

Original Research Article

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Insect Pollinator Diversity in Major Traditional Leafy Vegetables Kale (*Brassica oleracea* var. *acephala*) and Knol Khol (*Brassica oleracea* var. *gongylodes*) of Kashmir Himalayas

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ABSTRACT

Keywords

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The present investigation was conducted at vegetable seed production unit, Division of vegetable Science, Shuhama campus, SKUAST-Kashmir during 2014-15 on leafy vegetables viz., knol kohl and kale crops. The pollinator fauna of both the vegetables were collected and studied for their foraging ecology and behaviour during the study period. There are various threats to pollinator diversity in modern agriculture. Our focus was to record the insect diversity under present scenario. The collected pollinators/visitors of knoll khol and kale were identified and total of 15 insect pollinators/visitors belonging to orders and families of class insect were recorded from knoll khol bloom while as 17 insect pollinators/visitors belonging to orders and 10 families were recorded from kale bloom. Among all pollinator, Hymenopterans were most predominant contributing 91.64% of total pollinators on knoll khol and 90.04% of total pollinators on kale.

Introduction

Kale (*Brassica oleracea* var. *acephala*) and Knol khol (*Brassica oleracea* var. *gongylodes*), are widely used in Kashmir as vegetables. In Kashmir, these are popular vegetables both among rich and poor and grown in almost all kitchen gardens and also as a commercial crop around cities and towns. Kale grown in Kashmir is popularly known as 'HAK' and Knol khol as 'MONJE HAK'. In Kashmir, Kale and Knol Khol are grown round the year but they shine most as cold winter crops and are at their most flavourful and tender condition during winter months. The area under Kale crop in Kashmir valley is

nearly 3600 ha with an annual production of 1,06,780 tonnes while as area under Knol Khol crop in Kashmir valley is 4,500 ha with an annual production of 1,28,850 tonnes (Anonymous, 2012). These traditional vegetables are under cultivation since ancient times. In India, kale is not being grown as a vegetable crop for commercial use, however it is commercially grown in Kashmir and to a limited extent in Jammu, Assam, and Himachal Pradesh (Choudhary, 1977). Also knol khol is popularly grown in Kashmir, West Bengal, Maharashtra, Assam, Uttar Pradesh, Punjab and some parts of south India, but it is not cultivated commercially. Knol khol is an herbaceous plant, edible portion of

which is the swollen stem just above the ground. The small leaves grow out of this stem *arranged* in compressed spiral on this bulbous part (Nath *et al.*, 1994). This knob is harvested for human consumption as raw or cooked vegetables, though in some parts, young leaves are also used. They are highly nutritious vegetables like other members of Brassica family, rich in vitamins particularly vitamin C, pro vitamin A and minerals such as calcium phosphorus, potassium, magnesium, etc. and are excellent source of fiber. They contain health promoting phytochemicals such as isothiocyanates, sulforaphane, and indole-3-carbinol that are supposed to protect against prostate and colon cancers and have high amount of total nitrogen, raw proteins, fats, carbohydrates and amino acids. Both crops are rich in leucine, isoleucine, arginine, phenylalanine and lysine while equally good in threonine, tryptophan and histidine. Daily consumption of leafy vegetables lowers the risk of cancer and heart diseases, prevents tiredness, helps keeping well condition and prevents senescence (Kolton and Baran, 2008).

These crops are grown both during kharif and rabi season but for seed production only rabi crop is taken. Crop matures before the arrival of cold, flowering occurs in the month of March and in June-July seeds are harvested. Length of photoperiod has no significant effect on induction of flowering, but most brassicas require vernalization for flowering and seed setting. Vernalization requires exposure to a temperature of 39 to 50°F (4 to 10°C) for at least four to six weeks (McCormack, 2005). Brassica flowers are hermaphrodite and are borne in racemes. These flowers open during the early hours of daylight and few hours later, the anthers dehisce exposing their pollen but the stigma is receptive for about five days prior to anthesis and up to four days after anthesis and during this time period cross-pollination is obligatory

(McCormack, 2005). These crops are highly cross-pollinated (Kale 83% and Knol khol 91%) and mode of pollination is entomophily. The most effective pollinators are bees and flies. These crops have limited blooming period and due to the variable environmental conditions the potential of bees are not harnessed to their maximum due to which there is reduction in seed yield of the crop. Attempts are to be made to increase bee visits to the crop in the limited favourable period which will increase the seed yield.

Materials and Methods

To achieve the set objectives the following experiments was carried out at vegetable seed production unit, shuhama campus, SKUAST-K and the study were made on crops (Kale and Knol khol), raised during Rabi season of 2013-2014. The experimental site was situated at a distance of about 8 Km from Shalimar campus, SKUAST-K. It is located at latitude of 34.23° North and longitude of 74.78° East and 1616 m (5302 ft) above mean sea level. The study was made on the kale and knol khol fields raised during 2013-14. The experimental plot was kept free from any spray during flowering period. Five spots of 1 m² area were selected randomly for observation. Observations were made for different groups of pollinators visiting these crops during peak flowering at 1000 to 1100 hr., 1200 to 1300 hr. and 1400 to 1500 hr. for five minutes in each of the selected spots. Also unidentified pollinators were collected by using standard insect collecting hand net and were pinned, labelled and later identified. The collected data was later subjected to statistical analysis to infer the pollinator fauna as well as the dominance/relative abundance of particular group. Relative abundance of dominant species of pollinator was worked out by using the following formula after pooling all the data given by Nath and Virakthamath, 2010.

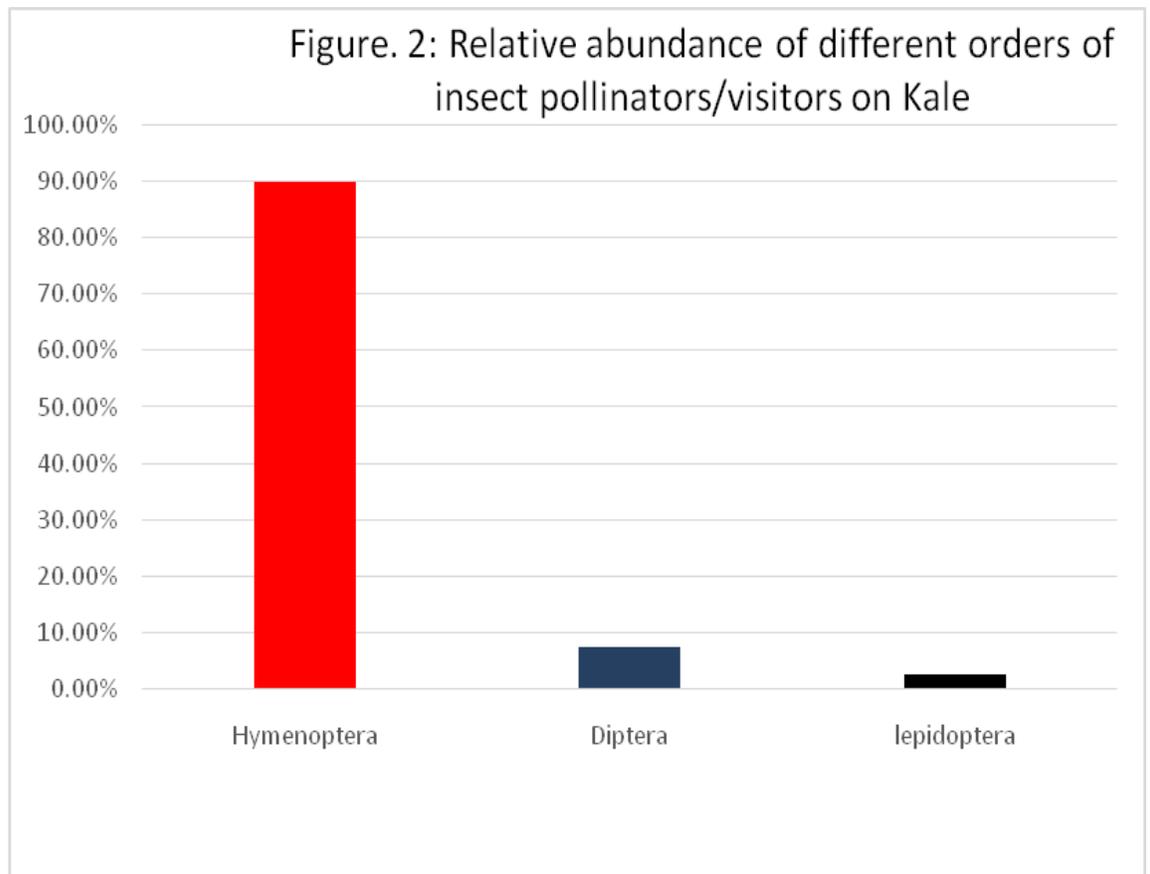
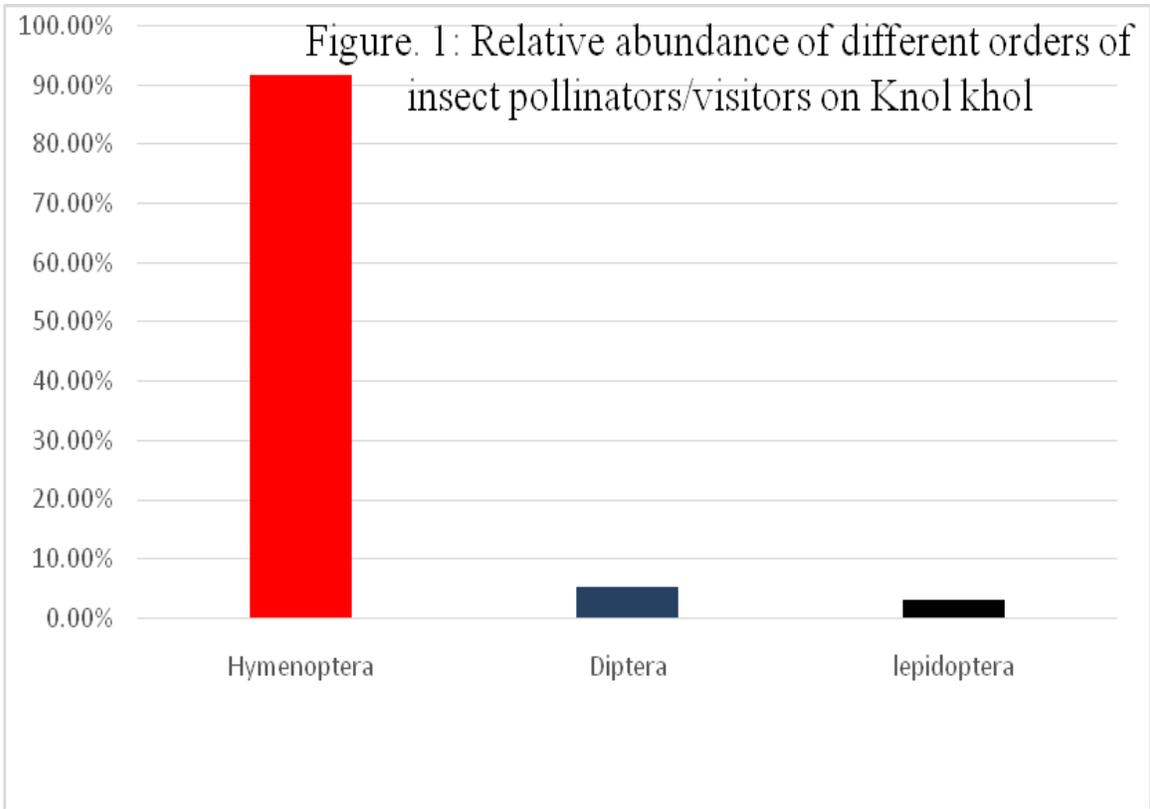


Table.1 Insect pollinators/visitors identified on Knol khol

S no.	Pollinator/visitor	Systematic position	Relative abundance of insect orders (%)	Relative abundance of pollinators (%)
1.	<i>Lasioglossum marginatum</i>	Halictidae: Hymenoptera	91.64	38.2
2.	<i>Apis cerana</i>	Apidae: Hymenoptera		27.09
3.	<i>Apis mellifera</i>	Apidae: Hymenoptera		20.13
4.	<i>Andrena spp.</i>	Andrenidae: Hymenoptera		
5.	<i>Xylocopa valga</i>	Apidae: Hymenoptera		
6.	<i>Eristalodesparia</i>	Syrphidae: Diptera	5.24	14.58
7.	<i>Eristalis tenax</i>	Syrphidae: Diptera		
8.	<i>Eoseristaliscerealis</i>	Syrphidae: Diptera		
9.	<i>Sphaerophoriabengalensis</i>	Syrphidae: Diptera		
10.	<i>Metasyrphusbacculatus</i>	Syrphidae: Diptera		
11.	<i>Plecia spp.</i>	Bibionidae: Diptera	3.12	
12.	<i>Scathophaga spp.</i>	Scathophagidae: Diptera		
13.	<i>Callophora sp.</i>	Callophoridae: Diptera		
14.	<i>Vanessa cordui</i>	Nymphalidae: Lepidoptera		
15.	<i>Pierisbrassicae</i>	Pieridae: Lepidoptera		
	<i>Danauschrysisphus</i>	Danidae: Lepidoptera		

Table.2 Insect pollinators/visitors identified on Kale

S no.	Pollinator/visitor	Systematic position	Relative abundance of insect orders (%)	Relative abundance of pollinators (%)
1.	<i>Lasioglossum marginatum</i>	Halictidae: Hymenoptera	90.04	38.31
2.	<i>Apis cerana</i>	Apidae: Hymenoptera		26.67
3.	<i>Apis mellifera</i>	Apidae: Hymenoptera		17
4.	<i>Andrena spp.</i>	Andrenidae: Hymenoptera		
5.	<i>Xylocopa valga</i>	Apidae: Hymenoptera		
6.	<i>Bombus tunicatus</i>	Apidae: Hymenoptera	7.31	18.02
7.	<i>Eristalodesparia</i>	Syrphidae: Diptera		
8.	<i>Eristalis tenax</i>	Syrphidae: Diptera		
9.	<i>Eoseristaliscerealis</i>	Syrphidae: Diptera		
10.	<i>Sphaerophoriabengalensis</i>	Syrphidae: Diptera		
11.	<i>Metasyrphusbacculatus</i>	Syrphidae: Diptera	2.67	
12.	<i>Plecia spp.</i>	Bibionidae: Diptera		
13.	<i>Scathophaga spp.</i>	Scathophagidae: Diptera		
14.	<i>Callophoraspp.</i>	Callophoridae: Diptera		
15.	<i>Bombyliinisp.</i>	Bombyliidae: Diptera		
16.	<i>Vanessa cordui</i>	Nymphalidae: Lepidoptera		
17.	<i>Pierisbrassicae</i>	Pieridae: Lepidoptera		

Relative abundance of pollinator = (Number of individuals of pollinator visiting flowers / Total no. of pollinators visited) x 100

The weather data like temperature, humidity, wind speed and sunshine were also recorded to correlate with the presence of pollinators.

Results and Discussion

Pollinators of KNOL Khol:- Insect pollinators collected from the bloom of knol khol during the year 2014 are listed in Table 1. A total of 15 insect pollinators/visitors belonging to 3 orders and 10 families of class insecta were recorded on knol khol bloom from Faculty of veterinary science Shuhama campus, SKUAST-K. Out of these, 5 pollinators belonged to Hymenoptera, 8 to Diptera and 3 to Lepidoptera. It was observed that among 5 hymenopteran pollinators, 4 were identified upto species viz., *Lasioglossum marginatum*, *Xylocopa valga*, *Apis cerana*, *Apis mellifera* and one upto genera viz., *Andrena spp.* represented by three families Halictidae, Andrenidae and Apidae. Out of 8 Dipteran insects, 5 pollinators were identified upto species viz., *Eristalodesparia*, *Eristalis tenax*, *Eoseristalis tenax*, *Sphaerophoria bengalensis*, *Metasyrphus bacculatus* and 3 upto genera viz., *Plecia spp.*, *Scathophaga spp.* And *Callophora spp.* Which Belonged to 4 families, Syrphidae, Bibionidae, Scathophagidae and Callophoridae. In case of Lepidoptera only 3 species were identified viz., *Pieris brassicae*, *Danaus chrysippus* and *Vanessa cordui* belonging to 3 families, Nymphalidae, Pieridae and Danidae.

Relative abundance of insect pollinators/visitors on knol khol bloom

The total number of insect pollinators/visitors species recorded on kale bloom was 15, out of which 5 belonged to Hymenoptera and constituted 91.64% of total pollinators, 8 to

Diptera contributing 5.24% of total pollinators and 3 to Lepidoptera which contributed only 3.12 % to total pollinators. Among Hymenopterans *Lasioglossum marginatum* was the most dominant pollinator constituting 38.20% followed by *Apis cerana* which constituted 27.09%, and *Apis mellifera* constituting 20.13% while rest of the pollinators collectively constituted only 14.58% and were categorized as other pollinators (Table 1, Fig. 1). Investigations carried out on the pollinator fauna visiting Knol khol bloom revealed that three groups of pollinators belonging to different orders of class insecta visited the Knol khol during flowering period. Among different insect orders observed, Hymenopterans (5 species) were the most abundant group (Fig. 1) constituting 91.64%, followed by Dipterans (8 species) 5.24% and Lepidopterans (3 species) 3.12%. These findings are in close agreement with Sihag (1986) who reported nine species of Hymenopterans, six species of Lepidopterans and three species of Dipterans as predominant visitors of radish flower, out of which Hymenopterans were most abundant. Similar results were also reported by Priti *et al.*, (2001) on radish flowers. Investigations carried out on the pollinator fauna visiting Kale bloom revealed that three groups of pollinators belonging to different orders of class insecta visited the Kale during flowering period (Table 2). Among different insect orders observed, Hymenopterans (6 species) were the most abundant group (Fig. 2) constituting 90.04%, followed by Dipterans (9 species) 7.31% and Lepidopterans (2 species) 2.67%. These findings are in close agreement with Sihag (1986) who reported nine species of Hymenopterans, six species of Lepidopterans and three species of Dipterans as predominant visitors of radish flower, out of which Hymenopterans were most abundant. Similar results were also reported by Priti *et al.*, (2001) on radish flowers.

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