



## Role of pollinators in Broccoli seed production

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**ABSTRACT:** A study on manual and open pollination was carried to understand the importance of insect pollination in broccoli crop. The results revealed that significantly higher pod weight, seed weight and 1000 seed weight was recorded in open pollinated crop compared to manually pollinated crop. Majority of the insect visitors belonged to Diptera followed by Hymenoptera and Lepidoptera. Since manual pollination is laborious and difficult to perform pollination uniformly, hence proper identification of the isolation and allowing the crop to pollinate openly could result in production of not only more seeds but also quality seeds in broccoli.

**Keywords:** Broccoli, insect pollination, pollinators, seed yield

### INTRODUCTION

Broccoli, *Brassica oleracea* var *italica* L. is an important fast growing edible green vegetable crop (Brassicaceae) belonging to cole group of vegetables including cabbage, cauliflower, Brussel sprouts, kale and kohlrabi (Rubatzky and Yamaguchi, 1997). Broccoli is a cross pollinated crop cultivated in moderate to cool climate which bears dense green cluster of flower buds surrounded by leaves and have perfect yellow flowers with four petals. In most of the cultivars, nectar is secreted by two functional nectaries located at the bases of two small anthers (Gray, 1982). Hence, a lot many pollinators including managed and wild are being attracted towards the flowers for pollen and nectar and the flowers get pollinated. In general, honey bees are the primary pollinators of broccoli seed crops but when the crop is allowed for wild pollinator's quality and quantity of the seeds will increase (Bohart and Frank, 1961). However, growers are facing major problems in broccoli seed production due to inadequate pollination. This may be due to lack of adequate number and diversity of pollinators in temperate regions. Therefore, there is a need to ensure pollination by conserving and attracting the pollinators towards the crop land (Sushil *et al.*, 2013). This can be achieved only through entomophily for enhancement of productivity and quality of broccoli seeds.

### MATERIALS AND METHODS

The experiment was carried at Naggur farm of the Indian Agricultural Research Institute (IARI), Regional Station, Katrain, Kullu Valley, Himachal Pradesh (31.87°N,

77.15°E and 1278m MSL). Pusa Broccoli KTS-1 variety was planted in an acre under adequate isolation for seed production during winter and summer 2013-14. The experiment was divided into 5 different strata. In each stratum, randomly selected 5 plants were tagged for natural pollination (wild pollinators) and another 5 plants were bagged for manual pollination before blooming. Observations were made on number of insect/flower visitors on the plants for open pollination. The flower visitors (insect) were collected, pinned and sent to Biosystematics Laboratory, Division of Entomology, IARI, New Delhi for identification. Hand pollination was carried out at regular intervals on the plants kept for manual pollination. The seeds were harvested separately; observations on pod weight, number of seeds/pod and 1000 seed weight were recorded. Besides, standard seed tests such as germination and seed vigour index were also carried out using formula:

$$\text{Speed of germination} = \frac{\text{No. of normal seedlings}}{\text{days of 1st count}} + \dots + \frac{\text{No. of normal seedlings}}{\text{days of last count}}$$

$$\text{Seedling vigour index - I (SVI - I)} = \text{Seedling Length} \times \text{germination}$$

$$\text{Seedling vigour index - II (SVI - II)} = \text{Seedling Dry Weight} \times \text{germination}$$

### RESULTS AND DISCUSSION

Results from the experiments on insect pollination revealed that significantly more pod weight (87.84 ± 20.83 q/ha) was observed in open pollinated compared to manually pollinated (17.28 ± 4.76 q/ha) (F=11.47;

**Table 1. Impact of wild pollinators on seed yield (q/ha)**

Treatment	Mean Pod weight (q/ha)	Mean 1000 seed weight (g)	Mean seed yield (q/ha)
Manual Pollination	17.28±4.76	3.516±0.30	4.92±2.06
Open pollination	87.84±20.83	4.866±0.35	27.13±7.48
F value	11.47	12.38	9.204
P	0.028	0.02	0.039
CD	34.72	0.88	20.32

**Table 2. Pollinators recorded at Naggar farm, Kullu Valley, Himachal Pradesh**

Order	Scientific name	Family
Diptera	<i>Eristalis tenax</i> (L.)	Syrphidae
	<i>Eupeodus</i> sp.	Syrphidae
	<i>Episyrphus baltiatius</i> (De Geer)	Syrphidae
	<i>Chrysomya</i> sp.	Calliphoridae
	<i>Calliphora</i> sp.	Calliphoridae
	<i>Musca</i> sp.	Muscidae
	<i>Sarcophaga dux</i> Thomson	Sarcophagidae
	<i>Tachina</i> sp.	Tachinidae
	<i>Odontomyia</i> sp.	Stratiomyidae
	<i>Sepsis</i> sp.	Sepsidae
	<i>Eristalis tenax</i> (L.)	Syrphidae
	<i>Eristalinus</i> sp.	Syrphidae
	Hymenoptera	<i>Bombus haemorrhoidalis</i> Smith
<i>Apis cerena indica</i>		
<i>Apis dorsata</i>		
<i>Apis florea</i>		
<i>Banchopsis ruficornis</i> (Cameron)		Ichneumonidae
<i>Lestica quadriceps</i> (Bingham)		Crabronidae
	<i>Vespula</i> sp.	Vespidae
Lepidoptera	<i>Vanessa cardui</i> (L.)	Nymphalidae
	<i>Macroglossum</i> sp.	Sphingidae

**Table 3. Impact of open and manual pollination on different seed parameters in broccoli at Naggar, Kullu Valley, Himachal Pradesh**

Parameter	Open Pollination	Manual Pollination
Germination (%)	82 ± 13.67	82.8 ± 10.33
Speed of germination	49.38 ± 10.14	49.48 ± 7.29
SVI - I	7001.09 ± 2352.83	7129.59 ± 1479.64
SVI - II	24780 ± 10366.54	11402 ± 5646.62
SVI - seedling vigour index		

P=0.028; CD=34.72) crop. Similarly, 1000 seed weight /plant was also higher in the plants pollinated under open conditions (4.866 ± 0.35 g) than manually pollinated plants (3.516 ± 0.30 g) (F=12.38; P=0.02; CD= 0.88). This resulted in maximum seed weight (27.13 ± 7.48 q/ha) in crops pollinated by insects (wild and managed insect pollinators) than manually pollinated crops (4.92 ± 2.06 q/ha) (F=9.204; P=0.039; CD=20.32) (Table 1). Pollinators collected on Broccoli crop were identified by Dr. V. V. Ramamurthy, Division of Entomology, IARI. Among the wild pollinators, the majority belonged to Diptera (Muscidae, Sarcophagidae, Tachnidae, Sepsidae, Syrphidae, Calliphoridae, Stratiomyidae) followed by Hymenoptera (Apidae, Ichneumonidae, Crabronidae, Vespidae, Formicidae) and Lepidoptera (Nymphalidae and Sphingidae) (Table 2).

Seeds from open and manual pollination were subjected to different seed parametric tests. Tests revealed that all the parameters *viz.*, germination, speed of germination and seed vigour indices were at par with each other (Table 3). Results indicated that wild pollinators are the specialists in pollinating broccoli crop as witnessed through not only recording highest seed yield but also good seed quality in the crop allowed under open pollination. Higher yield with good quality seeds of broccoli was due to pollination by different pollinators in broccoli (Thapa, 2006). Since, manual pollination has conducted meticulously; hence, the seed parametric tests are at par with wild pollination except SVI-II. The value of SVI-II is more for the seeds from open pollination indicates better accumulation of dry matter. In general, manual pollination is not only laborious but also in practical impossible to pollinate all plants at uniform time which resulted in recording low seed yield in the present study. Besides, manual pollination is not feasible in commercial seed production; however, it is only practiced in maintenance of nucleus seed stock. Therefore, it is clear that broccoli seed production and

quality of the seed could be increased by employing wild pollinators in pollination programme.

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