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Research Paper

Assessment of Habitat Availability and Diversity of Insect Pollinators on Mix and Isolated *Allium cepa* L. of Patan Tehsil in Satara District of Maharashtra (India)

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A B S T R A C T

Habitat loss due to intensified and managed agriculture along with use of chemicals lead to the decline in biodiversity of insect fauna. As insect pollinators are important keys for reproduction and survival of some plant species. The research aimed to assess the impact of farming on availability of habitat for insect pollinator and their abundance in mixed and isolated *Allium cepa* L. crops. Insect found on these crops reflects the diversity and abundance in an area. Variation in diversity and abundance of mix and isolated onion crop was recorded during January to march 2019 over time and space the 16 species of insects belonging to 6 orders and 11 families. The insects belonging to hymenoptera were most abundant followed by diptera, coleoptera, orthoptera. Higher foraging activities of insect pollinators occur in the morning as the abiotic factors like temperature, moisture have impact on foraging population.

***Key words*:** *Allium cepa* L., Insect pollinators, Mixed crop, Diversity, Abundance

Allium is the genus of onion with about 1250 species of perennial bulbous plants. Onion is an important vegetable crop worldwide as used in various ways of food. India, second in worlds onion production grows onion in approximately 8,00,000 ha with an average productivity of 10 tons per ha [1]. To obtain optimum seed yield, farmers face problems. Onion flowers are not self-pollinating So, the out-crossing becomes more critical due to the protandrous nature of the onion plant [2]. Pollination is an essential supporting ecosystem service required by the majority of flowering plants; it has been estimated that 87.5% of angiosperms require biotic pollination [3]. In the absence of abundant pollinators onion does not produce good quality seed [4]. Pollinating agents specially insects make huge contribution to crop production. Up to 90% of all flowering plant species depends on insect for pollination as bees [5]. Blossoms of onion is highly attractive to insects [6]. Pollinators visit flowers for many reasons, including feeding, pollen collection and warmth. When pollinators like Hymenoptera and Diptera visit flowers, pollen rubs or drops onto their bodies. The pollen is then transferred to another flower or different part of the same flower as the pollinator moves from one location to another. A wide variety of organisms can act as pollinators including birds, bats, other mammals and most common insects [7]. Of the insects, large insects like bees are most important pollinators both in natural and agricultural systems [8] and small insects are also actively participated in pollination and are abundant within many crops [9]. The decline in honey bee pollinators has focused on population stability of other vertebrate pollinators. Over 200 species of vertebrate pollinators are on the way of extinction [10]. The decline in pollinator species affect on food stability and economics. In absence of insect pollinators approximately a third of the world`s crops would flower and then lie barren. Pollinators ensures yield and quality of fruits and vegetables.

Intercropping is growing different crops in same field. Intercropping has advantages such as reducing insect pest populations, increasing beneficial insects, and weed suppression. Also, non-crop plants such cover crops and habitat plantings can be combined in space and time to increase numbers of pest and beneficial arthropods on the main crop [11]. Floristic diversity ,abundance ,pollen quality and diversity of nesting resources plays important role in presence and diversity of various insects. The nesting resources includes various habitats, substrates and material for nest production. The majority of bee species dig narrow tunnel in ground for living that lead to brood cells. Other species use existing tunnels of large dead woody vegetation or chew out the pithy twigs of plants [12]. Bumblebees use abandoned rodents nests [13] however, a meta-analysis [14] of studies assessing the threats found that habitat loss are detrimental to the abundance and diversity of bees also the growing research has demonstrated that farms located close to natural areas can receive their pollination services from wild bees alone [15] the crop yield are high in areas [16]. Presence of insect pollinators within flowering of *Alium cepa* fields and their role is poorly studied in given area therefore the present study is conducted to assess the relative diversity and abundance of the pollinator on mixed and isolated onion crop also to assess habitat availability affects on presence of pollinator and to determine the most frequent onion flower insect visitors in the study sites

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MATERIALS AND METHODS

The survey of pollinator was done from five fields from three different sites of Patan tehsil during January to March 2019. The three fields were with mixed cropping one was mixed with sugarcane, one with wheat and other was with brinjal and two with isolated onion crop fields. The distances between two sites were more than 2 kilometers. 10 plants were randomly selected from the field of mixed cropping each and 10 plants of onion were selected from isolated onion crop field the selected plants were thoroughly examined for the population of pollinators. I observed management practice of field, moisture, vegetation around field, soil texture, cavities on plants as quality of habitat depends on environmental characteristics. Insects visiting to flowers in selected areas were collected by hand net with 30 cm ring diameter, preserved and identified with help of taxonomist. Abundance of different insect pollinators visiting *Alium cepa* flowers were recorded separately for mixed and isolated crop during peak blooming period at two days intervals on randomly selected 10 plants for 2 min.at 1 hour interval in morning and evening and expressed as mean number of pollinators visited per 10 plants for 2 min. Data collected from field work were subjected to analysis.

RESULTS AND DISCUSSION

In selected fields weeding was with the mechanical method no chemical fertilizers were used also farm varied with slopes in patches and presence of woody substrates, open soil around the field was observed.

Table 1 Pollinators on onion mixed with sugarcane

Common name	Scientific name	Family
	Order: Hymenoptera	
Little honey bee	*Apis florea*	Apidae
Giant honey bee	*Apis dorsata*	Apidae
European bee	*Apis mellifera*	Apidae
Giant black carpenter bee	*Xylocopa sp.*	Apidae
Sand tailed digger wasp	*Cerceris arenaria*	Crabronidae
Great black digger wasp	*Sphex pensylvanicus*	sphecidae
Carpenter ant	Camponotus sps.	Formicidae
	Order: Diptera	
Housefly	*Musca domestica L.*	Muscidae
Flesh fly	*Sarcophaga sp.*	Sarcophagidae
Hover fly	*Eristalis sp.*	Syrphidae
	Order: Hemiptera	
Yellow/ brown bug	Megacyllene antennata	Pentatomidae
Stink bug	Halyomorpha species	Pentatomidae
Firebug	Pyrrhocoris sp.	Pyrrhocoridae
	Order: Coleoptera	
Lady bird beetle	*Coccinella septumpunctata*	Coccinellidae
	Order: Orthoptera	
Cricket	*Gryllus compestris*	Gryllidae
	Order: Thysanoptera	
Thrips	*Thrips tabaci*	Thripidae

On *Allium cepa* mixed with sugarcane a total of 16 species of insect pollinators (Table 1) belonging to 6 different orders viz. Hymenoptera, Diptera, Coleoptera, Orthoptera, Thysanoptera were found. On *Allium cepa* mixed with wheat a total of 6 species of insect pollinators belonging to 3 families viz Hymenoptera, Diptera, Hemiptera were found (Table 2). On *Allium cepa* mixed with brinjal a total of 4 species belonging to 3 orders viz. Hymenoptera, Diptera, Coleoptera were found (Table 3).

Table 2 Pollinators on onion mixed with wheat

Common name	Scientific name	Family
	Order: Hymenoptera	
Little honey bee	*Apis florea*	Apidae
Giant honey bee	*Apis dorsata*	Apidae
Great black digger wasp	*Sphex pensylvanicus*	sphecidae
	Order: Diptera	
Housefly	*Musca domestica* L.	Muscidae
Hover fly	*Eristalis sp.*	Syrphidae
	Order: Hemiptera	
Firebug	*Pyrrhocoris sp.*	Pyrrhocoridae

Table 3 Pollinators on onion mixed with Brinjal

Common name	Scientific name	Family
	Order: Hymenoptera	
Little honey bee	*Apis florea*	Apidae
Giant honey bee	*Apis dorsata*	Apidae
Giant black carpenter bee	*Xylocopa sp.*	Apidae
	Order: Diptera	
Housefly	*Musca domestica* L.	Muscidae
	Order: Coleoptera	
Lady bird beetle	*Coccinella septumpunctata*	Coccinellidae

On the other hand, total of 3 species of insect pollinators belonging to 2 different order viz. Hymenoptera, Diptera were found on isolated onion crop (Table 4). It was observed that the maximum diversity of pollinators was in the *Alium cepa* mixed with sugarcane crop as it was surrounded by different plants, fence, slopes in paths, which was followed by *Alium cepa* mixed with wheat, *Alium cepa* mixed with Brinjal. It was observed that isolated *Allium cepa* shows less diversity of pollinators as less availability of habitat was there.

Table 4 Pollinators on isolated onion crop

Common name	Scientific name	Family
	Order: Hymenoptera	
Little honey bee	*Apis florea*	Apidae
Giant honey bee	*Apis dorsata*	Apidae
	Order: Diptera	
Housefly	*Musca domestica* L.	Muscidae

During study all together 6 orders of insects viz. Hymenoptera, Diptera, Hemiptera, Coleoptera, Orthoptera and Thysanoptera were recorded from different crop fields. Among these Hymenoptera were recorded in highest number with 7 species belonging to 4 families, Diptera with 3 species belonging to 3 families, Hemiptera recorded with 3 species belonging to 2 families, Coleoptera with 1 species belonging to 1 family also the order Orthoptera and Thysanoptera were with 1 species each belonging to 1 family each. Hymenoptera

were recorded in highest number followed by Diptera, Hemiptera, Coleoptera, Orthoptera and Thysanoptera respectively (Table 1). The order Hymenoptera composed of 44%, Diptera composed of 19%, Hemiptera composed of 19%, Coleoptera, Orthoptera and Thysanoptera composed of 6% each of total recorded insect pollinator species (Fig 2).

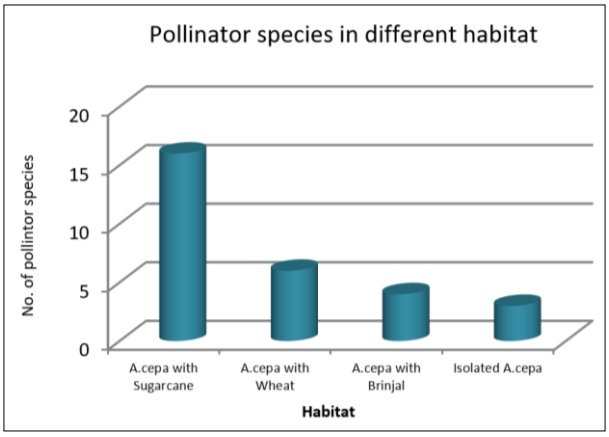

Fig 1 Variation of pollinator species found at different habitat

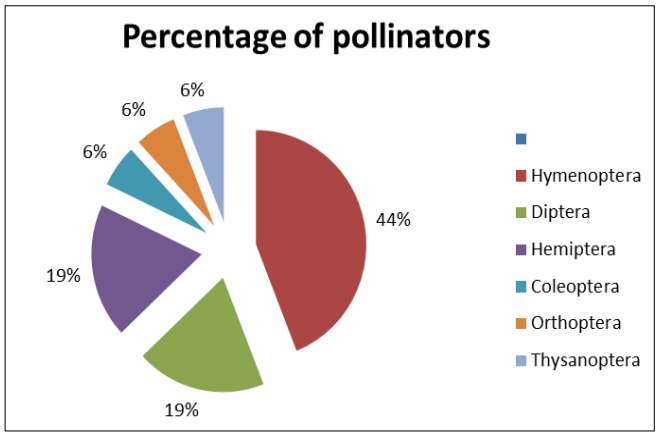

Fig 2 Order wise percentage of pollinators on *A. cepa* with sugarcane

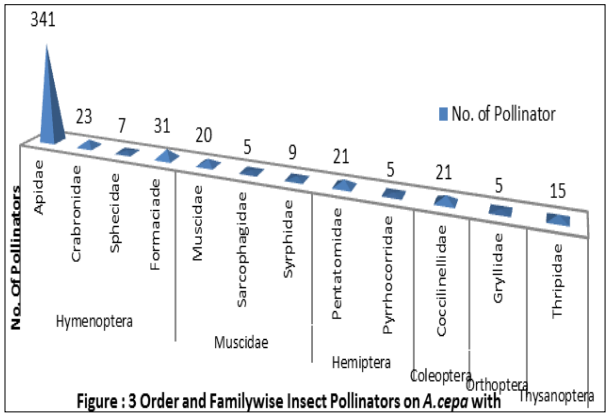

Fig 3 Order and family wise insect pollinators on *Allium cepa* with sugarcane

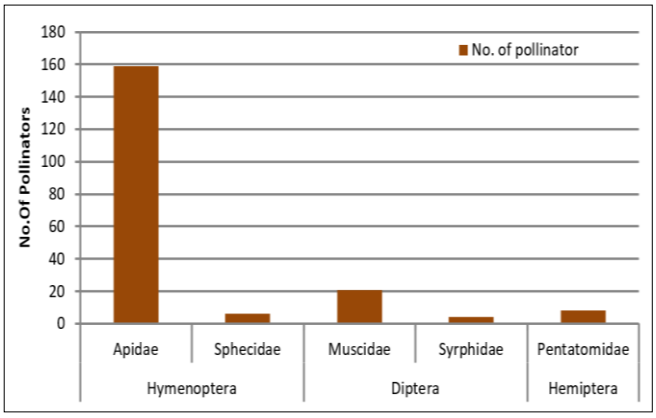

Fig 4 Order and family wise insect pollinators on *Allium cepa* with wheat

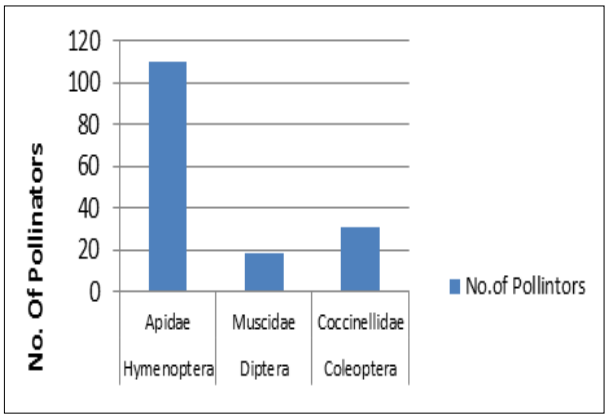

Fig 5 Order and family wise insect pollinators on *Allium cepa* with brinjal

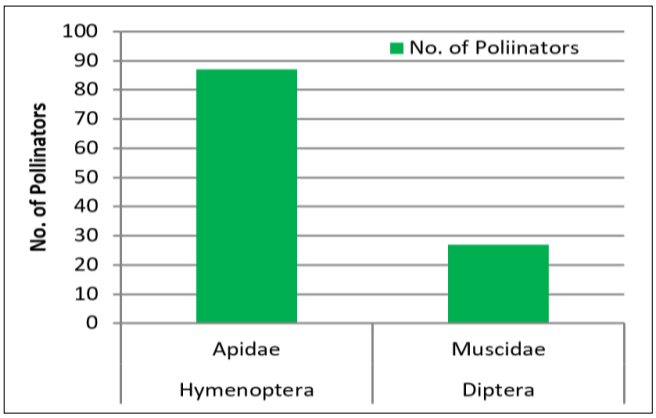

Fig 6 Order and family wise insect pollinators on isolated *Allium cepa*

It has been observed that intensive agriculture is the leading cause of local bee decline [17] with decreasing landscape heterogeneity pollinator richness will decline [18] also habitat destruction and fragmentation are negatively affect on pollinators [19-20]. The removal of vegetation mechanically or by spraying herbicides results in destruction of food sources in agriculture that provides the food for pollinators especially when the food crops are not in bloom [21]. There is evidence from Great Britain that heterogeneity of the surrounding habitat may buffered long-term declines in richness at local site levels [22], so the combination of heterogenous landscapes and large patches will help to maintain high bee species richness and communities with diverse trait composition, that may stabilize pollination services for both crops and wild plants on local and landscape scales [23]. Diversity of pollinators get vary [24] reported the abundance of *Apis dorsata*, *Episyrphus baltiatus* as 2.85 ± 1.57 and 14 ± 4.61 individuals / 25 plants respectively.

CONCLUSIONS

The aim of study was to assess the diversity and abundance of important insect pollinators on mixed and isolated *Alium cepa* to help for pollination in Patan Tehsil. Study revealed that as compared to isolated crops number of pollinators are more on mixed crops as supporting flora and nesting habitat is around and will help in finding efficient pollinators for increasing crop yield. So, farmers must be aware regarding the habitat management of insect pollinators as destruction of food sources, destruction of nesting or oviposition sites and destruction of resting or mating sites affects pollinator population. They should avoid the monocultures, land clearing, overgrazing etc. so that they can restore diversity of pollinator for enhancement of crop yield.

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