

## Comparative Attractiveness of Broad-leaf Mustard, Cauliflower and Radish to *Apis cerana* in Kathmandu Valley of Nepal

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Broad-leaf mustard, cauliflower and radish are widely cultivated in and around the Kathmandu valley of Nepal. These crops bloom simultaneously during February–March. The flowers produce good amount of nectar and pollen and are quite attractive to pollinating insects particularly honeybees. Many cultivated varieties are partially or completely self-sterile and require cross-pollination to produce fruit and seed (Partap, 1997; Partap and Partap, 1997; Verma and Partap, 1993, 1994). When these crops are grown in adjacent plots bees visit the crop that is most attractive and ignore the less attractive crops. Thus, pollination and, therefore, seed set in the less attractive crop is adversely affected.

Studies were conducted to find out the comparative attractiveness to bees of these three commonly planted cruciferous crops. Such studies are important in formulating strategies to manage pollination of crops that are planted in adjacent plots and bloom at the same time.

### Material and Methods

Studies on the comparative attractiveness to the Himalayan honeybee, *Apis cerana*, of three cruciferous crops—broad-leaf mustard (*Brassica juncea* var. Khumal Broad-leaf), cauliflower (*Brassica oleracea botrytis* var. Kathmandu Local) and radish (*Raphanus sativus* var. Meno Early) were conducted on the FAO/HMG Nepal Vegetable—Seed Production Farm, Khumaltar in the Kathmandu valley of Nepal during March (i.e. when these crop are in bloom).

The crops were planted adjacent plots and started blooming during late -February. One strong colony of *A. cerana*, having eight frames covered with bees and free of any sign of disease, was placed in the middle of each plot. The number of bees foraging in 1 m<sup>2</sup> (about four plants) in a -minute period were counted for each crop for one week at 10.00 h. Ten such plots (1 m × 1 m) were marked for each crop.

To collect nectar and pollen, about 100 plants of each crop were covered separately with nylon

cages (about 5 m × 3 m × 3 m) to prevent insects collecting either nectar or pollen. Nectar and pollen were collected daily around 10.00 h from flowers of almost the same age. Nectar was collected with graduated micro-capillaries. Ten such measurements were taken daily for one week for each crop. Sugar concentration in the nectar was measured with a hand refractometer. To collect pollen, flowers of the same age were plucked and pollen was extracted by sonication and weighed on an electronic balance. Ten such measurements were taken daily for one week for each crop. Nectar and pollen were extracted at the same time from flowers of all the three crops to minimise variations due to weather conditions.

Data were analysed statistically using arithmetic means and one-way analysis of variance.

## Results

Results show that flowers of cauliflower were most attractive to *A. cerana* and those of radish were least attractive (Table 1). This was evident from the fact that the average number of foragers was highest on cauliflower (14.3 bees per m<sup>2</sup>) followed by broad-leaf mustard (10.3 bees per m<sup>2</sup>), and was lowest on radish (6.2 bees per m<sup>2</sup>). Studies on the amount of pollen and nectar also revealed that radish produced more pollen (0.027 mg per flower) followed by cauliflower that produced 0.022 mg per flower and least in broad leaf mustard (0.016 mg per flower). Cauliflower produced 0.2 µl of nectar per flower, broad-leaf mustard produced 0.18 µl and radish produced 0.16 µl. Sugar concentration of nectar was highest in cauliflower (51%), 46% in broad-leaf mustard and least in radish (38%).

## Discussion

The attractiveness of a plant depends upon the calorific and nutritional rewards available to pollinators, and the efficiency with which

**Table 1.** Number of foragers per five minutes on 1 m<sup>2</sup> plots of cauliflower, broadleaf mustard and radish and the amount of nectar and pollen produced by a flower of cauliflower, broadleaf mustard and radish

Parameter	Cauliflower	Broadleaf mustard	Radish
Number of foragers in 1m <sup>2</sup> plot in five minutes	14.3 ± 0.9	10.3 ± 2.1	6.2 ± 1.4
Amount of pollen produced by one flower (mg)	0.022	0.016	0.027
Amount of nectar produced per flower (µl)	0.2	0.18	0.16
Sugar concentration in nectar (%)	51	46	38

pollinators can collect the rewards (Heinrich and Raven, 1972; Pyke, 1984; Pyke *et al.*, 1977). Crops that produce more nectar of higher sugar concentration per flower are comparatively more attractive to bees and other pollinating insects than those producing less nectar of low sugar concentration. Results of the present study showed that flowers of cauliflower attracted the highest number of *A. cerana* foragers. This is because cauliflower produced highest amount of nectar per flower compared to broad-leaf mustard and radish. Sugar concentration in cauliflower nectar was also highest. Radish produced least amount of nectar with lowest sugar concentration. As a result, radish flowers are least attractive to bees and other pollinating insects.

Such studies are important in managing pollination of crops that bloom simultaneously and are planted in adjacent plots. Results of the present investigation reveal that the presence of a crop (or a variety) that is more attractive to bees near one that is less attractive substantially affects bee visits to the less attractive crop and therefore, its cross-pollination. The most attractive crop cauliflower, attracted 2.3 times more bees than least attractive crop, radish. Therefore, for effective pollination and seed yield, radish should not be grown near cauliflower or broad-leaf mustard.

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