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Study the abundance of insect pollinators/visitors in rapeseed-mustard (*Brassica juncea* L.)

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Abstract
The present investigation entitled "Impact of honey bee (*Apis mellifera* L.) pollination in mustard (*Brassica campestris* var. *toria*) to the enhancement of seed yield" in randomized block design was recorded at Student Instructional Farm of N.D.U.A.T, Kumarganj, Faizabad during *Rabi* 2016-17. The result revealed that the insects of order-Hymenoptera namely; *Apis dorsata, Apis mellifera, T. irridipennis* were the major floral visitors belonging to family Apidae. The insects among this apidae family, *Apis dorsata* and *A. mellifera* were the most frequent visitors. The abundance of insect pollinators was found maximum in afternoon (3.00-4.00 PM) with 31.56 pollinators /plant/5 min. The higher number of floral visitors in the evening can be attributed of favorable meteorological parameters of afternoon. However, *A. dorsata* showed its maximum visit on flowers in afternoon with respect to other pollinators. The maximum pod setting 76.24 pod/plant and 83.50 percent seed setting were recorded in open-pollination followed by bee-pollination with 71.20 pod/plant and 78.25 percent seed setting and minimum pod setting 69.12 pod/plant and 71.80 percent seed setting in self-pollination.

Keywords: Abundance, pollinators, visitors, rapeseed-mustard, *Brassica juncea. Apis dorsata, Apis mellifera and Trigona irridipennis*

1. Introduction
India is one of the largest rapeseed-mustard growing country in the world occupying the third position in the area and in production after China and Canada with 12% of the worlds total production. *Brassica juncea* is the second most important oilseed crop in the country after groundnut and accounts for nearly 30.7% of the total oilseed production in the country. At global level rapeseed-mustard is cultivated on 36.15 m ha with production of 71.09 mt. Rapeseed-mustard oil production increased from 1.94 million MT from 2014-15 to 2.11 million MT in 2015-16. European Union (EU) is expected to be the top producer followed by China and Canada in 2015-16. India may be the fourth largest producer. India's share in global production of mustard oil in 2015-16 may be around 9.0 percent. The US and China were the leading importing countries of mustard oil in the world. India was the 7th largest importing country in 2013-14. (Anonymous 2015) [5].
Indian mustard [*Brassica juncea* L. Czern & Coss.], which is cultivated throughout the world belongs to the family C*ruciferae* (*Brassicaceae*) under the genus Brassica, cultivated all over India and it is the major *rabi* oilseed crop of northern India. It has 38 to 42% oil & 24% protein. Honeybees provide pollination services to several cultivated and wild species, thereby, maintaining biological diversity. Bee poisoning or killing of bees from pesticides continues to be a serious problem for beekeepers. Most bee kill occurs when pesticides are applied or allowed to drift on to flowering crops or weeds. Most (99%) bee kills result from bees picking up the pesticides when foraging. The hazards of insecticidal application on flowering crops include direct mortality, fumigative effects, repellent effects and toxicity of the residues present on various floral parts and in nectar (Pal *et al*. 2015) [6].

2. Materials and Methods
An extensive research work was conducted in order to collect the information pertaining to different aspects of the present investigation entitled "Impact of honey bee (*Apis mellifera*) pollination in mustard (*Brassica campastris* var. *toria*) to enhancement of seed yield". The investigation was carried out during *Rabi*, 2016-17 at Student Instructional Farm, Narendra Deva University of Agriculture and Technology Kumarganj, Faizabad (U.P.) India.

On the Faizabad Road at the distance of 42 km away from Faizabad district. The method of various experiments conducted as pre objectives are presented here as under.
The visit of different pollinators and their number on flowers were recorded on randomly selected 5 plants for 5 minutes each in forenoon (9-10 AM) noon (12-1:00) and afternoon (3-4 PM) in open- pollination crop (OP).

2.1 Abundance of pollinators on mustard

To quantify the insect pollinators, the regular visual observations of pollinators' number were recorded on flowers in open-pollinated plots (OP) of the mustard crop during flowering period (15 to 30 December, 2016-17) at the Student Instructional Farm, Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad and presented in the Table-1. Several insect pollinators were found during observation period. The pollinators visited on the mustard flowers were belonging to the orders Diptera, Hymenoptera and Lepidoptera. Among them the house fly (order: Diptera) were most dominating pollinators besides, honey bee (Hymenoptera).
The insects of order Hymenoptera contributed major group of pollinators on mustard crop. Among them *Apis dorsata* Fab. and *Apis mellifera* L. was dominating insects of genus-Apis Besides, *Trigona iridipennis* of same family i.e. Apidae. However, House fly, syrphid flies of Diptera and butter fly of Lepidoptera were also observed in open- pollinated crop.

Table 1: Abundance of insect pollinators on mustard crop during flowering period at Student Instructional Farm, Kumarganj, Faizabad, during 2016-17

S. No.	Common name	Scientific name	Order	Family
1	Rock bee	*Apis dorsata* Fab.	Hymenoptera	Apidae
2	Italian bee	*Apis mellifera* L.	Hymenoptera	Apidae
3	Dammer bee	*Trigona iridipennis*	Hymenoptera	Apidae
4	House fly	*Musca domestica*	Diptera	Muscidae
5	Syrphid flies	Unidentify	Diptera	Syrphidae
6	Butterflies	Unidentify	Lepidoptera	-
7	Moths	Unidentify	Lepidoptera	-

2.2 Abundance and Quantification of the pollinators

The relative abundance and quantification of recorded pollinators were presented in Table-2 and Fig.1. The result showed that honey bees were dominating among total pollinators' population. Among honey bees, *A. dorsata* was dominating species with 7.25 bees / plant / 5 min which was 12.01 percent of total insect pollinators of forenoon (9.00-10.00 AM) whereas, it was 12.83 percent of total population in afternoon (3.00 to 4.00) with 8.93 bees /plant/ 5 min. and minimum population of pollinators 5.87 bee/ plant/ min recorded in noon (12-1.00). However, population of *A. dorsata* was ranged from 3 to 13 bee/plant/5 min. in forenoon, 3 to 16 bee/plant/5 max. in afternoon and 3 to 9 bee/plant/5min. in noon (12-1.00) during whole observation period.
In case of *A. mellifera* foraging activity was higher in the afternoon (3.00 to 4.00 PM) with 7.16 bees/plant/5 min population, in respect to forenoon (9.00-10.00 AM) with 5.62 bees /plant /5 min which was 9.70 percent total pollinators' and 3.75 bees/plant/5min. population observed in noon (12-1.00 PM).
Dammer bee (*Trigona irridipennis*) was also recorded visiting on mustard flowers which population was recorded poor in comparison to others *spp*. of honeybee. Their population was observed highest in the afternoon (3.00-4.00 PM) 5.2 bees / plant / 5 min and 8.30 percent, forenoon (9.00-10.00AM) which recorded as 5.0 bees / plant / 5 min, 5 bees /plant/min. in noon (12-1.00 AM) 8.58 percent of total population.
House fly (*Musca domestica)* population was recorded on mustard flowers which population was lower in comparison to syrphid flies. The house fly was observed lowest in forenoon (9.00 to 10.00 AM) 2.93 house fly /plant /5 min, afternoon (3.00 to 4.00 PM) and 3.43 bees/ plant /5min in noon (12-1.00PM) which recorded as 5.77 percent of total population.

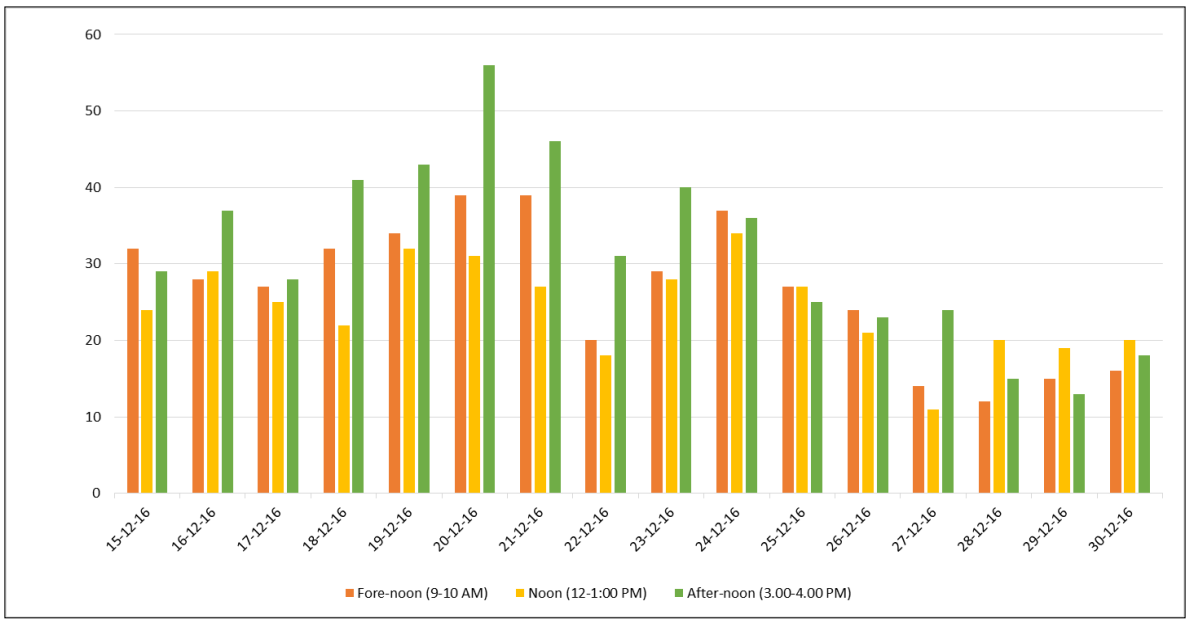

Fig 1: Quantification of different insect pollinators during flowering stage on mustard crop during season 2016-17.

Table 2: Quantification of different insect pollinators during flowering stage on mustard crop during season 2016-17

Days	Date	The average number of pollinators per plant/5 min.																				
		Fore-noon (9-10 AM)							Noon (12-1:00 PM)							After-noon (3.00-4.00 PM)						
		A.d	A.m	T. I	H.f	S.f	Other	Total	A.d	A.m	T.I	Hf	S.f	Other	Total	A.d	A.m	TI	Hf	Sf	Other	Total
1	15/12/16	7	6	6	4	7	2	32	4	4	6	3	7	0	24	8	8	3	4	5	1	29
2	16/12/16	6	7	7	5	3	0	28	8	5	3	5	6	2	29	9	12	5	6	4	1	37
3	17/12/16	5	8	3	3	6	2	27	4	3	5	4	7	1	25	7	10	3	3	5	0	28
4	18/12/16	9	9	4	4	5	1	32	7	6	8	2	5	1	22	10	12	6	7	4	2	41
5.	19/12/16	8	8	3	8	6	1	34	5	5	9	6	7	0	32	11	10	3	9	9	1	43
6.	20/12/16	9	10	5	5	9	1	39	7	8	7	5	4	1	31	13	12	13	5	10	3	56
7.	21/12/16	11	6	8	2	10	2	39	9	4	3	4	7	0	27	12	8	7	6	11	2	46
8.	22/12/16	7	5	4	1	3	1	20	5	3	5	1	4	0	18	8	7	4	3	8	1	31
9.	23/12/16	8	4	6	4	4	3	29	7	3	7	3	7	1	28	10	5	7	5	12	1	40
10.	24/12/16	13	4	9	2	7	2	37	9	3	5	6	9	2	34	16	4	4	3	8	1	36
11.	25/12/16	7	3	11	1	4	1	27	6	2	4	8	6	1	27	9	5	6	0	5	0	25
12	26/12/16	9	3	6	2	4	0	24	8	1	6	3	7	1	21	11	5	3	2	2	0	23
13.	27/12/16	5	4	2	0	1	2	14	4	2	2	1	3	0	11	8	6	5	0	4	1	24
14.	28/12/16	3	3	3	1	2	0	12	3	2	5	3	6	1	20	6	4	4	0	1	0	15
15.	29/12/16	4	6	2	2	0	1	15	6	4	3	2	4	0	19	3	7	2	1	0	0	13
16.	30/12/16	5	4	1	3	1	2	16	9	5	2	1	2	1	20	5	6	3	1	2	1	18
Mean		7.25	5.62	5.00	2.93	4.50	1.31	26.56	5.87	3.75	5.0	3.43	5.43	0.75	24.25	8.93	7.16	5.31	3.43	5.00	0.93	31.56
Percentage		12.03	9.32	8.30	4.86	7.47	2.17		8.87	5.68	7.57	5.69	8.22	1.13		17.6	14.12	9.86	6.76	7.20	1.83	
% (fore-noon, noon and afternoon)		12.83	9.70	8.58	5.77	7.63	1.71															

A.d = *Apis dorsata,* A.m = *Apis mellifera,* T.I = *Trigona iridipennis, HF = House fly, SF = Syrphid fly.*

The foraging activities of syrphid flies on mustard were started in the morning hours. Its population was observed more (4.5 Syrphid flies / plant / 5 min and 7.47 percent) in the afternoon (3.00-4.00 PM) in respect to forenoon (9.00-10.00 AM) with 2.93 Syrphid flies / plant / 5 min and 7.63 percent. In forenoon it ranged from 1 to 10 flies / plant / 5 min and in the afternoon it ranged from 0 to 11 flies / plant / 5 min. the maximum population recorded ranged from 2 to 9 bees /plant /5 min.

The other pollinators like as butter fly and moth were also recorded on mustard flowers. Their activity observed more in the afternoon (3.00 to 4.00 PM) with 1.31 Pollinators /plant/5 min. and 2.17 percent compared to forenoon (9.00 to 10.00AM) with 0.93 Pollinators / plant /5 min. and 1.71 percent of total population.

3. Result and Discussion

Different pollinators visited the mustard flowers during the present investigation at the student instructional farm, Kumarganj, Faizabad. The insects of order- hymenoptera namely; *Apis dorsata*, *Apis mellifera*, T. irridipennis were the major floral visitors belonging to family Apidae. The insects among this apidae family, *Apis dorsata* and *A. mellifera* were the most frequent visitors. Becides, *Musca domestica* and syrphid flies of order Diptera, butterflies and moths of Lepidoptera and other unidentify insects were also visited on the crop at flowering period. This is a partial agreement with the findings similarly, Ahmad and Srivastava (2002) [1] recorded eleven species of Hymenoptera viz.: *Apis cerana indica, A. dorsata, A. florea, A. mellifera, Xylocopa fenestrata, Halictus viridisima, Megachile femorata, Cressoniella relata, Cressoniella carbonaria, Cressoniella anthracina* and *Chalicodoma lanatum. A. dorsata* was not observed visiting the flowers of the early cultivars. A. florea was less active during the pre-winter months, but was most active on late cultivars in the post-winter period. *X. fenestrata* was also absent during the pre-winter months. The Cressoniella species were active during the pre-winter months, but were absent during the post-winter months on late cultivars. *Chalicodoma lanata* was more active in earlier than on late cultivars. Anonymous (2013, 2014 and 2015) [2-5] observed maximum number of pollinators in the afternoon followed by forenoon. The less sunshine hours or cloudy weather in day hours restricted the pollinators' visit Stanley *et al*., (2013) [9] observed the effect of the temperature, relative humidity and sunlight on the activity of visits of pollinators at 10:00 AM until 01:00 PM and this period can be characterized by higher sunlight and temperature with lower relative humidity periods. Kapkoti, *et al.,* (2016) [6] recorded various meteorological factors influenced the foraging activities of *A. cerana* significantly temperature showed positive relationship with foraging behaviour of honeybee. On the other hand, relative humidity showed non-significant negative relationship.

The present studies revealed that the abundance of insect pollinators were found maximum at 3.00-4.00 PM (Afternoon) with 31.56 pollinators /plant /5 min. followed by 8.93, 7.16, 5.0, 3.43, 5.31, and 0.93 pollinators /plant /5 min. in respect to forenoon (9.00-10.00 AM), 26.25 pollinators/plant 5 min., recorded as 24.25 pollinators/plant/5min. in noon (12-1.00 PM) 5.87, 3.75,5.00 3.43, 5.43 and 0.75 pollinators'/ plant /5 min respectively. The higher number of floral visitors in the evening can be attributed of favourable abiotic parameters of afternoon. Among the one species of honey bees, *A. dorsats* started foraging earlier followed by *A. mellifera* and weather factors also influenced the foraging activity of honey bees. Similar results were reported by Rath and Sihag (1993) [8] revealed that the honey bee species were more active from 11.00 h to 14.00 h, whereas, the solitary bees were more active later (12.00 to 15.00 h). Anonymous (2013, 2014 and 2015) observed maximum number of pollinators was 47.1 pollnators/plant/5 min in afternoon in respect to forenoon was 46.89 pollnators/plant/5 min.

4. Conclusion

The foraging activity of all *Apis sp* were varied from species to species at different day. The maximum average number of *A. dorsata* was noticed at 3.00 to 4.00 PM which decreased in the forenoon 9.00 to 10.00 AM and *A. mellifera* was maximum noticed at 3.00 to 4.00 PM with 14.1 foragers / plant / 5 min, which decreased in the forenoon 9.3 bee / plant / 5 min. and minimum population were recorded minimum in comparison to afternoon and forenoon respectively. Similarly, in case of *Trigona irridepennis* the foraging activity was maximum in the afternoon at 3.00 to 4.00 PM) with 5.2 bees / plant / 5 min, respectively. The foraging activities in both bees were lower in forenoon at 9.00 to 10.00 AM. With 9.3 and 3.7 bees/plant/5min. The number of syrphid flies gradually increased in the afternoon 3.00 to 4.00PM. (4.7 flies /plant /5 min). However, the number of the syrphid fly population was less recorded at 9.00 to 10.00AM (3.7 flies / Plant /5 min.) similarly, observation was recorded in case of house fly.

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6. Reference

1. Ahmad R, Srivastava DP. Relative visitation of Hymenopterans bees to rapeseed. Indian Journal of oilseeds Research. 2002; 15(2):203.
2. Anonymous. Annual Report, A.I.C.R.P.; National Seed Project (Crop), 2012-2013. ICAR-Directorate of Seed Research. Indian Council of Agricultural Research Kushmaur, Mau-275103 (U.P), 2013.
3. Anonymous. Annual Progress Report AICRP Rapseed-Msustard. Directorate of Rapeseed-Mustard Research: Bharatpur-321-303 (Raj.), India, 2013-14.
4. Anonymous. Annual Report, A.I.C.R.P.; National Seed Project (Crop), 2013-2014. ICAR-Directorate of Seed Research. Indian Council of Agricultural Research Kushmaur, Mau-275103 (U.P.), 2014.
5. Anonymous. Annual Report, A.I.C.R.P.; National Seed Project (Crop), 2014-2015. ICAR-Directorate of Seed Research. Indian Council of Agricultural Research Kushmaur, Mau-275103 (U.P.), 2015.
6. Kapkoti B, Rawal RS, Joshi RK. Insect pollinators of Brassica campestris in Kumaun, West Himalaya: influence of crop composition, altitude and flowering phenology. National Academy Science Letter. 2016; 39(5):389-394.
7. Pal S, Singh DK, Kumar S, Shekhawat CS, Kumar D. Seasonal abundance of insect-pests on mustard varieties (*Brassica spp*.) and relation to abiotic factors. Annals of Biology. 2015; 31(1):109-112.
8. Rathi A, Sihag RC. Differential attractiveness of *Brassica*

campestris L. and [*Cajanus cajan* L. (Millsp.)] to two honey bee species. Pollination in tropics: Proceedings of the International Symposium on pollination in tropics, Bangalore; India. 1993, 113-119.
9. Stanley DA, Gunning D, Stout JC. Pollinators and pollination of oilseed rape crops (*Brassica napus* L.) in Ireland: ecological and economic in centives for pollinator conservation. Journal of Insect Conservation. 2013; 17(6):1181-1189.