

**MANIPULATION OF THE SEVEN SPOTTED LADY BEETLE,
COCCINELLA SEPTEMPUNCTATA (COLEOPTERA :
COCCINELLIDAE) FOR CONTROLLING THE WOOLLY APPLE
APHID, *ERIOSOMA LANIGERUM* (HOMOPTERA : APHIDIDAE)**

ASHRAF A. H. MANGOUD

Plant Protection Research Institute, ARC, Dokki, Giza, Egypt

(Manuscript received 23 May 2006)

Abstract

The seven-spotted ladybird, *Coccinella septempunctata* L. (Coleoptera:Coccinellidae) is an important predator of aphids play a good role in reducing the population density of *Eriosoma lanigerum* attacking apple trees. *C. septempunctata* was released (one time), at early April 2004 and repeated in 2005, at Qualubia Governorate at rates of 30, 60 and 90 eggs/tree. During the first season (2004), the percent reduction of *E. lanigerum* increased gradually with elapse of time reaching the maximum in early Nov. The achieved average reductions in aphid population were 72.3, 87.3 and 95.5% in the end of November, respectively. The same trend of percent reduction of *E. lanigerum* was achieved in the second season (2005). The following percent reduction exhibited 77.1, 90.1 and 96.0% at release rate of 30, 60 and 90 eggs *C. septempunctata*, respectively.

From the above mentioned results, the seven-spotted ladybird, *Coccinella septempunctata* L. could be used successfully, as a biocontrol agents in the integrated program for controlling the woolly apple aphid, *Eriosoma lanigerum* (Hausmann) on the apple trees, for minimizing the risk use of insecticides on public health and environment.

INTRODUCTION

The woolly apple aphid, *Eriosoma lanigerum* (Hausmann) (Homoptera : Aphididae) is a monophagous species and a bark feeder, infesting both the trunk (arboreal population) and root (edaphic populations) of apple trees (Baker, 1915). This aphid attacks the trunks and branches of apple trees from mid-February until mid-November. When the temperature decreased in winter, the insects migrate to the crown region (Ismail *et al.*, 1990). Root galls and trunk splits began forming as a result of aphid feeding after only 4 and 8 weeks. Then the rate of infested trees had decreased and dry weight of roots, shoots and leaves were greater (Wiber and Brown, 1988).

The seven-spotted ladybird, *Coccinella septempunctata* L. (Coleoptera : Coccinellidae) is the commonest ladybird beetle known in Egypt, it is an important predator of many species of aphids; eggs and small nymphs of mealybugs, jassids, eggs and larvae of cotton leafworm (Ibrahim, 1948 & 1955b). The adults and early stages are often encountered in large numbers on the plants infested with aphids. They feed on these harmful insects and often play a great role in suppressing them

under control. It prey on eggs, larvae and adults of many species of insects and most important as a predator on aphids (Ibrahim, 1955a). Both the adult and larval stages feed on insects harmful to plants, such as aphids and scale insects (Anonymous, 1997). Adults can be consuming up to 100 aphids per day (Arnett *et al.*, 1980). The ladybug kills its prey outright and then devours it (Waldbauer, 1998).

The present work aimed to evaluate the management of the woolly apple aphid, *Eriosoma lanigerum* (Homoptera : Aphididae) by releasing the seven spotted lady beetle, *Coccinella septempunctata* (Coleoptera : Coccinellidae) on apple trees at Qalubiya Governorate.

MATERIALS AND METHODS

1. Mass rearing of the seven-spotted ladybird, *Coccinella septempunctata* and its prey the Cowpea aphid, *Aphis craccivora* (Koch):

1.1. Mass rearing of *A. craccivora* as a prey:

A. craccivora is considered the most preferable prey for mass production of *C. septempunctata*. Strong culture of this aphid should be available during the rearing time to maintain the predator rearing process.

The broad bean, *Vicia faba* seeds were planted in plastic trays (25X 40X15 cm) or foam trays (60X25X20 cm with 109 wholes) contained (peatmoss). The seeds were planted at 1-2 cm deep and followed with irrigation and fertilizers as required. When the first leaflet appeared after about one week from cultivation. Bean leaves were infested with *A. craccivora* which distributed over the new foliage of cultivated trays.

The infested trays were followed until the population of *A. craccivora* increased and become suitable for using as prey to the ladybird, *C. septempunctata*.

A. craccivora colonies were cultured under laboratory conditions (23±2°C and 60±5 %R.H.) on broad beans (*Vicia faba*). Such leaves of beans were infested by different stages of aphids and kept under a glass chimney which its upper opening was covered with white muslin. The potted plants were irrigated and fertilized whenever necessary and kept in wooden cages (100x135x135 cm) with nylon gauze sides using the method described by Mangoud (2003). *A. craccivora* instars were originally collected from infested broad beans, cultivated in Agriculture Research Center Farm.

1.2. Mass rearing of *C. septempunctata*:

When the population of *A. craccivora* increased and reached to suitable density individuals (approximately 100 individuals/plant) these plants were inoculated with *C. septempunctata*. The stock of ladybird was obtained from infested plants and transferred to laboratory. Only 10 adult ♂ + 10 adult ♀ of ladybird (to prevent larval cannibalism) were transferred to rearing cages (30 cm diameter X 25 cm high) and

kept in wooden cages (100x135x135 cm) with nylon gauze sides. To maintain the predator culture, with a suitable number of the prey were daily offered to the predator.

1.3. Egg picking:

The method for egg laying [black polyethylene strips fixed inside a plastic cylindrical (10 cm length X 2 cm diameter) for laying eggs and put in the rearing pots]. After laid egg-masses, they removed from plastic cylinders to separate the egg-masses from the cylindrical plastic and to be ready to sticky on the card for releasing. The plastic cylinder must be checked twice/day for egg-masses because of the cannibalistic habits of the adult, especially when there was a shortage of host food. In order to provide the developing larva with sufficient food throughout their developmental period, it was necessary to increase the amount of food with the advancement of their development.

2. Release of *C. septempunctata*:

Releasing study was conducted on Balady apple trees *Pyrus malus* (Mill) (Anna/Balady), at Qualubia Governorate during 2004 and 2005 years. The selected apple trees for the present investigation were away from any pesticide contamination for five months. The trees were similar in size, age, shape, height and vegetation as possible. They were infested by *E. lanigerum* aged about 12 years old, with about 4-5 meters in height.

Three levels of *C. septempunctata* eggs; first level consists of 30 eggs (one card), second level consists of 60 eggs (two cards) and the third one consists of 90 eggs (three cards). *C. septempunctata* were released (one time), by the beginning of April 2004 and repeated in the same time in 2005 years. The apple trees were divided into 4 replicates each replicate consists of 4 trees (16 trees) for each plot. Another 16 trees were selected to be as a check plot. *C. septempunctata* were released by hanging the carton cards including egg-mass in the centre of each tree as described by Mangoud (2003).

Samples were randomly taken monthly and counting started from the beginning April till the beginning November, which consider as the best time for release (Mangoud, 2000).

Each sample represented by 2 square inches were take after remarking the two inches by using marker, one inch from the trunk and the other inch from main branches. The sampled aphids were kept separately in plastic cups 5X9 cm covered with muslin cloth and held in position by rubber bands to prevent the insect escaping. They were then transferred to the laboratory for counting by the aid of a stereomicroscope.

Samples were microscopically inspected to estimate both aphids' individuals as well as the number of predators.

3. Statistical analysis:

The percent reduction of *E. lanigerum* aphid after *C. septempunctata* released was calculated according to Henderson and Tilton equation (1955).

RESULTS AND DISCUSSION

The seven-spotted lady bird, *Coccinella septempunctata* L. lives in a wide variety of habitats. Any place where there are infestation aphids may attract this species (Fleming, 2000).

I. Release of *C. septempunctata*:

I.1. First year (2004):

Three levels of *C. septempunctata* eggs; first level (30 eggs on one card), second level (60 eggs on two cards) and the third level (90 eggs on three cards) were released (one time), by the beginning of April 2004.

I.1.a. First level of release (30 eggs/tree):

In first level of release the pre-count in the releasing area with *E. lanigerum* was 179 individuals/2 square inches, while it was also 172 individuals/2 square inches in (check trees).

The results in Fig. (1) indicated that the number of *E. lanigerum* in the 1st release plot decreased gradually from 172 on April to 171, 169, 161, 145, 111, 61 and 41 on May, June, July, August, September, October and November, respectively as compared to check plot (aphid populations changed from 172 individuals/2 square inches on April to 245, 329, 315, 288, 273, 198 and 155 individuals/2 square inches in the same dates, respectively). Also, the results show that the percent reduction of *E. lanigerum* in 1st release plot increased gradually to reach 26.8, 45.5, 46.4, 47.2, 57.4, 67.7 and 72.3% on May, June, July, August, September, October and November, respectively.

I.1.b. Second level of release (60 eggs/tree):

In the second level of release the pre-count numbers of *E. lanigerum* in release area were 152 individuals/2 square inches, while reached 155 individuals/2 square inches in (check trees).

The results in Fig. (2) indicated that the number of *E. lanigerum* in the 2nd release plot decreased gradually from 152 on April to 141, 155, 121, 95, 44, 31 and 18 individuals/2 square inches on May, June, July, August, September, October and November, respectively as compared to check plot (aphid populations changed from 155 individuals/2 square

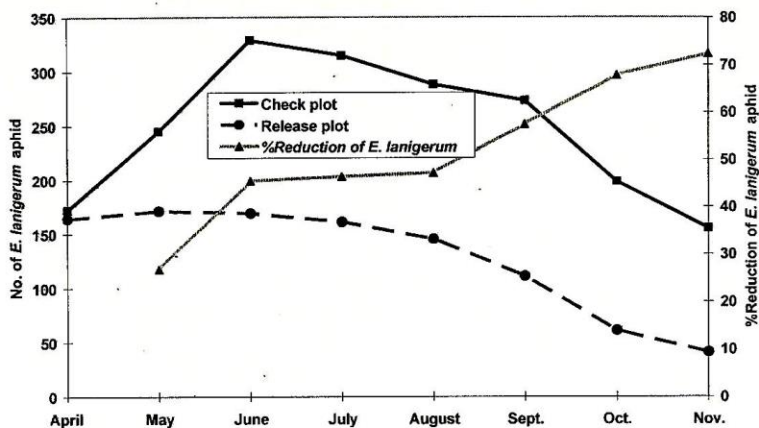


Fig. 1. Fluctuation in the population numbers of the woolly apple aphid, *Eriosoma lanigerum* in the 1st plot release at level of (30 eggs) and the corresponding %reduction of the aphid on apple trees during 2004.

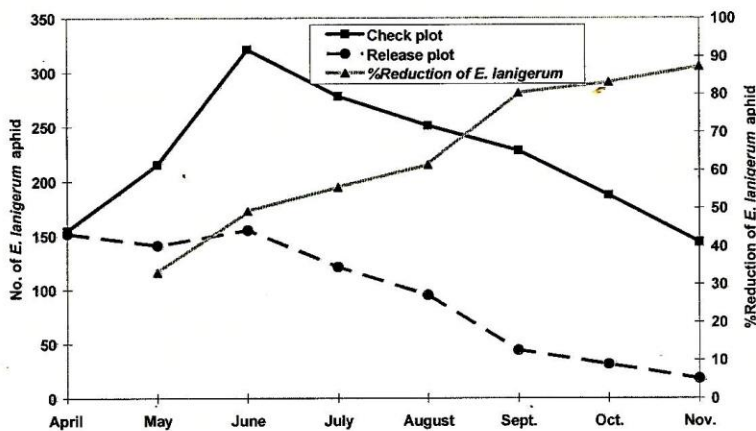


Fig. 2. Fluctuation in the population numbers of the woolly apple aphid, *Eriosoma lanigerum* in the 2nd plot release at level of (60 eggs) and the corresponding %reduction of the aphid on apple trees during 2004.

inches on April to 215, 321, 278, 251, 228, 187 and 144 individuals/2 square inches in the same dates, respectively). Also, the results show that the percent reduction of *E. lanigerum* in 2nd release plot increased gradually showing 33.1, 49.3,

55.6, 61.4, 80.3, 83.1 and 87.3% on May, June, July, August, September, October and November, respectively.

I.1.c. In third level of release (90 eggs/tree):

In the third level of release the pre releasing numbers of *E. lanigerum* before release were 170 individuals/2 square inches, while reached 166 individuals/2 square inches in (check trees).

The results in Fig. (3) indicated that the number of *E. lanigerum* in the 3rd release plot decreased dramatically from 170 on April to 127, 121, 90, 55, 31, 18 and 6 individuals/2 square inches on May, June, July, August, September, October and November, respectively as compared to check plot (aphid populations changed from 166 individuals/2 square inches on April to 224, 297, 264, 231, 212, 187 and 131 individuals/2 square inches in the same dates, respectively). Also, the results show that the percent reduction of *E. lanigerum* in 3rd release plot increased gradually reaching 44.6, 60.2, 66.7, 76.8, 85.7, 90.6 and 95.5% on May, June, July, August, September, October and November, respectively.

These results are in agreement with those obtained by Weber and Brown, (1988) who found the population's *E. lanigerum* on roots were more damaging than populations on trunk and main branches. Therefore edaphic *E. lanigerum* can be successfully controlled by releasing *C. septempunctata*, whereas arboreal *E. lanigerum* controlling before migration from trunk and main branches to roots to prevent root galling. This galling interferes with water and nutrient transport.

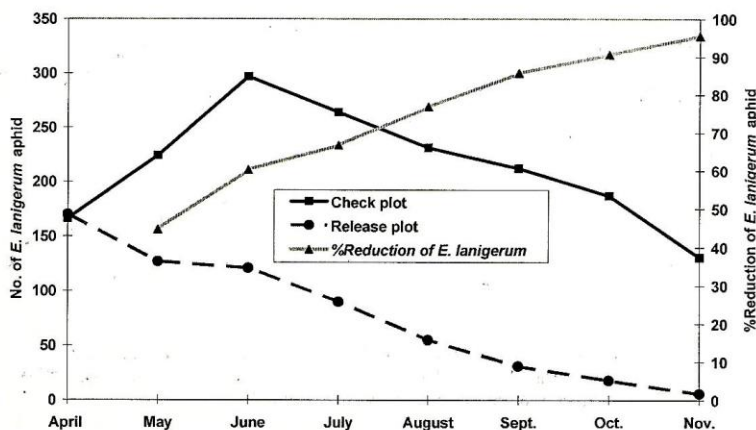


Fig. 3. Fluctuation in the population numbers of the woolly apple aphid, *Eriosoma lanigerum* in the 3rd plot release at level of (90 eggs) and the corresponding %reduction of the aphid on apple trees during 2004.

I.2. Second year (2005):

Also, three levels of *C. septempunctata* eggs; first level (30 eggs on one card), second level (60 eggs on two cards) and the third level (90 eggs on three cards) were released (one time), by the beginning of April 2005 year.

I.2.a. In first level of release (30 eggs/tree):

In the first level of release the pre-count numbers of *E. lanigerum* before release were 88 individuals/2 square inches, while reached 191 individuals/2 square inches in (check trees).

The results in Fig. (4) indicated that the number of *E. lanigerum* in the 1st release plot decreased gradually from 88 on April to 71, 60, 54, 40, 33, 19 and 17 on May, June, July, August, September, October and November, respectively as compared to check plot (aphid populations changed from 191 individuals/2 square inches on April to 264, 371, 345, 297, 287, 177 and 161 individuals/2 square inches in the same dates, respectively). The percent reduction of *E. lanigerum* in 1st release plot increased gradually as follows 41.6, 64.9, 66.0, 70.8, 75.0, 76.7 and 77.1% on May, June, July, August, September, October and November, respectively.

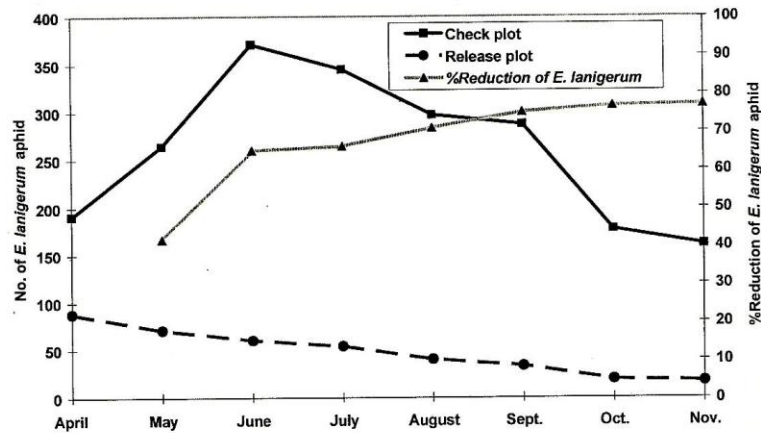


Fig. 4. Fluctuation in the population numbers of the woolly apple aphid, *Eriosoma lanigerum* in the 1st plot release at level of (30 eggs) and the corresponding %reduction of the aphid on apple trees during 2005.

I.2.b. In second level of release (60 eggs/tree):

In the second level of release, the pre-count numbers of *E. lanigerum* before release were 45 individuals/2 square inches, while reached 174 individuals/2 square inches in (check trees).

The results in Fig. (5) indicated that the number of *E. lanigerum* in the 2nd release plot decreased gradually from 45 on April to 32, 25, 22, 17, 11, 8 and 4 individuals/2 square inches on May, June, July, August, September, October and November, respectively as compared to check plot (aphid populations changed from 174 individuals/2 square inches on April to 267, 314, 345, 299, 214, 199 and 156 individuals/2 square inches in the same dates, respectively). The percent reduction of *E. lanigerum* in 2nd release plot increased gradually as follows 53.7, 69.2, 75.3, 78.0, 80.1, 84.5 and 90.1% on May, June, July, August, September, October and November, respectively.

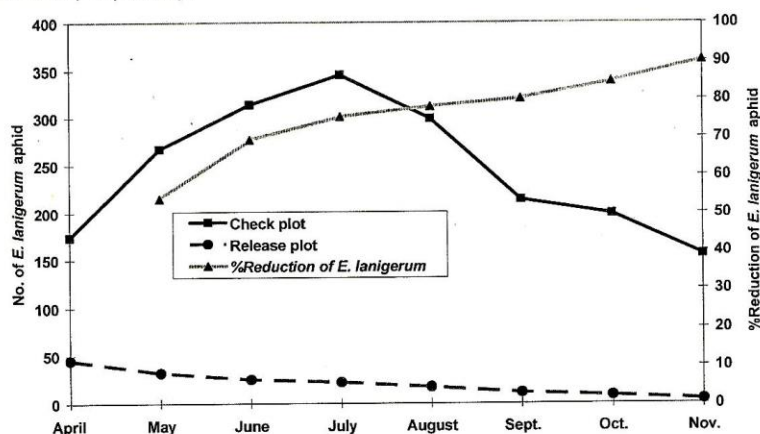


Fig. 5. Fluctuation in the population numbers of the woolly apple aphid, *Eriosoma lanigerum* in the 2nd plot release at level of (60 eggs) and the corresponding %reduction of the aphid on apple trees during 2005.

I.2.c. In third level of release (90 eggs/tree):

In the third level of release, the pre-count numbers of *E. lanigerum* before release were 25 individuals/2 square inches, while reached 155 individuals/2 square inches in (check trees).

The results in Fig. (6) indicated that the number of *E. lanigerum* in the 3rd release plot decreased gradually from 25 on April to 12, 9, 8, 5, 2, 1 and 1 individuals/2 square inches on May, June, July, August, September, October and Nov., respectively as compared to check plot (aphid populations changed from 155 individuals/2 square inches on April to 187, 201, 211, 198, 184, 176 and 154 individuals/2 square inches in the same dates, respectively). Accordingly, the percent reduction of *E. lanigerum* in 3rd release plot increased gradually as follows 60.1, 72.2, 76.5, 84.3, 93.3, 96.5 and 96% on May, June, July, August, September, October and Nov., respectively.

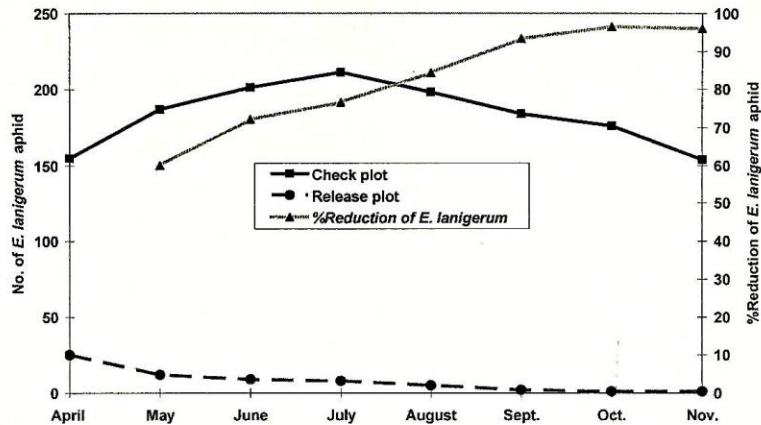


Fig. 6. Fluctuation in the population numbers of the woolly apple aphid, *Eriosoma lanigerum* in the 3rd plot release at level of (90 eggs) and the corresponding %reduction of the aphid on apple trees during 2005.

The results which obtained from the first year (2004) show that as a result of releasing *C. septempunctata* the numbers of aphid which migrated in winter from aerial parts (main branches and trunk) to underground parts (roots) was low, therefore the infestation by *E. lanigerum* in the second year (2005) decreased.

These results are in harmony with those obtained by Hoyt and Madsen (1960) found the control of *E. lanigerum* is complicated by the continue dispersal of aphids from the roots to the aerial portions of the tree, and a corresponding dispersal in the opposite direction. Release *C. septempunctata* adopted here can cope very well with this behaviour.

In this respect, Singh (2003) found the feeding efficiency of the predator, *C. septempunctata* increased progressively on *E. lanigerum*, with the development of grub stages of the predator. The consumption of woolly aphid by the grub uniformly decreased with increase in size of woolly aphid at all stages of the grub.

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تقييم كفاءة أبو العيد ذو السبع نقاط في خفض تعداد من التفاح الصوفي على أشجار التفاح

أشرف عبد السلام هندي منجود

معهد بحوث وقاية النباتات - مركز البحوث الزراعية - الدقي - جيزة - مصر

يعتبر من التفاح الصوفي من أهم الآفات التي تصيب أشجار التفاح خاصة الأشجار المطعومة علي أصول بلدي في مصر. يرتبط بهذا النوع من المن مفترس قوي وهو أبو العيد ذو السبع نقط. أجري هذا البحث لتقييم مستويات مختلفة من الإطلاق (٣٠، ٦٠، ٩٠ بيضة موضوعة علي كروتون) في خفض تعداد من التفاح الصوفي علي أشجار التفاح بمحافظة القليوبية خلال موسمين متتاليين ٢٠٠٤، ٢٠٠٥.

أدي إطلاق هذا المفترس بمستوي ٣٠ بيضة/شجرة الي خفض نسبة الإصابة بمن التفاح الصوفي بنسبة وصلت أقصاها ٧٢,٣% وذلك في بداية نوفمبر خلال عام ٢٠٠٤. بينما أدي إطلاق هذا المفترس بمستوي ٦٠ بيضة/شجرة خفض نسبة الإصابة بمن التفاح الصوفي وصلت أقصاها الي ٨٧,٣% وذلك في بداية نوفمبر خلال عام ٢٠٠٤. بينما أدي مستوي إطلاق المفترس بمعدل ٩٠ بيضة/شجرة الي خفض نسبة الإصابة بمن التفاح الصوفي وصلت أقصاها الي ٩٥,٥% وذلك في بداية نوفمبر خلال عام ٢٠٠٤.

في الموسم التالي ٢٠٠٥، أدي إطلاق هذا المفترس بمستوي ٣٠ بيضة/شجرة الي خفض في نسبة الإصابة بمن التفاح الصوفي وصلت أقصاها الي ٧٧,١% وذلك في بداية نوفمبر خلال عام ٢٠٠٥. بينما أدي إطلاق هذا المفترس بمستوي ٦٠ بيضة/شجرة الي خفض في نسبة الإصابة بمن التفاح الصوفي وصلت أقصاها الي ٩٠,١% وذلك في بداية نوفمبر خلال عام ٢٠٠٥. كما أدي إطلاق المفترس بمستوي ٩٠ بيضة/شجرة الي خفض في نسبة الإصابة بمن التفاح الصوفي وصلت أقصاها الي ٩٦% وذلك في بداية نوفمبر خلال عام ٢٠٠٥.

ومن النتائج السابقة يمكن استخدام المفترس الحشري أبو العيد ذو السبع نقاط بنجاح كأحد عناصر المكافحة البيولوجية الفعاله في برامج المكافحة المتكاملة لمن التفاح الصوفي علي أشجار التفاح.