

Floral management for pollinator conservation bee restaurants

pollinators provide us food, in-turn can we?

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Almost 98% of tropical and 78% of temperate plants in the world require animal pollination. These pollinators move to flowers in search of their food i.e pollen and nectar and in turn pollinate them. Many of the insect pollinators other than honeybees do not store food and thus require food source throughout the year. To manage this, floral availability throughout the year needs to be documented first in the form of floral calendar. The floral calendar depicts dearth periods with low flower availability to pollinators in the region and thus management practices can be taken. Crop diversification, slight changes in cropping pattern, promotion of mixed-cropping, agroforestry and crop production along with natural ecosystems and forest fragments can conserve pollinators. When natural habitat is disturbed, growing of ornamental plants like sunflower, marigold, cosmos, cuphea, zinnia and climber like campsis, shrubs like hibiscus, lagerstroemia and ligustum near houses and on-farm road sides, also provided food to pollinators during dearth and conserve them.

Key words: Conservation, Floral management, Food, Pollinators

FOOD is basic need for the survival of any living organism. Most of the insect pollinators visit flowers for getting their food (pollen and nectar) and during the course they intentionally or unintentionally pollinate crops. Of these, some pollinators like honeybees are potent enough to store excess of food in their hives for use during dearth. This excess store of honeybees is extracted during honey flow period as honey. Due to one or other reason, if food is not available to bees for some period, they can manage to sustain on their reserve stocks. But all pollinators do not possess this quality. Besides honeybees, all other pollinators have to struggle for food throughout the year. They can feed as long as they visit flowers otherwise remain hungry. The insect pollinators

especially the bumble bees are driven to the brink of extinction because of scarcity of floral resources. Thus year round availability of sufficient pollen and nectar containing flowers is essential for the sustenance of these pollinators. But most crop plants or even wild flora bloom seasonally and remain for short duration in the field. So, there is a need to manage the availability of flora to provide food and conserve the pollinators.

Cropping pattern and floral calendar

In general, agricultural crops are grouped based on the cropping season - *kharif* and *rabi*. Important crops of *kharif* are rice, maize, finger millet, buckwheat, soybean, horsegram, pigeonpea, frenchbean, tomato, capsicum etc. Of these, buckwheat and pigeonpea attract/

draw insect pollinators more as evident by large number of pollinators visiting these crops during blooming. Similarly, crops grown during *rabi* include wheat, barley, lentil, pea, *toria*, coriander, onion, garlic etc. out of which *toria* and onion grown for seed are more attractive to pollinators and provide pollen and nectar. Coriander also attracts some pollinators especially syrphids and other flies. All these crops are seasonal and available in some intervals during a year. Thus, floral management becomes desirable for promoting pollinators and conserving them. Apart from honey bees, many other pollinators are also found to pollinate crop plants. A concise list of pollinators/ flower visitors of some of the crops is given in Table 1.

Table 1. Flower visitors or pollinators on their corresponding plants

Plants	Flower visitors/ Pollinators
Mustard/ toria	Indian bees, Italian bees, syrphids, flies, wasps, butterflies, andrena bees and moths.
Coriander	Indian bees, Italian bees, houseflies, syrphids, nomia bees, wasps and ants.
Onion	Indian bee, Italian bee, wasps, carpenter bee, bumble bee and butterflies.
Cucurbits	Indian bees, Italian bees, sweat bees and beetles.
Pigeonpea	Megachilid bees, Amegilla bees, nomia bees, wasps, carpenter bees and bumble bees.
Buckwheat	Indian bees, Italian bees, wasps, butterflies, syrphids, flies, beetles and ants.
Radish	Butterflies, leaf cutter bees, Andrena bees, moths, Italian bees, Indian bees, carpenter bees, wasps and bumble bees.
Cabbage/cauliflower	Italian bees, Indian bees, ceratina bees, butterflies and wasps.
Fenugreek	Italian bees, Indian bees and syrphids.
Tomato	Amegilla, carpernter bee and bumble bees.

For the conservation of these diverse insect pollinators food should be made available throughout the year. Before we think of food management, it is necessary to have acquaintance with the flora already existing in our fields which provides pollen and nectar to bees and other pollinators. Thus a calendar (Fig. 1 and 2) can be designed where initiation and cessation of bloom of all these crops are mentioned.

This calendar has several advantages:

- This provides information on peak periods of pollen and nectar availability to bees and other pollinators, so that we can extract good amount of honey from honey bee colonies at the right time.
- Besides, we also know dearth periods for pollinators

and thus can arrange alternate sources of food for them.

The floral calendar of ICAR-VPKAS experimental farm, Hawalbagh depicts the blooming of different crops grown at the farm

during a year (Fig. 1). By observing this we can propose that January to August is most suitable to pollinators in view of food availability. Due to availability of enough pollen and nectar containing crops like mustard, coriander, radish, onion, squash, buckwheat, pigeonpea, and fruit trees like peach, pear etc. Maize (*Zea mays*) provides copious amount of pollen during July-August. Apart from this, we could also decide the most unfavourable period for pollinators using the floral calendar. According to Fig. 1, food availability is less between September and December, wherein proper steps should be taken for their management. The floral calendar for the nearby villages adjoining the institute reveals a still worse condition, wherein, the dearth season starts from June onwards and prolongs upto December, since onion and squash are not commonly under

Months Crops	January	February	March	April	May	June	July	August	September	October	November	December
Mustard												
Coriander												
Onion												
Squash												
Tomato												
Pigeon pea												
Buck wheat												
Radish												
Carrot												
Maize												
Peach												
Pear												

Fig. 1. Floral calendar of VPKAS, Hawalbagh for utilization in pollinator forage and pollination-crops

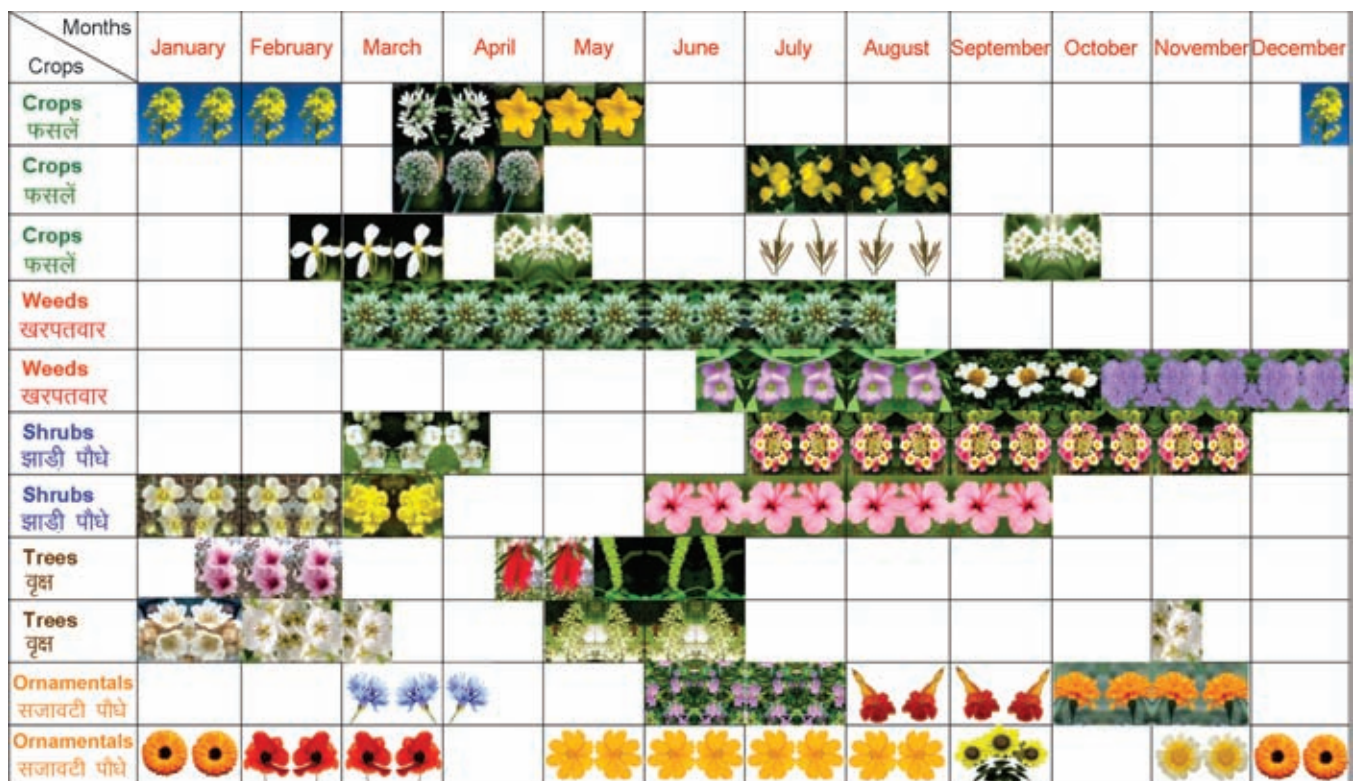


Fig. 2. Floral calendar with crops, weeds, wild shrubs, trees and ornamental plants

cultivation. Diversity of crops is necessary for the maintenance of ecosystem services like pollination. Pollinator diversity is closely linked to floral diversity (especially of annuals) and nectar resource. Thus the diversity and abundance of pollinators dwindle at this season and they have to depend only on uncultivated wild flora. Due to clearing of forests or habitat degradation, availability of wild flowers are also becoming scarce. If the pollinators decline, the plants that they pollinate set less seed, so that there is even less food for the pollinators. This shows the importance of pollinators and thus needs proper management plan to conserve them.

Floral management for pollinators

Floral management for pollinator conservation aims in flower availability throughout the year and especially at lean seasons (August to December). Growing buckwheat, *Fagopyrum esculentum* during September- October is an old age practice in mid-hills of Uttarakhand but it is not noticed now-a-days. Growing of this crop may be encouraged because it is a rich source

of nectar and pollen and a large number of pollinators are found visiting this flower. Growing buckwheat in lieu of rice or finger millet or soybean is not economical but some area may be allocated to this short duration crop of two months.

Growing *toria*/ mustard, *Brassica rapa* along with wheat as a mixed cropping is being done traditionally in the villages. *Toria* grown with wheat not only supports the pollinators at large but also attracts syrphids for egg laying. Syrphid maggots are efficient predators which prey upon aphids in *toria* and then go to wheat in search of aphids. Thus make a ready availability of bio-control agent in wheat crop also.

Growing sunflower, *Helianthus annuus*, a day neutral plant during July is another option for pollinator conservation. This comes to bloom when other crops are in seedling or tillering stage and provide copious amount of nectar and pollen to the pollinators. Apart from honeybees, a large number of bumble bees and other solitary bees are found foraging on sunflower during August. Pollinator densities were reported positively related to the availability of

highly rewarding mass flowering crops.

Apart from this, uncropped areas of farmland, such as hedgerows, roadside verges, shelterbelts and borders of streams and ponds can provide flowers throughout the season and tend to support far greater number of foraging pollinators than cultivated areas. White clover, *Trifolium repens* is a common weed found in bunds of cropped fields of the region. This is found to bloom continuously throughout the year and attracts more number of bees for its nectar. Allowing white clover to grow in field bund besides adding stability to the bunds also conserves the pollinators. This is an important forage crop also. Enhancement of spring floral resources is regarded as one of the most important strategy to enhance pollinators in agricultural fields. Radish, *Raphanus sativus*, is normally grown by every villagers of the region in their crop fields or home gardens. There is a practice of leaving some of the crop near the side bunds for seed purpose. It attracts many pollinators and supports them by supply of both nectar and pollen.

Weed plants like *Oxalis* sp., *Biden*



Fig. 3. Pollinator friendly farm paths at Vivekananda Parvatiya Krishi Arusandhan Sansthan, Hawalbagh (Almora)

spilosa, *Ageratum conyzoides* etc. found to grow in the cropped field also supports pollinators especially of solitary bees and butterflies in lean seasons (Fig. 2). A practice of selective weeding or leaving these plants in non-cropped areas is a good management practice for pollinator conservation. Plants grown in non-cropped areas as bushes viz., *Lantana camara*, *Rubus ellipticus*, *Berberis asiatica*, *Pyracantha crenulata*, *Rosa moschata* also attract pollinators of which rubus locally known as *hisalu* is a good source of nectar which attracts bees apart from other pollinators. Stinging nettle, *Urtica dioica* which grows as a weed forms an important food source for the caterpillars of nymphalid butterflies, *Aglaeiscash miriensis*.

Some ornamental annuals like marigold, rose, cosmos, cuphea, zinnia and climbers like *Campsis grandiflora* is found to flower from June to September, when there is limited availability of other pollinator friendly crops in the region. Growing this in pine and other wild trees is an option to support pollinators with added aesthetic value. The ornamental annuals listed above may be grown as flower beds in front of houses or as alley rows on road sides during food scarcity to pollinators. The false heather, *Cupheahys sopifolia*, produces flowers rich in nectar from May to November where other plants are not available thus sustaining more number of honeybees, solitary bees and wasps. Ornamental shrubs like shoe flower *Hibiscus rosinensis*, crape myrtle *Lagerstroemia indica* and

Ligustrum provide food for pollinators in dearth season to sustain them and thus can be widely grown.

Peach and pear trees are the rich source of nectar and pollen to pollinators found flowering between February and March. Other tree species like bottle brush *Callistemon lanceolatus* (*citrinus*), wild pear *Pyrus pashia*, willow *Salix alba*/*S. babylonica*, butter tree *Sapium sebiferum* produces copious amount of nectar which attract pollinators of which butter tree provides nectar from May second fortnight to June to the pollinators. Such roadside and forest vegetation support a variety of pollen and nectar sources and unlike agricultural fields, are unploughed and therefore can provide potential nesting sites for ground-nesting bees also. Management of this vegetation by planting of native species will have a major say in pollinator abundance and thus conserving them.

A floral calendar for uncultivable but pollinator friendly weeds, shrubs and trees ornamental plants when superimposed with that of the crops will fill all the months of the year with flowers for the pollinators to survive throughout the year (Fig 3). Thus an agro-ecosystem along with its natural vegetation will sustain the pollinating species and have a sustainable production. Ecosystem service of forest lands to agriculture is already been documented. Forest fragments provide nearby farms with a diversity of pollinators especially of native species, which increased both the amount and stability of pollination services. When these forest lands are disturbed by means of climate change or anthropogenic

effects, we may have to grow some pollinator friendly flowering plants and, trees.

By adopting all these measures we can provide food sources to bees and other pollinators and can sustain them even in the absence of seasonal crops so that their population will not reduce too low due to limited food resources. If pollinators are present in good numbers at the start of cropping season, crops will get proper pollination without any pollination deficiency. Pollination deficiency is reported to cause serious reduction in crop yields especially in cross pollinated crops. At least one-third of the world's agricultural crops depend upon pollination service provided by insects and other animals. Pollinators fed us these many years with their free pollination services to our farm lands. This is time for us to feed them and made them available for our future generations too.

SUMMARY

Pollinators such as bees, birds and bats affect 35% of the world's crop production, increasing the output of 87 of the leading food crops worldwide. They pollinate the crop plants and when crops are not available, they are sustained by forest covers and natural habitats. When the natural habitat is disturbed, we have to feed them by growing pollinator friendly trees, shrubs and annuals.

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