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SHORT COMMUNICATION

The impact of leafcutting bee (*Megachile minutissima*, Megachilidae, Hymenoptera) (Radoszkowski, 1876) artificial nest sites on seed production of alfalfa, Ismailia, Egypt

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Alfalfa, *Medicago sativa* (L, 1753), is a high quality forage and green manure crop that originated in the Middle East. Currently there are 80-120,000 hectare of alfalfa planted in Egypt, and acreage is rising each year especially in the newly reclaimed lands. The leafcutting bees are very important pollinator of alfalfa, artificial nests were prepared and transferred to experimental field. The experimental field was divided into three main parts close to the nest (20 m), near to the nest (30 m), and far from the nest (40 m). 12 plants were labeled for each location and subjected for counting total number of open flowers, pods, seeds, weight of seeds and weight of seeds per each plant. 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. The average number of pods was 17.25; average number of seeds /100 pods was 288.5, dry weight of 100 seeds was 0.25 g and average weight of seed per each plant was 5.42 g .

Key words: leafcutting bees, artificial nesting, alfalfa pollination, seed production

INTRODUCTION

Agriculture development in Egypt has been a national goal during the last decades. This development has involved several approaches e.g. expansion of cultivated land, maximization of land production and animal production. 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) (Hobbs 1965).

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).

Alfalfa (*Lucerne*) seed weight and number of seeds per pod are important characteristics, which have been associated with seed yield and seed quality. The position of the seed in the pod influenced seed weight. The largest seed occurred at the base of the pod. Both seed and pollen parents influenced seed weight and number of seeds per pod (Katepa – Mupondwa et al. 1996). Open flowers decreased more rapidly over time than total bracts in commercial alfalfa fields, indicating that the decline in open flowers was not strictly due to a decline in available flowers. Some of the decline in open flowers was

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apparently due to rapid turn over as flowers were pollinated by bees (Strickler 1997).The present study is aimed to study which is better to put the artificial in one site in the field or distribute it to cover the whole field in relation to seed production of alfalfa.

MATERIAL AND METHODS

Artificial nesting of Megachile minutissima (Radoszkowski, 1876)

Artificial bee nests were prepared in March 2006 and transformed to natural nest sites in Tel El Kebir (30°33' 30''N, 31°56' 13''E) about 50 kilometers west of Ismailia on the Delta of River Nile (Kamel et al. 2007).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 foam nests. The nests consist of 50 pieces of foam. Each piece was 50 cm length, 12 cm width and 2 cm thickness. In each piece of foam were 26 holes, the hole was 10 cm depth and 6 mm diameter. After sticking the foam pieces above each other holes were created in this block and the shelter was performed. Straws of paper tubes 10 cm in length and 5.2 mm internal diameter, one tube was putted in each hole. All foam nests were painted with black color for imitation of the natural nests. The artificial nests transferred to the natural nests sites in different villages of Tel El Kebir in April till the end of July 2006. The total numbers of bee shelters (nests) were 20 and the total numbers of emerged bees were 1495.

Experimental field preparation

In the beginning of October 2007, the experimental field of bees' research unit, Suez Canal University, Ismailia was prepared for alfalfa seed cultivation. The variety used was Ismailia 1 produced by Agricultural experimental station in Ismailia. The grown distance between plants was 30 cm and the total number of plant in the field was 1200 plants. Normal nitrogen fertilizer was added to the field. The experimental field divided into three parts near to the nest (20 m), near to the nest (30 m), and (far from the nest (40 m). To study the seasonal blooming of alfalfa, 36 of plants were labeled, 12 plants for each location. Each plant was subject to record the number of total flowers, number of total pods, number of seeds in 100 pods, weight of 100 seeds and average seed production per plant during blooming season of alfalfa. The blooming season start in med of March till end of May (seed production). The blooming season was synchronized with the leafcutting bees emergency which start at the end of March and end by the end of May. The whole field harvested in end of June.

Statistical analysis

The data were analyzed by using CoStat statistical method analysis.

RESULTS

As shown in Table 1, results indicated that there were no significant differences between the average number of flowers per inflorescence per plant, they were (22.75, 21.5 and 20.75 flowers per inflorescence), for 20 m, 30 m and 40 m distance from the artificial nests, respectively. In the case of numbers of pods, results were (17.25, 15.75 and 10 pods per inflorescence) for 20 m, 30 m and 40 m distance from the artificial nests, significant differences between the treatments were found. Table 1 also showed that there were no significant differences between the average numbers of seed per 100 pods for all treatments, average numbers were (288.5, 238.25 and 249.5) seeds per pods for 20m, 30m and 40m distance from the artificial nests, respectively. There were significant differences between dry weights of 100 seeds for all treatments; weights were (0.25, 0.22 and 0.17 g) for 20 m, 30 m and 40 m distance from the artificial nests, respectively. Concerning the weights of seeds per plant, there were significant differences between seed weights for all treatments, the highest weights was for 20 m distance from the artificial nests (5.42 g) followed by (4.2 g) for 30 m and the lower seeds weights was for 40 m distance from the artificial nests (1.75 g).

Table 1. The number of flowers, pods, seeds /100 pods, weight of 100 seeds and weight of seeds per one plant in relation to the distance from the artificial nests in 2007 (20 m, near to the nest (30 m), and (far from the nest (40 m)

Treatment	Average No. of flowers	Average No. of pods	Average No. of seeds /100 pods	Dry weight of 100 seeds g	The average weight of seeds / one plant g
F1*	22.75[a]	17.25[a]	288.5[a]	0.25[a]	5.42[a]
F2	21.5[a]	15.75[a]	238.25[a]	0.22[a]	4.20[b]
F3	20.75[a]	10.00[b]	249.50[a]	0.17[b]	1.75 c
L.S.D at 5%	2.40	2.20	74.00	0.03	0.94

F1 20 m (near to the nest)

F2 30 m (far from the artificial nests)

F3 40 m (far from the artificial nests)

DISCUSSION

The data showed in Table 1 agree show how the foraging activity of leafcutiing bees and the distance have a big influence on the alfalfa seed production. The flower abundance and pollinator movement have a impact on seed or fruit yield and may have implications for crop pollinator management. Alfalfa may yield less seed when flowers are abundant; suggesting that early introduction of bees into alfalfa is desirable to maintain a low flower standing crop (Strickler 1997). Composite pattern of floral resource availability demonstrated an initial burst of bloom, followed by a linear decline in total flower per raceme

and an exponential decline in number of racemes with open flowers over the season. Number of open flowers and nectar availability declined more rapidly close to bee shelters than at a distance from them (Strickler and Freitas 1999). Environmental influence and pod position effects on seed weight and number of seeds per pod were small when compared with genetic effects. Selection for seed characteristics in seed and pollen parents could improve alfalfa seed production and seed quality (Katepa – Mupondwa et al. 1996). Leafcutting bee *Megachile rotundata* (Fabricius, 1793) appears to move with a 56% probability of leaving a given raceme and a given plant; this foraging behavior results in a few flowers visited per plant (Strickler and Vinson 2000).

The more rapid decline in open flowers per raceme close to bee shelters was consistent with this interpretation. The model of alfalfa pollination predicts a similar decline in flower standing crop of open flowers decreases and thus pollination was completed sooner. An exponential decline was standing crop of open flowers provides an explanation for the advantage of using large numbers of bees to pollinate alfalfa rapidly (Strickler 1997). To reach the maximum production of seed yields, the shelters of bees should be repeated every 20-30 m. More research could be carried out to find the relation between the adequate numbers of bees to reach the maximum production per one plant of alfalfa.

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