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SHORT COMMUNICATION

WINTER SEASON BLOOMER HAIRY BERGENIA *BERGENIA CILIATA* (HAW.) STERNB. (SAXIFRAGALES: SAXIFRAGACEAE), AN IMPORTANT WINTER FORAGE FOR DIVERSE INSECT GROUPS

Aseesh Pandey, Ravindra K. Joshi & Bhawana Kapkoti Negi

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WINTER SEASON BLOOMER HAIRY BERGENIA *BERGENIA CILIATA* (HAW.) STERNB. (SAXIFRAGALES: SAXIFRAGACEAE), AN IMPORTANT WINTER FORAGE FOR DIVERSE INSECT GROUPS

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Abstract: Pollinators can play an important role in production improvement in organic farming. It is, therefore, essential to ensure their year-round availability, particularly in winter season in Sikkim Himalaya. Thus, attempts were made to explore resources which could support and provide switching over platforms to pollinators during the winter season. Among the few observed forage species, *Bergenia ciliata* was found to be an important species that supports a diverse group of pollinators by providing the necessary forage. Therefore, *B. ciliata* is to be protected and managed to provide forage to pollinator insects during winter season.

Keywords: Eastern Himalaya, insect diversity, pollination management.

In agro-ecosystems, availability of insect pollinators is essential for improved production, as they benefit the yields up to 75% of globally important crop species (Klein et al. 2007). Worldwide, the value of insect pollination services to agriculture is estimated to cost around 153 billion Euro per annum (Gallai et al. 2009). Sikkim, recently inscribed as the first organic state of India, has subtropical to temperate and alpine type of climatic conditions with an elevation range from 300m to 8,500m. This eastern Himalayan state is

situated between 27°04'46"–28°07'48" N & 88°00'58"–88°55'25" E and internationally bordered by Tibet to the north-east, Bhutan to the south-east and Nepal to the west (Pandey et al. 2018). Being an integral part of the global Biodiversity Hotspot (Myers 2000), Sikkim harbors approximately 5,580 plant species (SBAP 2012). The livelihoods of inhabitants mostly (75%) depend on agriculture and contributes about 17% to the gross domestic production of the state (Kumar 2012). Mostly, the low elevational agricultural landscapes are utilized for double crop production while the higher landscapes are utilized for single crop production (Sundriyal et al. 1994). Sikkim possesses a rich agro-biodiversity that consists of about 132 species of vegetables; more than 126 landraces of cereals, 38 spices/condiments; 34 cultivars of pulses and beans; and 18 cultivars of oilseeds; (Sharma et al. 2016) within 7,096 km². Inhabitants, however, prefer to grow low-land high-incentive crops like large cardamom, *Amomum subulatum* and other entomophilous crops like cucurbits, vegetables and flowers for livelihood, which have varying levels of

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pollinator dependency (Pratap et al. 2012; Gaira et al. 2016).

Being the first organic state of the country, Sikkim has to evolve methods that can compensate the input costs without hampering the yield. Garibaldi et al. (2016) have demonstrated how ecological intensification can create synchronous biodiversity and yield outcomes in small and large farms of pollinator-dependent crop systems. Although the state policy has provisions that can be considered pollinator friendly, yet it lacks any mention of pollinators, pollination services and pollination management (SPOF 2015). As agro-ecosystems are turning into more profitable cultivation of cash crops largely comprising entomophilous ones, the management of pollination services has become a cause for concern in recent times. It has been observed that flowering resources not in synchrony with crop bloom can play a crucial role in pollination management and need to be identified because year-round availability of foraging resources is important to maintain the pollinator abundance and richness (Kapkoti et al. 2016a). In view of the above this study was attempted to find such important non-crop forage species which can be managed along the agro-ecosystems to support sustaining pollinator population.

MATERIALS AND METHODS

During the winter months (i.e., January–March), different surveys were conducted in nearby areas of Fambong Lho Wildlife Sanctuary (27°21'50.89"N and 88°34'07.54"E; 2,025m), East Sikkim, eastern Himalaya, India. Among the few blooming forage species, *Bergenia ciliata* Sternb (Saxifragaceae), locally known as Pakhanbhed was observed to be visited by a diverse group of insects. Data on insect visitation was recorded to assess the importance of *B. ciliata* as a potential winter forage resource by following Kapkoti et al. (2016b) with some modifications. Populations of *B. ciliata* were identified near the Fambong Lho Wildlife Sanctuary and weekly data on visiting insect diversity and visitation pattern were collected for one month. Observations were recorded for 30 minutes each during 11.00–11.30 h and during 16.00–16.30 h on both sunny and cloudy days. A total of 500 flowers were monitored during the main flowering period of *B. ciliata* and insect visitors were photographed for identification.

RESULT AND DISCUSSION

The flowers of *B. ciliata* were visited by a diverse group of insects (Fig. 1, Image 1). A total of eight insect visitors were observed within the monitoring

Table 1. Insect visitors of *Bergenia ciliata*.

Common name	Scientific name	Order	Family
Honey Bee	<i>Apis cerana</i>	Hymenoptera	Apidae
Bumble Bee	<i>Bombus</i> sp.	Hymenoptera	Apidae
Wasp	<i>Vespula</i> sp.	Hymenoptera	Vespidae
Syrphid	<i>Eristalis tenax</i>	Diptera	Syrphidae
Hoverfly	-	Diptera	Syrphidae
House Fly	<i>Musca domestica</i>	Diptera	Muscidae
Painted Lady	<i>Cynthia cardui</i>	Lepidoptera	Nymphalidae
Tortoise Shell	<i>Aglaia cashmirensis</i>	Lepidoptera	Nymphalidae

time (Table 1). Maximum number of forager species were recorded on sunny days. Mostly the flies, *Musca domestica* and *Aglaia cashmirensis* visited the flowers to forage on cloudy days (Fig. 1). Overall, the maximum average density and flower visitation time was recorded for insects belonging to the order Diptera (Table 1). Species belonging to order Diptera are reported to visit more than 550 species of flowering plants regularly and considered potential (Larson et al. 2001) or primary pollinators for many plant species, both wild and cultivated (Szymank & Kearns 2009). *Bergenia ciliata* blooms in winter with an extended flowering time from January–April, this provides a valuable alternative to foraging pollinators, when resources start dwindling and become scarce successively in winter. The flowering in *B. ciliata* continues to support till spring, when resources like, large cardamom and others start flowering. Kapkoti et al. (2016b) stated that non-cropping species play a key role in ensuring pollinator abundance and existence of natural habitats that help in the proliferation of diverse floral elements with variation in flowering phenologies. In this context, it is appropriate to recommend *B. ciliata* for cultivation across the farms to play its role in ensuring pollinator availability in the habitat.

Besides, *B. ciliata* is also a well-recognized herbal medicine and widely used in the local traditional medicinal practices across Bhutan, India Nepal, Pakistan and some other countries (Shrestha & Joshi 1993; Rai et al. 2000). This deciduous medicinal herb grows up to 50cm tall in rocky and stony habitats with an extensive distribution range from 1,500–3,000 m in Sikkim and other temperate regions of Himalaya (Rai et al. 2000; Sanghamitra et al. 2001). Terrace cropping system is commonly opted in Sikkim and the habitat characters of *B. ciliata* can be utilized to manage this species along the fringes of agricultural terraces in integrated cropping mode. This approach will create an opportunity for the

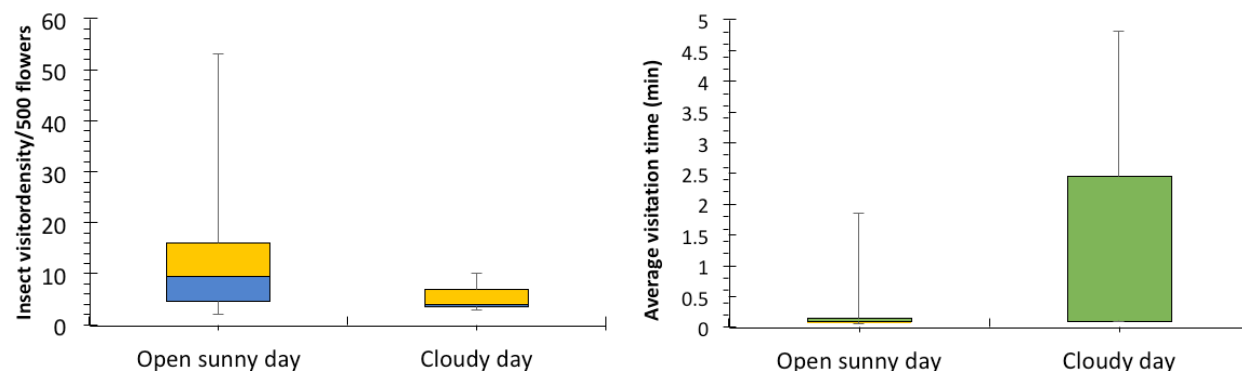


Figure 1. Insect visitor density and visitation time in *B. ciliata* during open sunny day and cloudy day: A - insect visitor density | B - insect visitation time (Data was collected for one month (30min each day)).



Image 1. Insect visitor diversity of *Bergenia ciliata* during dearth period: A - Syrphid | B - Hover Fly | C - Honey bee | D - Tortoise shell | E - Painted lady | F - House fly. © Aseesh Pandey.

farmers to succeed. This integrated management plan can be implemented between 1500m and 3000m to cover altitudinally diverse crops and to address the issue of the organic produce and sustainable utilization of *B. ciliata*.

Recommendations

A cautious approach is required to ensure year-round availability of pollinators along the agro-ecosystems. We recommend inclusion of crop-pollinator interactions in the Sikkim state policy on organic farming, with clear mention of pollination and pollinators to strengthen its second principle i.e. ecology (management of ecological processes), which is essential for fruit and seed set.

Furthermore, a comprehensive calendar of non-crop foraging resources needs to be developed, with special mention of high value species like *B. ciliata*, which could benefit the community with multiple ways through provisioning of improved goods and services.

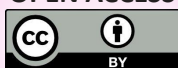
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