Indian Forester, 143 (10) : 1042-1045, 2017
http://www.indianforester.co.in

ISSN No. 0019-4816 (Print)
ISSN No. 2321-094X (Online)

PRELIMINARY STUDY ON DIVERSITY OF INSECT POLLINATORS IN NAVDANYA ORGANIC FARM, DEHRADUN, UTTARAKHAND, INDIA

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ABSTRACT

Situated adjacent to Shivaliks, foot hills of the Himalaya, the Navdanya Organic Farm (40 acres; 30°19'38.78"N, 77°52'30.83"E; 534 m asl) in Doon valley in the Uttarakhand state, India, is known for developing its own seed bank grown for nine crops that represent country's collective source of food security. The present communication reports a total of 19 insect pollinators belonging to five orders under 14 families from the farm during January to May, 2011, indicating rich insect pollinator diversity. The major pollinating species were Syrphid flies (Diptera: Syrphidae) (1521 individuals) followed by bees *Apis mellifera* (273) and *Apis florae* (121) (Hymenoptera: Apidae). *Daucus carota* (Carrot) had maximum number (19 species) of pollinating species, reaching a number of 852 individuals (36.4 % of the total) followed by *Citrus aurantifolia* (lemon) (12 species) and *Matricaria chamomilla* (chamomile) (12 species). This study generates baseline information about diversity of insect pollinators in Doon valley in a managed organic farm like Navdanya.

Key words: Biodiversity, Conservation, Organic farm, Doon valley, Pollination, Seed bank.

Introduction

Pollination by wild animals is one of the key ecosystem services and holds most important mechanisms in the maintenance and promotion of biodiversity and, in general, life on the Earth. It also benefits society by increasing food security and improving livelihoods (Eardley *et al*., 2006). Several ecosystems, including agro-ecosystems, depend on pollinator diversity to maintain overall biological diversity (Eardley *et al*., 2006). Seventy five per cent of the crops grown for human consumption rely on pollinators, predominantly bees, for a successful harvest (Tracy and Jessica, 2015). Bees alone are responsible for about eighty per cent to one hundred per cent of the pollination of crops, especially those related to the production of seeds and fruits (Rosemeire *et al.,* 2009).

Pollinators are extremely diverse, with more than 20,000 pollinating bee species and numerous other insect and vertebrate pollinators in the world (Eardley *et al*., 2006). Matheson *et al*. (1996) stated that although there are conclusive data that indicate 1200 wild vertebrate pollinators may be at risk due to declining population and data on the status of most invertebrate species that act as pollination agents is lacking. Worldwide, nearly 200 species of wild vertebrate pollinators may be on the verge of extinction (Nabhan, 1996), along with an indescribable number of invertebrate pollinators. The major pollinator dependent crops are fruit and vegetable crops, spices and plantation crops, pulses, oilseeds etc. (Gallai *et al.,* 2009). It has been estimated that the total annual economic value of crop pollination worldwide is about € 153 billion (Euro) (Gallai *et al.,* 2009). Klein *et al.* (2007) found that eighty seven of the world's leading food crops depend upon animal pollination, representing thirty five per cent of global food production.

Pollinators provide benefit to the society by increasing food security and improving livelihoods and due to their role in conserving biological diversity in agricultural and natural ecosystems (Nabhan *et al.,* 1996). Bees are considered as more efficient pollinators in comparison to others due to the presence of hairs on body and pollen basket present in the legs. A single honey bee can visit between 50 to 1,000 flowers in one trip and make between seven and fourteen trips a day (Tracy *et al.,* 2015). Losey and Vaughan (2006) also emphasized that flower-visiting insects provide an important ecosystem function to global crop production through their pollination services (Rosemeire *et al.,* 2009). Insufficient pollination is a major reason for reduction in agricultural yields and deformation in fruit rather than other agricultural inputs (Nabhan *et al.,* 1996). Keeping in view, the importance of pollinators and its association for crop production, the need was felt to access the diversity of insect pollinators in Navdanya Organic Farm (NOF), located in Doon valley, India.

A good number of pollinators indicates the productivity of area and health of ecosystem.

Material and Methods

Study area

The present study was carried out in 'Navdanya's learning center' or '*Bija Vidyapeeth*' (School of the Seed) on its Biodiversity Conservation and Organic Farm in Dehradun valley, Uttarakhand, India (30°19'38.78"N, 77°52'30.83"E; 534 m asl; 40 acres; Fig. 1). Navdanya means nine crops that represent India's collective source of food security. NOF was built on a land that had been degraded with more than two decades of *Eucalyptus* plantation and is now home to a rich variety of food crops.

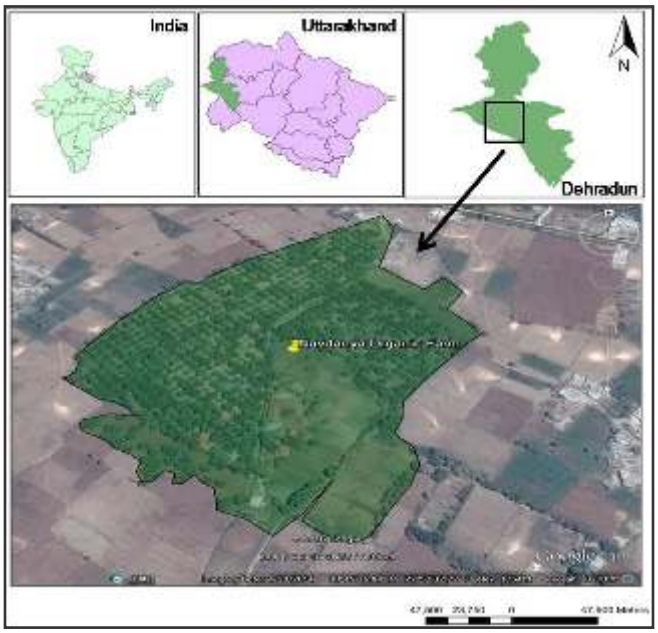

Fig. 1: Location of Navdanya organic farm, Dehradun, Uttarakhand.

Interestingly, more than twelve hundred varieties of plants now flourish on the farm, including five hundred rice varieties, seventy five wheat varieties, and diverse varieties of millets, pulses, oilseeds, vegetables and medicinal plants. The farm has its own seed bank spread over an area of 20 acres. In order to estimate the abundance and diversity of pollinators, visual surveys were carried out in the organic farm in four times in a day (after a gap of three hours) *i.e*. 8:30 am, 11:30 am, 2:30 pm and 5:30 pm, from January to May, 2011. The visual observations and direct counts were carried out in selected five plant species namely, Mango (*Mangifera indica)*, Carrot (*Daucus carota*), Lime (*Citrus aurantifolia*), Camomile (*Matricaria chamomilla*) and Fenugreek (*Trigonella foenum-graecum*) in flowering. Monitoring locations near the flowering crops were fixed and the pollinators visiting the flowers were observed and counted. All the species were photographed and the species which were unidentified in the field were collected using a net. The identification was done using Beeson (1941) and Kehimkar (2008).

Results and Discussion

A total of 19 species of insects belonging to five orders under 14 families were recorded in the farm (Table 1). Syrphid flies (Syrphidae) (1521 individuals) followed by (Apidae): *Apis mellifera* (273) and *Apis florae* (121) were recorded as the major pollinating species. The other pollinating species having the major role in pollination were lady beetle (*Harmonia* sp.); rock bee (*Apis dorsata*), housefly (*Musca domestica*) and members of Lepidoptera.

Table 1: List of insect pollinators visiting Navdanya organic farm in Dehradun valley (Jan-May, 2011).

S.No.	Order	Family	Common name	Scientific name
1.	Diptera	Tachinidae	Tachinid fly	*Hysticia abrupta*
	Diptera	Calliphoridae	Green bottle fly	*Lucilia sericata*
	Diptera	Tabanidae	March fly	*Scaptia* sp.
	Diptera	Muscidae	Housefly	*Musca domestica*
	Diptera	Muscidae	Lesser house fly	*Fannia canicularis*
	Diptera	Syrphidae	Drone fly	*Eristalis tenax*
	Diptera	Sarcophagidae	Flesh fly	*Sarcophaga* spp.
2.	Hymenoptera	Apidae	European bee	*Apis mellifera*
	Hymenoptera	Apidae	Rock bee	*Apis dorsata*
	Hymenoptera	Apidae	Dwarf bee	*Apis florea*
	Hymenoptera	Vespidae	Wasp	*Polistes* sp.
3.	Coleoptera	Coccinellidae	Lady beetle	*Harmonia* sp.
	Coleoptera	Chrysomelidae	Altica (blue beetle)	*Montipora* sp.
	Coleoptera	Erotylidae	Orange beetle	*Ischyrus quadripunctatus*
4.	Hemiptera	Pyrrhocoridae	Red cotton bug	*Dysdercus koenigii*
5.	Lepidoptera	Pieridae	Cabbage white	*Pieris brassicae*
	Lepidoptera	Pieridae	Mottled emigrant	*Catopsilia pyranthe*
	Lepidoptera	Pieridae	Grass yellow	*Eurema* sp.
	Lepidoptera	Nymphalidae	Blue glassy tiger	*Tirumala limniace*

Table 2: Major pollinators recorded on different crops in Navdanya organic farm, Dehradun (Jan-May, 2011).

S.No.	Crop	Botanical name	Family	Insect species (no.)	Major pollinators	Other pollinators
1.	Mango	*Mangifera indica*	Anacardiaceae	3	Syrphid flies	Lady beetle
2.	Fenugreek	*Trigonella foenum-graecum*	Fabaceae	5	Syrphid flies	Bees and Lady beetle
3.	Citrus	*Citrus aurantifolia*	Rutaceae	12	Bees	Lady beetle
4.	Camomile	*Matricaria chamomilla*	Asteraceae	12	Syrphid flies	Bees and Butterflies
5.	Carrot	*Daucus carota*	Apiaceae	19	Dwarf bees	Syrphid flies

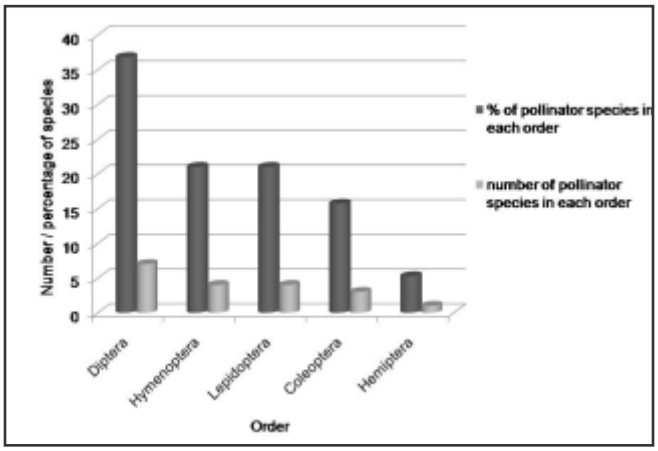

Fig. 2: Percentage of insect pollinators in different insect orders.

Carrot (*Daucus carota*), had the maximum number of pollinating species diversity with 19 species, reaching a number of 852 individuals which constituted 36.4% of the total number of pollinators visiting the farm. Though the number of the bee species was less in comparison to the Syrphid flies, in case of Carrot and *Citrus* spp. the pollination efficiency of the bees was more than flies. This is attributed due to the presence of hairs on body, pollen comb, pollen basket present in the legs of the bees. Hence, bees were considered as the major pollinators of Carrot and *Citrus* spp. in the farm. During the morning and evening sessions, diversity of Syrphid flies was very high (as reported in Carrot) during 8 to 9 a.m., and after that it starts declining which was replaced by the high population of bees, then eventually the number of Syrphid flies increased again with the onset of dawn. The highest population of the pollinators in the farm was found to be that of Syrphid flies which was, 65.1%, followed by dwarf bee, 11.69% and the lady beetle, 8.99%. In this study plant species, insect pollinators under Diptera was reported highest (36.8%) followed by both Hymenoptera and Lepidoptera having (21%) and Coleoptra having (15.7%) Fig.2. Major pollinators recorded in different crops of the farm are given in Table 2.

Conclusion

The richness in pollinator population provides more efficient pollination which results in sustainable crop productivity. A good number of pollinators shows that the area is ecologically balanced and biologically controlled and may be an indicator of a healthy environment. The study generates baseline information about diversity of insect pollinators in a managed organic farm like Navdanya located at the base of the lower western Himalaya.

नवदान्य आर्गेनिक फार्म, देहरादून, उत्तराखंड, भारत में कीट परागणकर्ताओं की विविधता पर प्रारंभिक अध्ययन

जिजू जे.एस., अमित कुमार और वी.पी. उनियाल

सारांश

उत्तराखंड राज्य, भातर में दून घाटी में शिवालिक, हिमालय की तलहटियों के समीप अवस्थित नवदान्य आर्गेनिक फार्म (40 एकड़ ; $30^0$19'38.78" उत्तर $77^0$52'30.83" पूर्व, 534 औसत समुद्र तल से ऊपर) नौ फसलों के लिए उगाए गए अपना स्वंय का बीज बैंक विकसित करने के लिए जाना जाता है, जो देश की खाद्य सुरक्षा के सामूहिक स्त्रोंत का प्रतिनिधित्व करते हैं। वर्तमान सूचना में जनवरी से मई, 2011 के दौरान फार्म से 14 कुलों के तहत पांच गणों से संबंधित कुल 19 कीट परागणकर्ताओं को सूचित किया गया है, जो समृद्ध कीट परागणकर्ता विविधता को दर्शाता है। प्रमुख पराग सींचित करने वाली प्रजातियां थी- *सीरफिड फ्लाइज* (डिप्टीरा : सीरफिडा) (1521 एकल) इसके बाद मधुमक्खियां *एपिस मीलिफेरा* (273) और *एपिस फ्लोरा* (121) (हीम्नोप्टीरा: एपिडा)। *डयूकस कैरोटा* (कैरट) में पराग सींचित करने वाली प्रजातियों की अधिकतम संख्या (19 प्रजाति) थी, जिसमें 852 एकलों की संख्या (कुल का 36.4%) थी, इसके बाद *सीट्रस औरेन्टिफोलिया* (लेमन) (12 प्रजाति) और *मेट्रिकेरिया केमोमिला* (केमोमिली) (12 प्रजातियां) में थी। इस अध्ययन में नवदान्य जैसे एक प्रबंधित आर्गेनिक फार्म में दून घाटी में कीट परागणकर्ताओं की विविधता के बारे में आधारभूत सूचना का सृंजन किया गया है।

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