Chapter 43

Management of Bees for Pollination

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Bees are effective pollinators of crops. They increase seed yield of many entomophilous crops (Free, 1993; Sihag, 1986). Honeybees and some solitary bees are especially helpful and have been successfully managed for this purpose. For effective bee pollination management is required at two levels: crop and pollination. This paper briefly describes methods for management of pollinators.

Management of Crop Environment

To increase the visitation frequency and pollen–gathering efficiency of bees, the agro-ecosystem can be manipulated. The following are required.

Crops attractive to bees

Crops with good floral fragrance, nectar quality, nectar volume and concentration, and pollen mass can be grown or bred (Hawkins, 1969).

Sprays, bee attractants and repellants

To encourage foraging on certain crop and to repel it from others, sprays can be used (Boch, 1982; Frisch, 1967; Praagh and Ohe, 1983; Woodrow *et al.*, 1965).

Removal of floral competitors

Some crops are more attractive to bees than others (Rathi and Sihag, 1993; Sihag, 1982, 1990a, 1995). For pollination of a less attractive crop, the more attractive crops should be removed.

Foraging ecology of *Apis cerana* and *Bombus tunicatus* in pollinating balsam flowers

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Balsam (*Impatiens balsamina*) is a major source of nectar in the Himalayan region. A survey of insect pollinators showed 20 species on this crop in the Shimla hills; *Apis cerana* and *Bombus tunicatus* were the chief pollinators. Foraging studies revealed that peak periods of foraging activity were 1000–1100 h for *B. tunicatus* and 1100–1200 h for *A. cerana*. Both species differed significantly only in a few foraging parameters. *Apis cerana* showed diurnal fluctuations in population of pollen and/or nectar collectors.

Management of Bee Pollinators

Honeybees

Two species of honeybee, *Apis mellifera* and *Apis cerana*, are usually utilised for pollination of crops. Following points should be kept in mind.

Selective breeding of honeybees through artificial insemination to produce desired strains is possible. Strains with traits promoting strong colonies and high pollination efficiency can be bred (Cale and Rothenbuhler, 1978; Gary and Witherell, 1977; Meekensen and Nye, 1966).

General colony and apiary management practices for beekeeping in the tropics and temperate climates are now well known (Sihag, 1990b, 1991; Dadant and Sons, 1993). The following conditions should be ensured for strong colonies: presence of newly mated and laying queen; presence of ample brood and honey; colonies should be free from diseases, pests and predators; specific management.

In the tropics, *A. mellifera* is often infested by the ecto-parasitic mite, *Tropilaelaps clareae*, (Sihag, 1991) and in temperate climates, *Varroa jacobsoni* has become a threat (Sihag, 1997a). Diseases infecting this honeybee and their control measures have been listed by Dadant and Sons (1993). *Apis cerana* in India is affected by Thai Sac Brood Virus Disease (TSBVD). Other enemies are common to *A. mellifera*. Therefore, management practices for the dearth period and for management of diseases, pests and predators are required in both climates (Sihag, 1990b, 1991; Dadant and Sons, 1993).

Stingless bees

Stingless bees are mainly natives of tropical climates. Many species of these bees that can be kept in artificial hives have now been identified (Roubik, 1995; Sihag, 1997b).

Bumble bees

Bumble bees are natives of cold climates. They are excellent pollinators of crops with large corollas especially glasshouse vegetable crops. Domestication is possible (Sihag, 1997b) and a large number of bumble bee species have been utilised for pollination of crops.

Carpenter bees

Two species of carpenter bees have successfully been managed. These are *Xylocopa fenestrata* and *X. latipes*. The former can be cultured in hollow castor/*Arundo* tunnels and the latter in specially devised wooden hives (Mardan, 1995; Sihag, 1997b).

Solitary bees

Several species of solitary bees are managed throughout the world for pollination of crops. The nomid of the genus *Nomia* and megachilids of the genus *Megachili, Chalicodoma* and *Osmia* are important bees whose management practices are now known (Sihag, 1997b). Their parasites, predators and enemies have also been identified and control methods are known.

Methods of Utilising Bee Pollinators

For better pollination of crops, the method of utilising bee pollinators is important. Methods are different for honeybees and solitary bees.

Honeybees

For honeybee pollination, four things must be kept in mind: time of movement of colonies (Free *et al.*, 1960); site of placement of colonies (Free and Williams, 1974); orientation and dispersion of colonies (Gary, 1979); kinds and numbers of colonies (Burgett *et al.*, 1984; Sihag, 1997c, 1997d).

Other bees

Bees other than honeybees (except some larger species) are generally short fliers with a small foraging range. Therefore, their domiciles must be placed near target crops.

Number of Foragers Required

For maximisation of pollination, optimisation of forager strength (number) is important. Standard honeybees colonies (Burgett *et al.*, 1984) with a given forager strength (Danka and Gary, 1987) are used for pollination of crops. The number of pollinators required is determined on the basis of the following relationship (Sihag, 1997c, 1997d).

$$N = \frac{d}{PE} x \frac{\overline{Y}}{T} x\, a$$

where, N = number of the bees required
d = floral longevity/receptivity
PE = pollinating efficiency of the species with reference to the given crop
Y = average floral density
T = average activity duration of the species on the given crop
a = crop area

Likewise, the number of females/foragers of other bee species required for a given crop area can be determined and this number can be provided by artificial manipulation.

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