Anatomical study of the association between *Cuscuta chinensis* and it's host plant (*Ocimum basilicum*).

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Abstract

This work was carried out in a farm in (Kurkuk) province. This investigation was conducted to evaluate the anatomical relationship between dodder (*Cuscuta chinesis*) and it's host plant (*Ocimum basilicum*). The samples were collected from the infected parts of the host that found in infested field. These results showed the destructive effects of the dodder on the anatomical structure of the host plant. The aim of the present work is to investigate the anatomical association between dodder (*Cuscuta chinensis*) and (*Ocimum basilicum*) in order to focus more lights on the mechanism of parasitism in this parasitic flowering plants.

Keywords: *Cuscuta chinesis*, *Ocimum basilicum*, parasitic plants.

Introduction

Cuscuta is classified as a member of Cuscutaceae (Swift, 1996) or Convolvulaceae (Visser, 1981; Nickrent, 2005 and Stefanovic *et al*., 2002). Convolvulaceae or Cuscutaceae as described by Visser, (1981) included only one genus which is *Cuscuta*, while others separated this family into two genera, *Cuscuta* with one genus, and *Grammica* which include five species based on the shape of the stigma (Swift, 1996).

In Iraq, the following species have been recorded: *Cuscuta arabica*, *Cuscuta babylonica*, *Cuscuta chinensis*, *Cuscuta kurdica*, *Cuscuta kostschyana*, *Cuscuta palaestina* and *Cuscuta planiflora* (Chakravarty, 1976).

All species of *Cuscuta* are likely to passess allied medicinal properties (Chakravarty, 1976), for example, effects of the flavonoids extracted from *Cuscuta sinesis* on the reproductive-endocrine system of male rats (Qin et al., 2000).

Dodder (*Cuscuta sp*.) is an annual stem angiosperm. Seedlings of dodder are leafless and rootless with twining tendrils (Haidar, et al., 1998). They are twining herbs with reduced vegetative organs attach to the host by stem haustoria, that vary in color from pale green to yellow or bright orange. The haustoria which already formed in the parent plant make their way into the host and attach their xylem and phloem-element to the corresponding elements of it's vascular bundles. It is long, slender, thin-walled, with abundant protoplasmic contents and their cells contain large nuclei and great capacity for growth (Sibony et al, 1999). The haustoria absorb the water, organic matter, and nutrients (Garcia, 2004, and Lanini, *et al*., 2002). The haustorium itself plays an important role in establishing a tight contact between the host and the parasite (Kujit, 1969). When it contacts a host, the stem coils around the host plant and produces small structures called haustoria that penetrate the host's vascular tissues (Lanini, *et al*., 2002). Parasitic plants have a negative effect on growth, reproduction and photosynthesis of their hosts (Koskela, *et al*., 2001). It is possible that major shifts at that familial or generic levels are due to a change in development (Atsatt, 1998).

Ocimum basilicum (common basil) is member of the family Lamiaceae. Basil is an annual herb which reaches to (0.5-0.9m) tall with green stems that are square in cross section (Peterson, 2003).

Basil as well as the oil which is extracted from it, have received a lot of attention for their potential medicinal properties. It has been widely used in cosmetics, perfumes, shampoos and soaps (Peterson, 2003).

Materials and methods:

1- Samples collection:

Samples (stems) of *Ocimum basilicum* infested by *Cuscuta chinesis* were collected in August, 2005 from Kurkuk city in the North of Iraq. The samples fixed in 2.5% glutaraldehyde in 0.1M Cacodelate buffer.

Anatomical method:

Tissue preparation

The following method of tissue sections preparation was performed:

-Plastic method (Arildite method):

The glutaraldehyde fixed samples were postfixed in 1% osmium tetroxide, dehydrate, cleared in acetone and embedded in araldite mixture. Half micrometer thick sections were stained by 1% toludin blue (Ruzin, 1999).

Results:

1- Morphology of *Cuscuta chinesis*

The size of infestation of *Ocimum basilicum* heavily infested with *Cuscuta chinensis* as shown in (Fig.1). Seeds have rough coats and vary in size depending on species but are generally about (0.16cm) in diameter. The bell shaped flowers are cream colored and small about (0.3cm) in long), usually occurring in cluster (Lanini, *et al*., 2002), the capsule in *Cuscuta chinensis* is globs-depressed, hermaphrodite (Fig.2(Fig.1).).

2- Anatomical study

Plastic sections of the attachment zone showed penetration of the haustorium into the host tissues destroying the epidermis and cortical cells (Fig.3). In the latter figure, part of structure called adhesive disk is appearing which represents the starting point of

infection. This disk has elongated cells especially in close to the host cells (Fig.4). A cementing material attaching the parasite and host cells has been seen as dark bands (Fig.5, a). Soon, the invadive cells spreads and reach the vascular tissues of the host (Fig.5, b)

Through penetration of host cells, the haustorial cells undergo high rate of proliferation and accumulation of starch granules (Fig.6). The mechanism of deep invasion by invadive cells includes xylem-xylem contact after differentiation of invadive parachymatous cells into xylem (Fig.7, 8). In some occasions, the differentiated invadive xylems destroy the host xylems and penetrate it for achieving the parasitic process (Fig.9).

Parasite invadive cells have no tendency to move through fibrous tissue, instead, they move around them towards the cells beneath it (Fig.10, a), and reach the pith cells of the host easily (Fig.10, b).

Fig. 1: (a) and (b) *(Ocimum basilicum)* heavily infested by *Cuscuta chinensis*

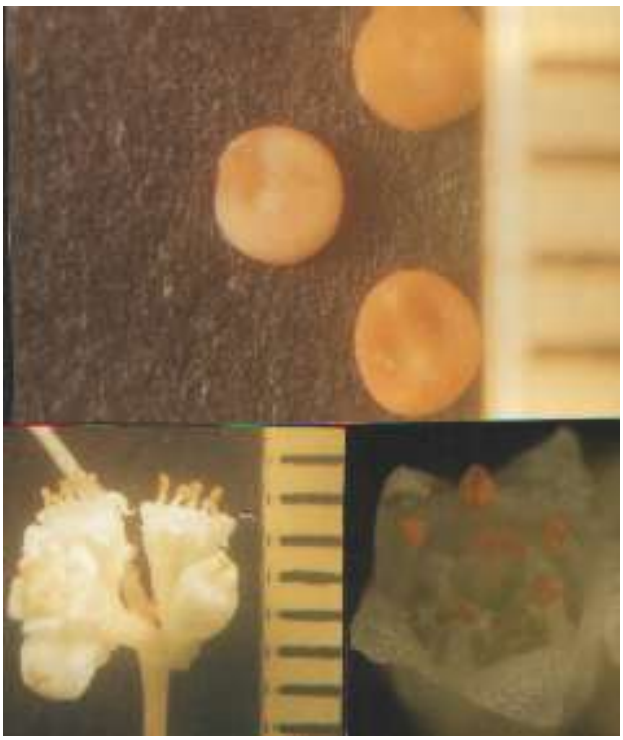

Fig. 2: (a) Shape and size of *Cuscuta chinensis*
(b) Cluster of flowers. (c) Magnified flower

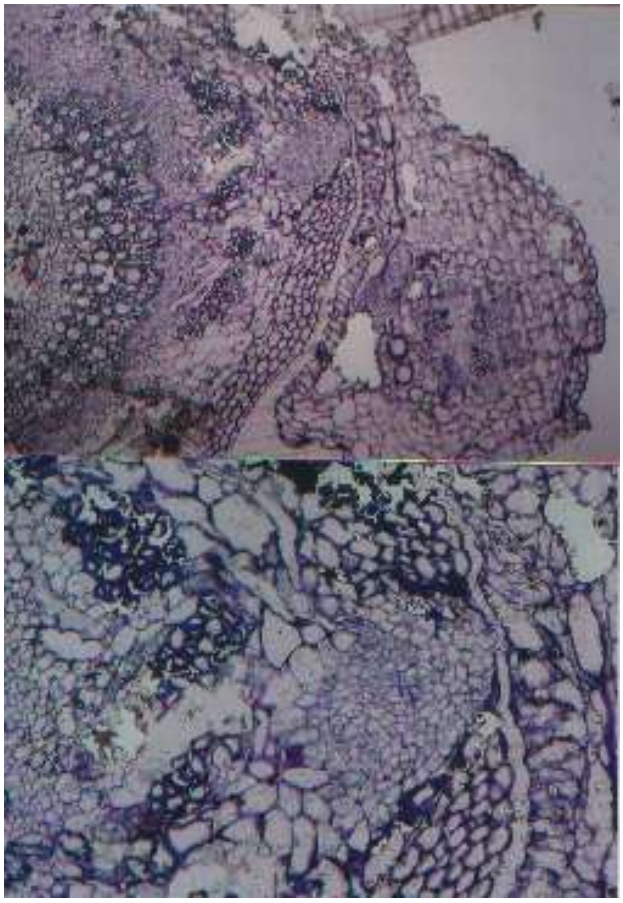

Fig. 3: *Ocimum basilicum* infested with *Cuscuta chinensis*

(a) Cross section showing the host – parasite association. (6.3X).
(b) Higher magnification showing haustorium cells (h). (16X)

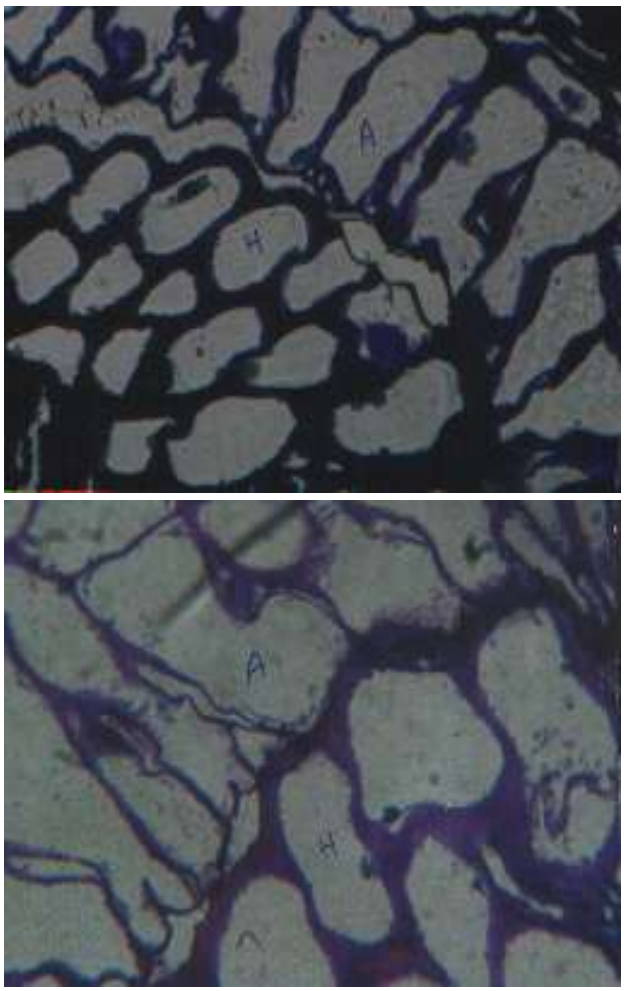

Fig. 4: (a) Attachment between cells of adhesive disk and host cells. (16X)
(b) Tight attachment between cells of adhesive disk (A) and host cells (H). (40X)

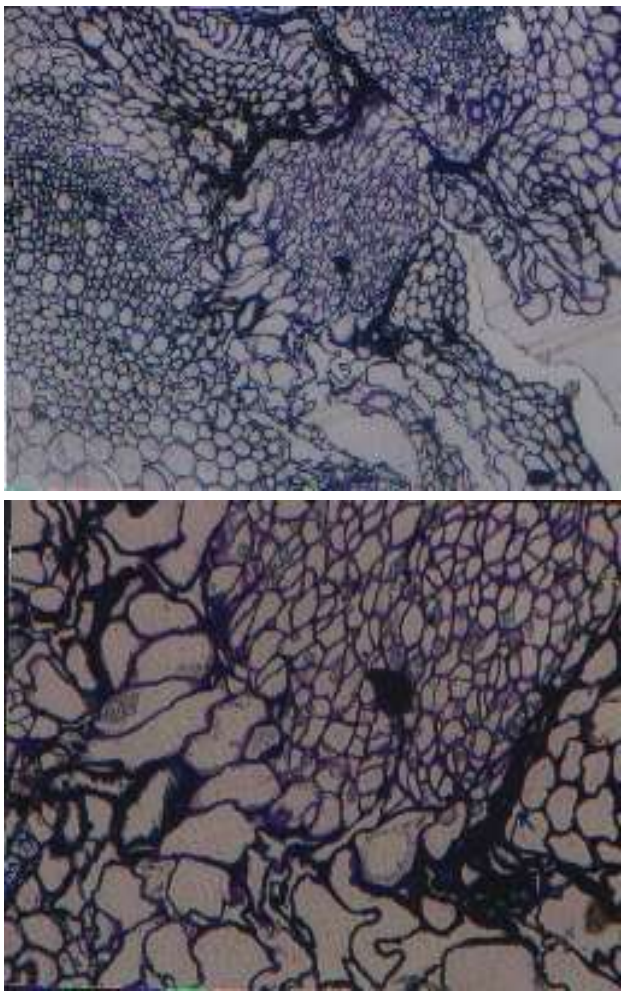

Fig. 5: (a) The host – parasite association showing the cementing material (↑). (6.3X).
(c) The invading cells (l) reached the vascular bundle (↑↑). (40X)

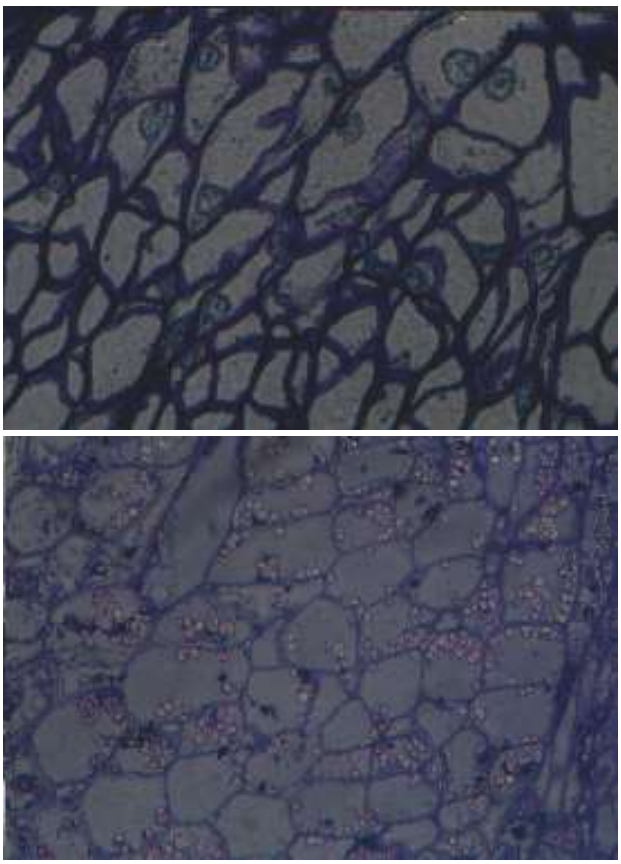

Fig. 6: (a) Haustorial cells. (100X).
(b) **Starch grains in parasite cells. (10X)**

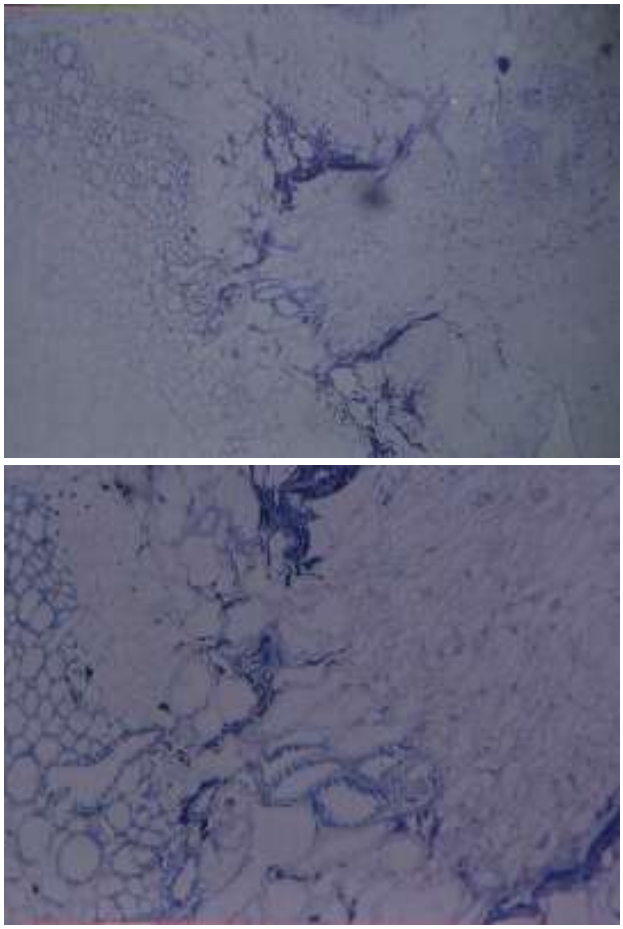

Fig. 7: Invadive cell differentiated to xylem (X1) then attached to host xylem (X2).

(a) 4X (b) 10X

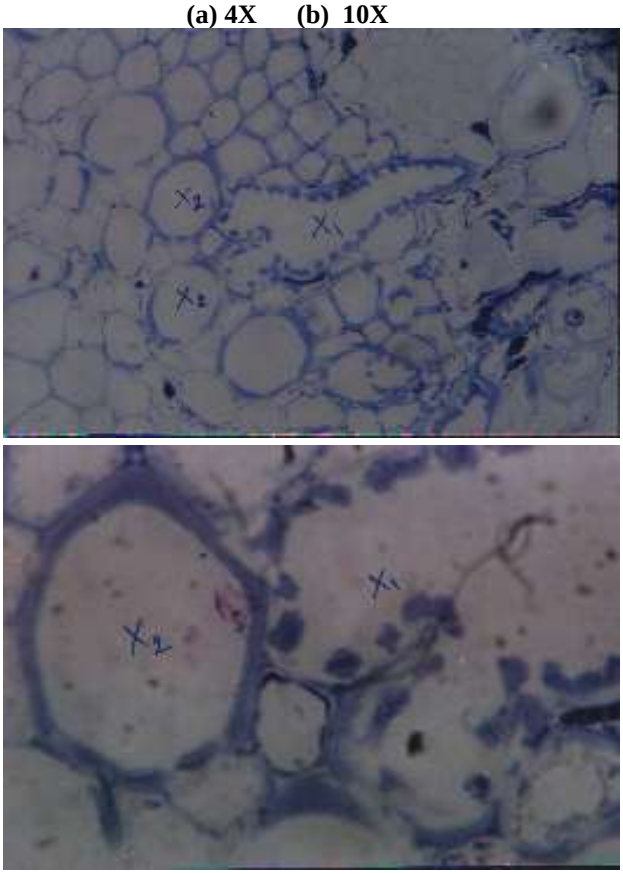

Fig. 8: Magnified (Fig. 7).
(a) 40X (b) 100X

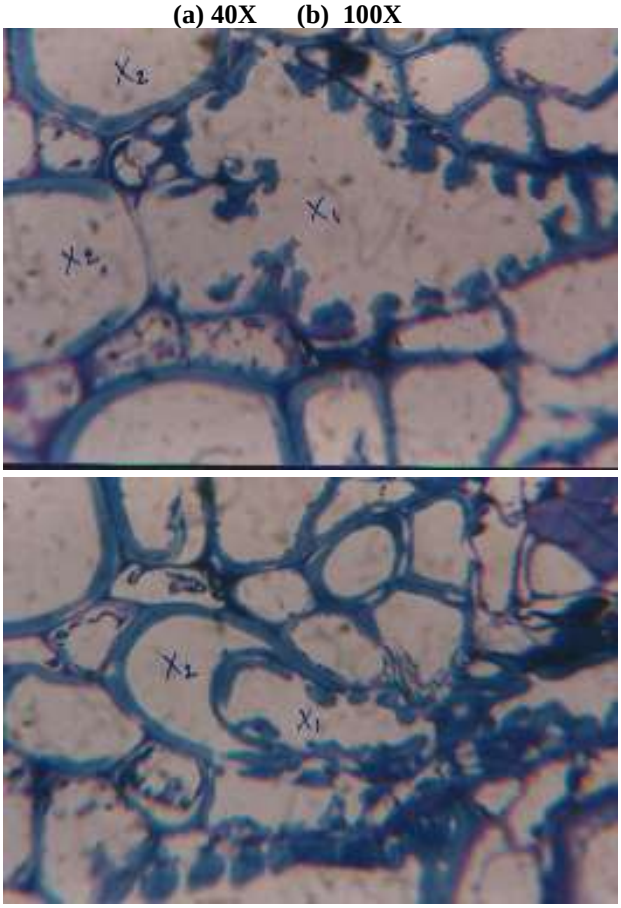

Fig. 9: (a) Invadive cell differentiated to xylem (X1) and attached to host xylem (X2). (100X).

(b) Another slide showing Invadive cell differentiated to xylem (X1) and destroyed the host xylem (X2) and enter it. (100X).

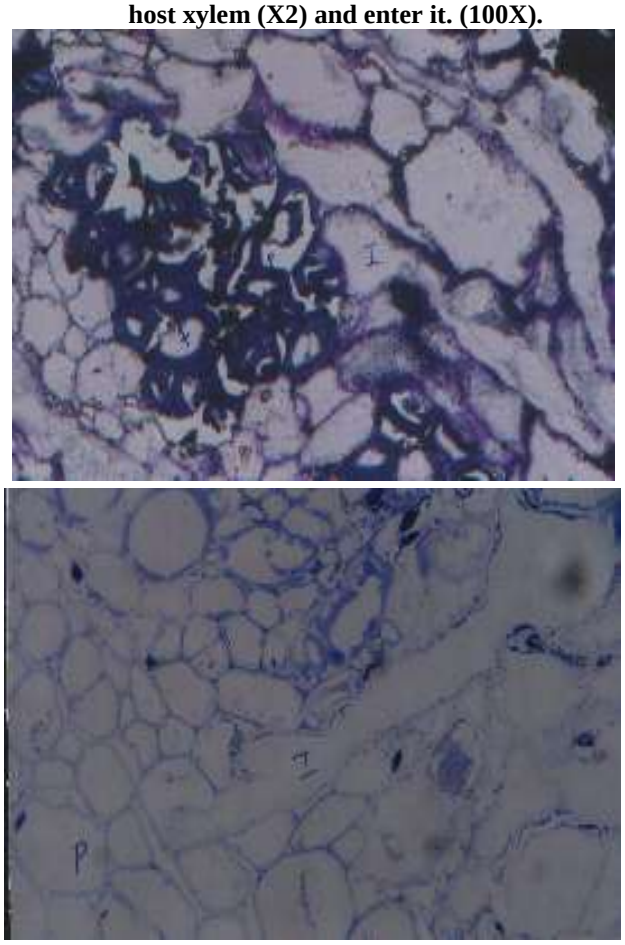

Fig. 10: (a) Invading cell (1) avoid the fibrous tissue (f) and destroying cells beneath it. (40X).

(b) Invading cell (1) reach the pith of the host (P). (40X).

Discussion

The large destructive capacity of dodder to the different hosts has drown attention of investigators to study the anatomical association between the host and parasite (Agrios, 1997).

The most important stage of infection by *Cuscuta* is the formation the adhesive disk, although the full mechanism for this formation or its induction is still unknown (Vaughn, 2002).

The term "adhesive disk" has been found to be more reliable (Kong et al., 2005). The adhesive disk of *Cuscuta chinesis* that infect *Ocimum sp.* has been modified itself very well to attach the epidermal cells of the host (Lee and Lee, 1989).

The haustorial cells are long, slender, thin- walled, with abundant protoplasmic contents, large nuclei and have great capacity for growth (Sibony *et al*., 1999).

Xylem lumen-lumen connection between host and parasite has been noted in this work which reflect high level of parasitism as this mechanism allow direct extraction of host solute (water and mineral salt) (Hibberd *et al*., 2001).

Fibrous tissue in *Ocimum* stem may act as structural barrier against penetration by the parasite.

Dodder is parasitic and cause damaging to leguminous crops, especially alfalfa and clover. It also impacts vegetable and forage crops, furthermore dodder can suppress or kill ornamentals native plants and weeds (Little et al., 2003).

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دراسة العلاقة التشريحية بين الحامول (*Cuscuta chinesis*) والنبات العائل الريحان (*Ocimum basilicum*)

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الملخص

اجري هذا البحث في احد الحقول الزراعية في محافظة كركوك. يتضمن هذا البحث دراسة العلاقة التشريحية بين الحامول (*Cuscuta chinesis*) والنبات العائل الريحان (*Ocimum basilicum*). جمعت هذه النماذج من الأجزاء المصابة للنبات العائل وهذا العمل يبين التأثيرات المدمرة للحامول على التركيب النسيجي للعائل. الهدف من هذا البحث هو تشخيص العلاقة التشريحية بين الحامول (*Cuscuta chinesis*) و الريحان (*Ocimum basilicum*) لغرض الحصول على معلومات إضافية لمعرفة آلية التطفل لهذه الطفيليات الزهرية.