Chapter 46

Pollination of Peach and Plum by *Apis cerana*

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Peaches and plums are widely planted in the middle hills of Nepal. Varieties of plum are self-incompatible and require cross-pollination to produce fruit. Peach is self-compatible; however, cross-pollination increases yield and improves fruit quality (Free, 1993). Cross-pollination is brought about by insect pollinators that visit flowers for pollen and nectar. Among pollinating insects, honeybees, in particular, are attracted to these crops and are reported to be of great benefit (Choi and Lee, 1988; Free, 1993; Mann and Singh, 1983). The flowers provide good amounts of pollen and nectar for about two to three weeks. Plum blooms one to two weeks earlier than peach. The present investigation looked at the impact of *Apis cerana* on the yield and quality of peach and plum.

Materials and Methods

The experiment was carried out on plum (*Prunus domestica*) during the last week of February 1997 and on peach (*Prunus persica*) during mid-March 1997 at ICIMOD's Trial and Demonstration Farm, Godavari in the Kathmandu valley of Nepal.

To determine the effect of *A. cerana* pollination on fruit yield and quality, three treatments were replicated three times: control (plants in a cage with no insect pollinators); open pollination (plants accessible to naturally occurring insect pollinators); and honeybee pollination (plants caged with *A. cerana*). For control, three trees were covered with a cage (15 m × 3 m × 2.5 m) to exclude all natural insect pollinators including free-ranging honeybees. In open-pollinated plots, observations were taken of trees not protected by cages thus permitting naturally occurring insect pollinators to visit flowers freely. In honeybee-pollinated plots, three trees were covered with a cage (15 m × 3 m × 2.5 m) so that no insect pollinator could enter; when plants started blooming, one medium-sized colony of *A. cerana* having seven frames covered with bees and free of any sign of disease was placed in each cage for each crop.

For each treatment, two to four branches on each tree (8–12 branches for each treatment) were marked and the number of flowering buds were counted. About one month after petal fall, the number of fruits on each branch were counted. After ripening, 5–10 fruits from each branch (60–120 fruits from each treatment) were collected. Fruits from each treatment were weighed. Length and diameter of each fruit were measured.

Data were analysed statistically using analysis of variance.

Results

Table 1 summarises the impact of *A. cerana* pollination on the yield and quality of fruit in peach and plum.

Bee pollination significantly increased fruit set in peach by 21.9% over control and 9.4% over open pollination, and in plum by 13.0% over control and 8.6% over open pollination. It also significantly increased the weight per peach fruit by 43.8% over control and 25.6% over open pollination and the weight per plum fruit by 38.6% over control and 10.8% over open pollination. Similarly, it increased the length per peach fruit by 28.9% over control and 21.6% over open pollination and the length per plum fruit by 11.4% over control and 2.1% over open pollination, and the diameter per peach fruit by 22.5% over control and 12.1% over open pollination and the diameter per plum fruit by 13.6% over control and 4.2% over open pollination. Bee pollination decreased the time required for ripening of fruit by one week in both peach and plum.

Discussion

Since plum and peach bloom during early spring in the Kathmandu valley, *A. cerana* is important for pollination as natural insect pollinators are only present in small numbers because of low temperatures. Partap *et al.* (1999) reported that *A. cerana* mostly worked flowers from on top and collected mainly pollen indicating its efficiency in fruit-crop pollination. Top workers collecting pollen are considered to be better pollinators than side workers collecting nectar.

Apis cerana pollination enhanced fruit set and fruit weight, and increased both length and diameter of fruits as compared to control and open-pollinated plants. Increase in fruit set and fruit weight as a result of bee pollination could be because of greater numbers of pollinators in the plots caged with bees and the superior pollinating efficiency of honeybees. Natural insect pollinators, on the other hand, because of their lower numbers and lower pollinating efficiency resulted in lower fruit set and fruit weight. Any fruit set in plots caged without pollinating insects resulted from a limited amount of self-pollination that might have occurred by pollen blown from anthers on to stigmas.

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Table 1. Impact of *Apis cerana* pollination on the yield and quality of fruit in peach and plum in the Kathmandu Valley, Nepal. Values are mean SE.

Parameter	Control	Open-pollinated	Bee-pollinated	Increase over control	Increase over open-pollinated	Values of *f* and degrees of freedom
Peach						
% Fruit set	18.04 ± 4.7	30.5 ± 4.3	39.9 ± 3.9	21.9	9.4	$F = 11.9$; $df = 33$
Weight per fruit (g)	111.7 ± 16.4	127.7 ± 27.2	160.5 ± 21.7	43.8	25.6	$F = 61.81$; $df = 76$
Length of fruit (cm)	8.3 ± 0.8	8.8 ± 0.7	10.7 ± 0.9	28.9	21.6	$F = 11.61$; $df = 77$
Diameter of fruit (cm)	18.2 ± 2.5	19.9 ± 1.5	22.3 ± 1.1	22.5	12.1	$F = 22.74$; $df = 77$
Plum						
% Fruit set	3.9 ± 2.1	8.3 ± 1.9	16.9 ± 1.8	13.0	8.6	$F = 18.9$; $df = 33$
Weight per fruit (g)	22.3 ± 5.9	27.9 ± 3.7	30.9 ± 2.9	38.6	10.8	$F = 59.65$; $df = 76$
Length of fruit (cm)	4.4 ± 0.5	4.8 ± 0.5	4.9 ± 0.7	11.4	2.1	$F - 21.5$; $df = 83$
Diameter of fruit (cm)	11.0 ± 0.6	12.0 ± 0.8	12.5 ± 0.4	13.6	4.2	$F - 39.4$; $df = 71$

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References

Choi, S.Y. and Lee, M.L. 1988. Studies on the diurnal flight activities of honeybees on peach flowers. *Korean Journal of Apiculture*, **3**: 81–89.

Free, J.B. 1993. *Insect Pollination of Crops* (second edition). Academic Press, London, UK.

Mann, G.S. and Singh, G. 1983. Activity and abundance of pollinators of plum in Ludhiana (Punjab). *American Bee Journal*, **123**: 595.

Partap, U., Shukla, A.N. and Verma, L.R. 1999. Comparative foraging behaviour of *Apis cerana* and *Apis mellifera* in pollinating peach and plum flowers in Kathmandu Valley, Nepal. *Proc. 4th AAA Conference*, 23–27 March 1998, Kathmandu, Nepal.