

SUSTAINABLE USE OF LEAFCUTTING BEE HIVES FOR ALFALFA POLLINATION

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ABSTRACT: The pollination of flowering plants is an important ecological service in natural and agricultural ecosystems. The majority of angiosperm plants rely on animals for pollination. The coevolution of bees and flowers has resulted in special morphological adaptations for both insects and plants, and the need of some plants for pollination by bees are absolute. One of the major forage corps in Egypt and other part of the world is alfalfa. The leafcutting bees are very important pollinator of alfalfa, different natural nests had been found in Eastern part of Egypt but these nests under a high risk due to construction of news house instead of old mud wall houses. Foam nests had been created yearly from 2003 and used as hives for conservation of bees and used it for alfalfa pollination. The impact of using leafcutting hives proved a high seed production and easy to handle by farmers, the hives are very easy for preservation, storage and reuse.

KEY WORDS: Alfalfa, Pollination, Seed Production, Leafcutting bees.

One of the major problems that face most of the newly reclaimed areas is the relatively low production of crops due to the lack of insect pollinators. The same problem is found also in the certain areas of the old cultivated land due to the wide use of pesticides. The mechanization of agriculture affected on the wild pollinators as well as the honey bees industry. Also the concrete houses have been moved quickly to replace the old mud houses in the villages. Alfalfa, *Medicago sativa* (L., 1753), is a high quality forage and green manure crop that originated in the Middle East. Varieties are available and are being bred that are well-adapted to reclaimed agricultural lands in Egypt. Solitary bees and bumble bees are most efficient pollinators of alfalfa. Honey bee efficiency on the other hand is low after opening alfalfa flowers several times honey bee "learns" to collect nectar without tripping them, owing to the specific structure of alfalfa flower. For that reason, despite the abundance of honey bee in alfalfa fields, seed yield per hectare may be very poor when solitary bees and bumble bees are not present. For instance, low alfalfa seed yields were recorded in the most agriculturally developed countries, which were the first to apply pesticides and the first to destroy the natural habitats of native solitary bees by introducing monocultures over vast areas. This soon resulted in thinning the fauna of native pollinators and caused a drastic reduction in alfalfa seed yields. The problem was successfully overcome for the first time in the USA and Canada with the domestication and utilization of the solitary bee *Megachile rotundata* (Fabricius, 1793) (Stephen, 1961; Bohart, 1962; Klostermeyer, 1964; Hobbs, 1965; Free, 1976). Alfalfa flowers require visiting bees to trip the sexual column, there by providing pollination and subsequent pod and seed set. However, tripping done by a specialized group of bees which enter the flowers and press their keel by their own weight there by releasing male and female organs to distribute pollen and effect cross- pollination (Abrol, 1993). Natural nests of leafcutting bees had been found at Eastern part of Egypt (Fig.1)

but these nests under a big risk because most farmers exchange the old mud houses with new concert houses (Kamel et al., 2007). These areas have many natural nests of leafcutting bees which are very important for alfalfa pollination in the world (Shebl et al., 2009a).

The goal of this research is to develop self-sufficiency and stable high yields in seed production for locally adapted, high quality alfalfa varieties for reclaimed lands. To attain this goal, management protocols for one or more native solitary bee species that pollinate clover and alfalfa must be developed.

Artificial bee nests were prepared in March 2006 and transformed to natural nest sites in Tel El Kebir and El- Huseiniya (30°33' 30"N, 31°56' 13"E) about 50km west of Ismailia on the Delta of River Nile (Kamel et al., 2007) (Fig. 1). The natural nests transferred to the experimental field by the end of July and August for overwintering period. The artificial nests preserved and kept from any damage or attack by ants or any other pests during all seasons. The artificial which used for nesting bees were prepared by using foam nests. Each hive consists of 50 pieces of foam (50 cm length; 12 cm width and 2 cm thickness). In each piece of foam were 26 holes (10 cm depth; 6 mm diameter). After sticking the foam pieces above each other holes were created in this block and the hive was performed, paper tubes (10 cm in length; 5.2 mm internal diameter), inserted in each hole. All hives were painted with black color for imitation of the natural nests (Fig. 2). The artificial nests transferred to the natural nests sites in different villages of Tel El Kebir in April till the end of July 2006.

Nesting activities of leafcutting bees first appeared just shortly after the emergence of females i.e. during mating period and continued to the end of the activity season. The emergency of bees was started on April (females activity was from April to June) The female usually hovers around the nests to select suitable nesting site for herself. After selecting the nest, she started cleaning it before inhabiting it (Fig. 3) (Shoukry et al., 2007; Shebl et al., 2008a). Using artificial nests showed good results and big variation between different hives was clear. This is easily explained because of using different localities of natural nests and different biotic factors specially wind. The percentages of nesting obtained were 32.04 % in 2005 and 48.3% in 2006.

Alfalfa, *Medicago sativa*, had a blooming period in the experimental farm of about 8 weeks from late March till the end of May. During the blooming period leafcutting bees visited and pollinated the alfalfa flowers. Observations indicated that males of leaf-cutting bees start flying a few days before the females but there is no role for the males in the tripping of alfalfa flowers (Fig. 3). The female bees have special characters on the ventral side on abdomen, group of hairs (scopa) for collecting pollens from alfalfa flowers, this character lacked in males and other bees (honey bees the scopa on the hind leg) (Fig. 3). In this way the male has no efficiency in the pollination of alfalfa (Cane, 2002). Bees start to visit alfalfa flowers around 9 am, the number of bees increased considerably at 10 am; bees were most active around 1 pm (Fig. 4).

The influence of temperature and light intensity at the beginning of flight of males and females was studied. Bees start foraging under conditions of low temperature and high light intensity or vice versa. The females spend the night in the nest, faced inward. As temperatures rise in the morning, they turn around and face the entrance but do not come out and fly only when the temperature exceeds 20°C. Bees stopped foraging in the evening bees fly approximately ¼ mile to find food (Peterowski, 1991).

Results indicated that there were no significant differences between the average numbers of flowers per inflorescence per plant, but numbers of pods

significant differences between the treatments were found. The maximum high production of alfalfa seeds was in the plants so close to the nest then production becomes less due to the distance from artificial nests (Shebl et al., 2008b; Shebl et al., 2009b) (Table. 2).

The impact of flower abundance and pollinator movement on seed or fruit yield is of economic importance, and may have implications for crop pollinator management. The number of open flowers and nectar availability declined more rapidly close to bee shelters than at a distance. Interrupted the rapid decline in floral resources partly as a result of steady pollination over time (Strickler & Freitas, 1999) (Fig. 5).

CONCLUSION

Relying on honeybees for crop pollination may will lead to decrease of seed production. It is mandatory searching for other bee pollinators, conservation of wild bees will solve this problem. Recently honeybees affected by many problems and disease, especially colony collapse disorder. Using and conserving leafcutting bees will increase alfalfa seed production and other crops as well. Using artificial hives so recommended to framers for many reasons easy to handle, storage and reuse. In addition, by using the hives it could help for keep these bees in nature and save it from disappear. However, the high seed production had been shown by the recent and previous studies. 1/3 of human diets are responsible of bee pollination; recommending farmers which such kind of information of wild bees hopefully will increase crop production and better life.

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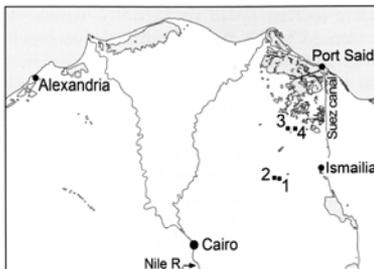


Figure 1. Positions of natural leafcutting bee nests, 1- 2 (Tel El-Kebir); 3 -4 (El- Huseiniya).

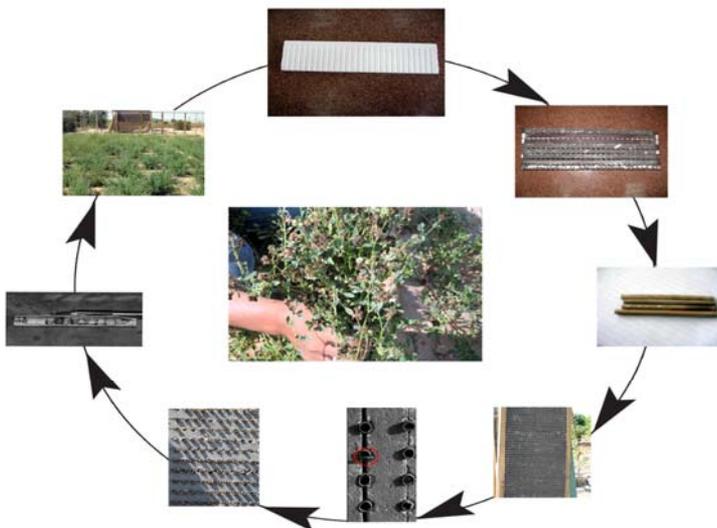


Figure 2. The manufacture processing of leafcutting bees hives.

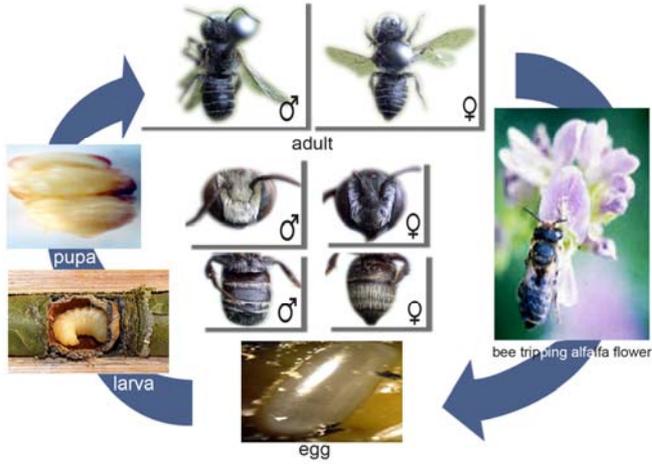


Figure 3. Lefacutting bees life cycle.

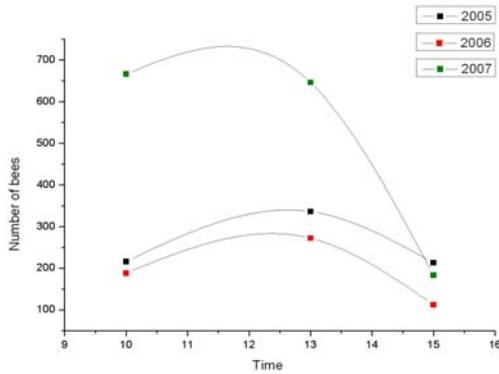


Figure 4. The total number of bees at three times per day at 2005, 2006 and 2007.

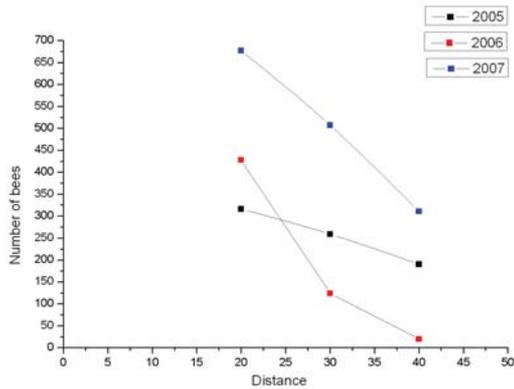


Figure 5. The total number of bees at three distances from the nest at 2005, 2006 and 2007.