

Pollinator Management- A Realistic Way To Improve Yield of Vegetables and Spices

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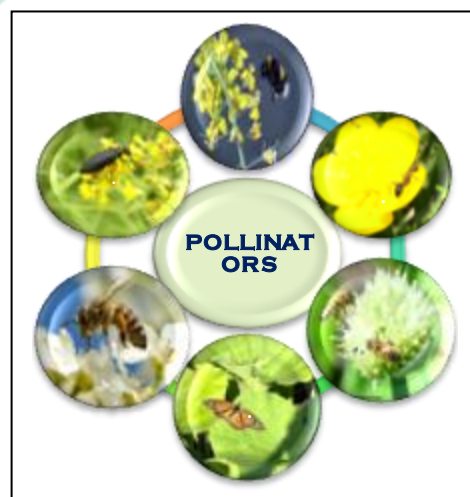
Abstract

A copious amount of insects visits the diverse species of vegetables and spices during the entire flowering initiation to crop harvest stage for foraging. Ideal pollinators such as butterflies, birds, ants, bees play a vital role in pollination to enhance yield and provide a comprehensive benefit by improving crop quality. Agricultural intensification and shrinking pollination services cause misleading of International policies. A substantial dwindling in pollinator population leads to alternations in food, nesting habits, chemical poisoning, human activity, climate vagaries and smuggling is a condemning issue for crop production. Consequently, preservation and safeguarding of pollinators through the implementation of agro-environmental conventions to escalate plant resources and nest sites for bees are fundamental.

Keywords: Pollinators, Spices, Vegetables, Yield, Environment.

Introduction

A significant section of the small and marginal farming community, who constitute 80% of the country's farm holdings is significantly dependent on the production of vegetables such as various gourds, brinjal, cucumber, tomatoes apart from potatoes, onions, etc. (Sindhu *et al.*, 2005) Vegetables are a critical source of vitamins, proteins, minerals, dietary fibres, micronutrients, antioxidants and phytochemicals having anticarcinogenic properties and antioxidative chemicals such as flavonoids, glucosinolates



isothiocyanates. Yield of the majority of vegetables is optimized by the activity of pollinating insects. Approximately 70% of the tropical vegetable crop species produced are dependent on the activity of insect pollinators (Klein *et al.*, 2007). A potentially serious decline in pollinators population was observed due to agricultural development as the use of chemicals increased. 7.53 million tonnes of vegetable is produced in India of which, 13.4% is the global production dependent upon pollinators (Charan *et al.*, 2010). Currently, there are 150 million colonies essential to satisfy the demand of the population for 50 million ha bee dependent crops, nevertheless, there are barely 1.2 million colonies maintained in India. (TNAU Agritech portal)

Seed spices are an important segment of aroma as it adds flavour to countless dishes. India is bestowed upon with 63 spices crops, among which 20 spices are considered as seed spices. Most of the seed spices are cross pollinated in nature such as coriander (*Coriandrum sativum* L.), cumin (*Cuminum cyminum* L.), fennel (*Foeniculum vulgare* Mill.), ajwain (*Trachyspermum ammi* L.), dill (*Anethum sowa* Roxb.), etc. Insect visitors are required to accomplish the process of pollination in seed spices.

Insect pollination is valued as an ecosystem service where the pollinators play an immense role in the production of vegetables, fruits and spices. It provides economic benefits and agricultural food production at global and national level. A pollinator is a biotic agent that transfers the pollens from the anthers of one flower to the stigma of the other to accomplish syngamy in the ovule of the flower. (Klein *et al.*, 2007).

Globally, 250000 species of flowering plants are pollinated by 200000 species of animals. More than 85% cross pollinated flowers are dependent upon insects for pollination. Plant species propagated by seeds are also dependent upon entomophily. Honeybees are of paramount importance for crop pollination. Beetles, wasps, butterflies are also responsible to carry out pollination of a large number of ecologically and economically important phyto-species. Pollinating birds such as humming birds, perching birds, flies, ants, rodents, monkeys, snails and slugs are also effective pollinators. Improved pollination in crops is elemental for sustainable food production as it reduces the time between flowering and fruit setting and enhances better shaped fruits (Anon, 2010).

Pollinator limitation has emerged as a potential risk as pollinators are declining at an alarming rate due to alterations in food and nesting habit modifications, trading of endangered species, invasive species, ecosystem collapse, etc. (Abrol, 2012)

Why are pollinators important?

Pollinators are also friends of the crops and farmers which help in dramatically augmenting the yield as it affects 35% of the World's crop production. Proliferation of pollinator species is indispensable for an uninterrupted food supply as production and livelihood are linked to the wild ecosystem since many wild animals are dependent upon food and shelter with agricultural production systems. The ecosystem could collapse without these interconnected species inhabiting, and processes functioning. Pollinators provide support to biodiversity, and are a great indicator of the overall health of an ecosystem. With an adequate pollination, the pollinator dependent plant communities can set to bloom before frost damage, and help to bind the soil, reducing erosion. (Das *et al.*, 2018)

- ❖ Pollinators are vectors of genetic exchange.
- ❖ Helps in creating diversity and variation among the population.
- ❖ Useful in crop improvement programme, multiplication and seed production of vegetables, fruits, spices and oilseeds.

Influence of pollinators on yield and seed production in spice and vegetables

Insect pollination is a requisite for the vegetables to produce qualitative and quantitative seeds. To facilitate seeds set, an adequate pollination mechanism is required. Irrigation promotes nectar production and is important for pollinator visits. Honey bees and bumble bees pollinate cucumber and squash which have male/ female and hermaphrodite flowers among which male and hermaphrodite flowers produce pollens. Bees are considered to be mid morning risers, can visit upto 5000 flowers in a single day & can survive at a lower temperature.

Walters and Taylor (2006) studied the effect of honey bee (*Apis mellifera* L.) pollinating jack-o-lantern (*Cucurbita pepo* L.), large-sized (*C. maxima* Duch.) and processing pumpkins (*C. moschata* Duch. ex Poir.) which had a significant impact on seed set, fruit set and yield under



Fig: Bee pollinating Melon blossom.
Photo: Dan Wyns

open field condition.

In Onions, the florets produce nectar and pollens. Bees collect the nectar but to facilitate pollen collection, the hives need to be supplied with sugar syrup.

In an experiment conducted by Chandel *et al.*, (2002) *A dorsata*, a most efficient pollinator and a dominant visitor pollinated 7.5 flowers/umbel/visit during its peak hours. It had the maximum foraging period (1200-1400 hrs) compared to *Apisflore*, *A. mellifera* and *A. cerana*. Introduction of bee pollination, increased seed yield 2.5 folds and produced 971 seeds per umbel which resulted in 90% germination.



Fig: Bee pollinating Onion florets.

Honey bees, Bumble bees and flies can pollinate *Brassica spp.* which are majorly grown in the Indian Himalayas and under protected conditions. Flowers produce sufficient nectar that facilitates in pollination. Sushil *et al.*, (2013) noted 6.05 bees (*Apis mellifera*) to be visitors on broccoli under net house condition followed by kohlrabi and Chinese cabbage. Pollinated broccoli crop produced more seed yield compared to naturally pollinated crop.

Sanz and Serrano (2006) reported bumble bee activity on fruit quality of sweet pepper under greenhouse condition. An increase of 49.8% and 40.7% in seed set per fruit in two varieties was noted.



Fig: Foraging Bumble bee on *Brassica*. Photo: Kathy Keatley

Vergara and Buendia (2012) observed more number of seeds in tomato under polyhouse condition when pollinated by *B. ephippiatus*. Yankit *et al.*, (2018) recorded an increase in number of 6.76 fruits per cluster, fruit length, girth, weight and yield when pollinated by bumble bee inside polyhouse condition.

Coriander (*Coriandrum sativum* L.) produces pink-white flowers and bloom during the month of January-March producing good amount of nectar and pollens. Chaudhary and Singh., (2007) reported an increase in seed yield when pollinated by honey bees as it plays a vital role in enhancing productivity level.

Fennel a highly cross pollinated seed spice is protandrous in nature and is highly entomophilous in nature. The most common pollinators are Honey bees (*Apis cerana* F., *A. florea* F. and *A. mellifera* L.) and syrphid flies. Researchers reported an increase in the mean seed yield in caged pots pollinated by bees compared to open pollinated.

Flies and bees play a significant role in enhancing yield of dill (*Anethum sowa* Roxb.). Improper seed setting in *Nigella* leads to irregular yield due to pollination failure. To enhance the number of seeds set and yield, *nigella* flowers can be pollinated by honeybees bumble bees, wasps in India.

Table 1. Pollinators on which different crops depend.

S.No.	Insect pollinators	Crops
1.	Honey bees	Tomato, Watermelon, Pumpkin, Squash, Coriander, lettuce, Asparagus, Okra, Onion, Peppers, Cole crops, Beans, Fennel
2.	Wild bees	Tomato, Pumpkin and squash, Lettuce, cole crops.
3.	Bumble bees	Lima beans, Cowpes, field bean, scarlet runner bean, Okra
4.	Beetles	Pumpkin, Squash, Parnish
5.	Butterfly	Lettuce
6.	Flies and moths	Pumpkin and squash, Onion, Lettuce, Coles, Dill.
7.	Drone flies	Onion
8.	Thrips	Lima beans, Beet, Muskmelon
9.	Ants	Muskmelon

Constraints of apiculture:

A decline in the pollinators poses a direct impact upon production of food and consumer prices. The health of consumers could be affected worldwide due to a reduction in the availability of fruits and vegetables. The diminishing pollinator population leads to malnutrition and poverty as, pollinators also impart nutrients, thus affecting different regions of the World differently. The curtailing in pollination services leads to improper seed set formation which decreases the quality of produce and disrupts food supplies in natural conditions, thus creating economic discrepancy.

- 1) **Prominent de-forestation** poses a major problem in promotion of commercial bee cultivation, though the country has a huge resource of bee flora.
- 2) **Irrational and Indiscriminate use of toxic chemicals** such as insecticides, pesticides and herbicides on the crops leads to the death of the bees due to brood poisoning of the hives due to poisoned nectar has a devastating impact.
- 3) **Wild fires** is a common practices inculcated by farmers in Rajasthan, Madhya Pradesh, Maharashtra and other adjoining states. Wild fire is also practices in Jhoom cultivation in north eastern region of the country.
- 4) A decline in the **Biodiversity** causing direct and indirect impact on ecosystem functions and services that are poorly quantified.
- 5) **Monoculture** is bad for bees as it causes poor immune system as bee feed on a single food crop for nectar and pollen and thus is denied of the vital nutrients.
- 6) **Inadequate awareness among the farmers** and extension functionaries in adopting beekeeping in remote and interior areas.
- 7) Non availability of good quality bees, unskilled labour, high charges on honey and absence of quality tools.
- 8) **Unfavourable weather conditions** such as extreme hot or cold weather affects bee population severely.

Measures adopted to regulate pollinators decline:

According to Albert Einstein, “If the bee disappeared off the surface of the globe, then man would only have four years of life left. No more pollination, no more plants, no more animals, no more man.”

- a) **Expanding abundance, diversity and continuity of floral resources** by sowing flower rich field margins to increase pollinator population and provide better incentives to farmers.
- b) A ubiquitous prophylactic application of systemic insecticide as a seed dressing when exposed to bees resulted in accumulation of chemicals in environment. Use of **integrated pest management(IPM)** as a preventive measure helps in reducing exposure to bees, environment and improve the profitability of the farm.

- c) Strict quarantine measures can be implemented during the shifting and movement of commercial bees to develop better means of rearing bees free of diseases.
- d) **Global pollinator initiatives** can be adopted. The importance of pollinators have been identified by Convention on Biological Diversity with the establishment of the International Initiative for the conservation and sustainable use of Pollinators (also known as the International Pollinators Initiative-IPI) in 2000, facilitated and coordinated by FAO.

Conclusion:

To elicit the crop yield qualitatively and quantitatively, cross pollination is contemplated as an adequate and cheap method. Insect pollinators, the pals of flowers, elevate yield by promoting uniform and early seed set. A naturalistic measure to ensure conservation of pollinators is a requisite. Bee keeping in India need to be encouraged at a larger scale for the farming community and for the general public to upgrade its value in the society. In the current situation, measures should be adopted for conservation, augmentation and utilization of the pollinators for escalating pollination and promote production of crop and honey to support the livelihoods of the farmers and generate income. An active involvement of researchers and extension specialist will help to educate the benefits of pollinators and the profitability so generated through its adoption.

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