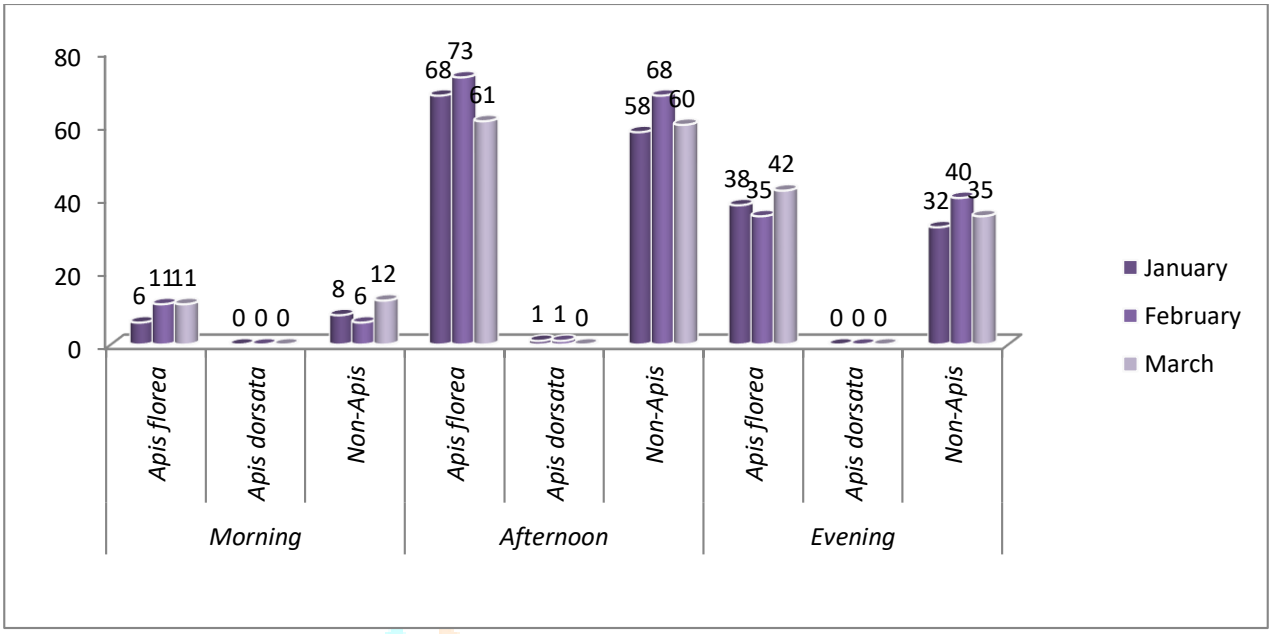

Fig No. 8: Graph showing the *Apis* and non-*Apis* pollinators in PLOT-D in onion field

IV. ACKNOWLEDGEMENT

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