WHEAT SEED GALL NEMATODE *ANGUINA TRITICI* IN DUHOK PROVINCE, KURDISTAN REGION - IRAQ AND ITS BIOLOGY.

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ABSTRACT

A survey of several wheat fields at Duhok province during 2010 and 2011 was carried out in Slevani (Duban) plain, Kemeka and Bakhetmi villages, fields around Semel city and other fields along roads of Kora and Kemeka to determine infection percentage by *Anguina tritici* . Highest infection during 2010 was 11% and 10.4% in wheat fields of Kemeka and Bakhetmi respectively, whereas the lowest was 0.56% in wheat field of Bakhetmi village during 2011.

***A tritici* completed its life cycle in 135- 165 days under field conditions at Faculty of Agriculture and Forestry, Semel-Duhok. Dimensions of Females were 2400 × 132.55 µm, whereas for males was 1790 × 82.19 µm and for second stage Juveniles (J_2) and eggs were 490 × 24.9 µm and 94.5 × 38.7 µm respectively.**

Introduction

Anguin tritici (Steinbuch,1799) Filipjev,1936 (Anguinidae,Tylinchida) was observed at the first time in England by John Needham in 1743 (Perry and Moens, 2006).Bhatti,*et al.,*(1978) stated that Ear- cockle was the oldest reported disease of wheat which was caused by *A. tritici*. It is one of the major aerial diseases and causes sustainable losses in wheat crop of tropical and sub-tropical countries (Kort,1972),and It is present wherever wheat is grown and this pest still common in Eastern Europe and in part of Asia and Africa (Agrios, 2005).Early records of nematode detection in the USA included California, Georgia, Maryland, New York, North and South Carolina, Virginia and West Virginia (CABI, 2005). In Iraq, the first record of ear-cockle disease reported by Rao in 1921.This nematode remained an important nematode pest in Iraq occurred in the most wheat growing areas by 22.9 to 45% on mexipac c.v. of Wheat (Al-Beldawi *et.al*.1974) increased to 75% on the same cultivar in Duhok Province in 1989 (Stephan and Antoon,1990), Ami, *et.al*.,(2004) reported that the percentage of infestation by galls reached its maximum value (50%) in bread wheat in Bashika - northern of Iraq. Ear- cockle disease reduces human consumption and market price of wheat (Paruthi and Bhatti, 1988), with significant reduction in the protein and gluten contents of the flour product of infested wheat with seed galls (Mustafa, 2009).

Symptoms of nematode attack can be discerned at seedling stage but farmers generally fail to recognize the disease before harvesting and threshing of the plant (Khan and Athar, 1996).The aim of this study is to determine the occurrence of ear –cockle disease in several wheat fields in Duhok province and then following the life cycle of the causal organism (*A. tritici)*.

Materials and Methods

Field survey:

Field survey was conducted in Duhok province by selecting several wheat fields at different locations involved: Bakhetmi village, Semel,Distance between Kora and Kemeka, kemeka village, and Slevani (duban) plain. Five fields were selected for each location to estimate infection percentage during two seasons (2010 and 2011).Samples were taken by walking in the field in two axis vertical with each other using wood Frame with an area of 1m².Wood Frame was thrown in two directions (left and right) alternatively and a number of infected plants were calculated to estimate infection percentage according to the following equation: Infection percentage = (Number of Infected plants ÷ Total number of plants in the frame) × 100

Description of some stages of *A.tritici*, life cycle and diagnostic symptoms of ear-cockle disease:

Many samples of green and mature galls were collected from diseased wheat plant

Cham-6 c.v. from trail fields, samples were opened in Petri dish containing distilled water under Stereomicroscope. Different stages were picked up on the slides containing a drop of lactophenol. Specimens were examined to measure the dimensions of eggs, J_2, females and males using light microscope which was calibrated with micrometer slide and eye piece 8×.Eggs measurements were accomplished by Eye-Piece Graticule, other stages were measured using camera Lucid.

Symptoms caused by *A. tritici* on wheat plants were described continuously through growing season to determine the appearance of nematode stages.

The following dimensions were calculated:

a- Length & width of eggs, J_2 , females and males (µm/stage). b- Distance between valve and posterior end of the female (µm/female). C- Length of spicule of male (µm/spicule).

RESULTS AND DISCUSSION

Field survey:

Results shown that the infection of wheat fields by seed gall nematode during 2010 increased significantly, particularly in fields of Kemeka village and declined in Semel city (Fig.1). In general the highest infection during 2010 was 11% and 10.4% in wheat fields of Kemeka and Bakhetmi respectively, whereas the lowest 0.56% was found in wheat field of Bakhetmi village during 2011. This reduction of infection in Bakhetmi (2011) might be due to early grazing of wheat seedlings in some fields infected severely and reduction in kemeka might due to field grazing and nematicide sprayed **(**personal communication with farmers in 2010**)** This might have caused the death of many wheat J_2 of *A. tritici* so the numbers of galls / plant decreased which caused reduction of inoculum source for the next growing season of 2011.

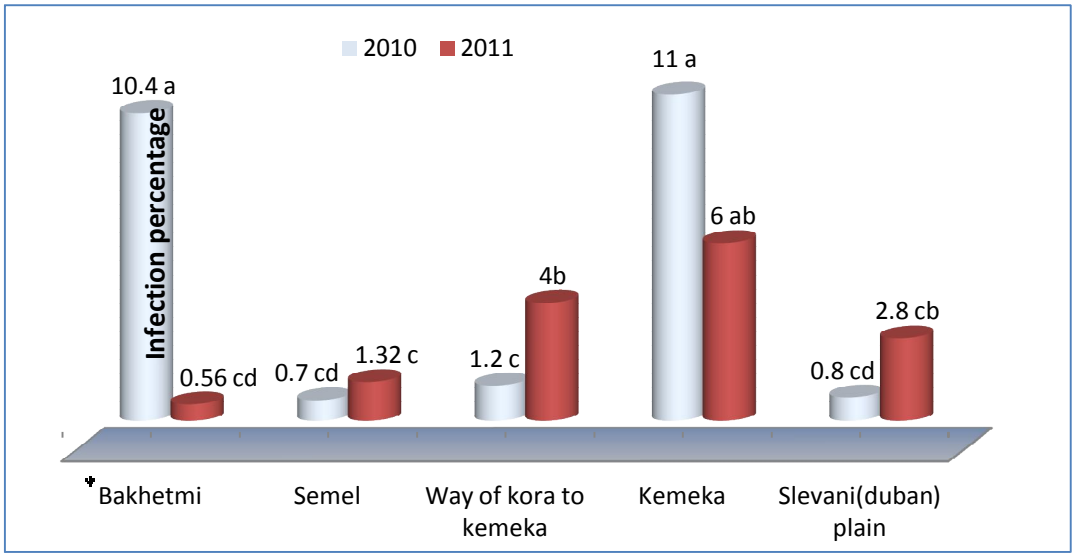

Fig (1) percentage of infection in surveyed fields in 2010 and 2011.

*Means followed by different letters are differ significantly based on Duncan's Multiple Range test (P = 0.05). each number is mean of 5 values replications.

Occurrence of infection in other locations (Semel, Way of kora to kemeka, Slevani plain) were due to sowing of the same wheat seeds with no crop rotation. Means of infection percentage of locations showed that wheat field of kemeka village had more infection among another region of survey and this might be due to mountainous topography that has more humidity.

Life cycle of *A.tritici* with description of certain stages and symptoms:

Females (Fig. 2-A) were 2.4 mm in length and 132.55 µm in diameter, males (Fig. 2-D) were 1.79 mm length with 82.19 µm . Females of *A. tritici* were larger than male. Distance from vulva

Life cycle of *A.tritici* with description of certain stages and symptoms:
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Table (1) Dimensions of *A. tritici* stages.

Female			**Male**		
Length (mm)	Diameter ((µm)	Distance from vulva opening to tail end. (µm)	Length (mm)	Diameter ((µm)	Spicule (µm)
2.40	132.55	238.55	1.79	82.19	11.68
(1.17 - 2.95)	(56.81 – 147.72)	(178.21 – 485.14)	(1.07 – 2.38)	(57.95 – 95.9)	(8.82 – 14.7)

J2		Egg	
Length (µm)	Diameter (µm)	Length (mm)	Diameter (µm)
490 (400-650)	24.9 (22.72 – 34.09	94 (49.5 – 104)	38 (25.7 – 40)

*Each number is means of 15 samples from different galls of wheat Cultivar (Cham 6 cv.) .

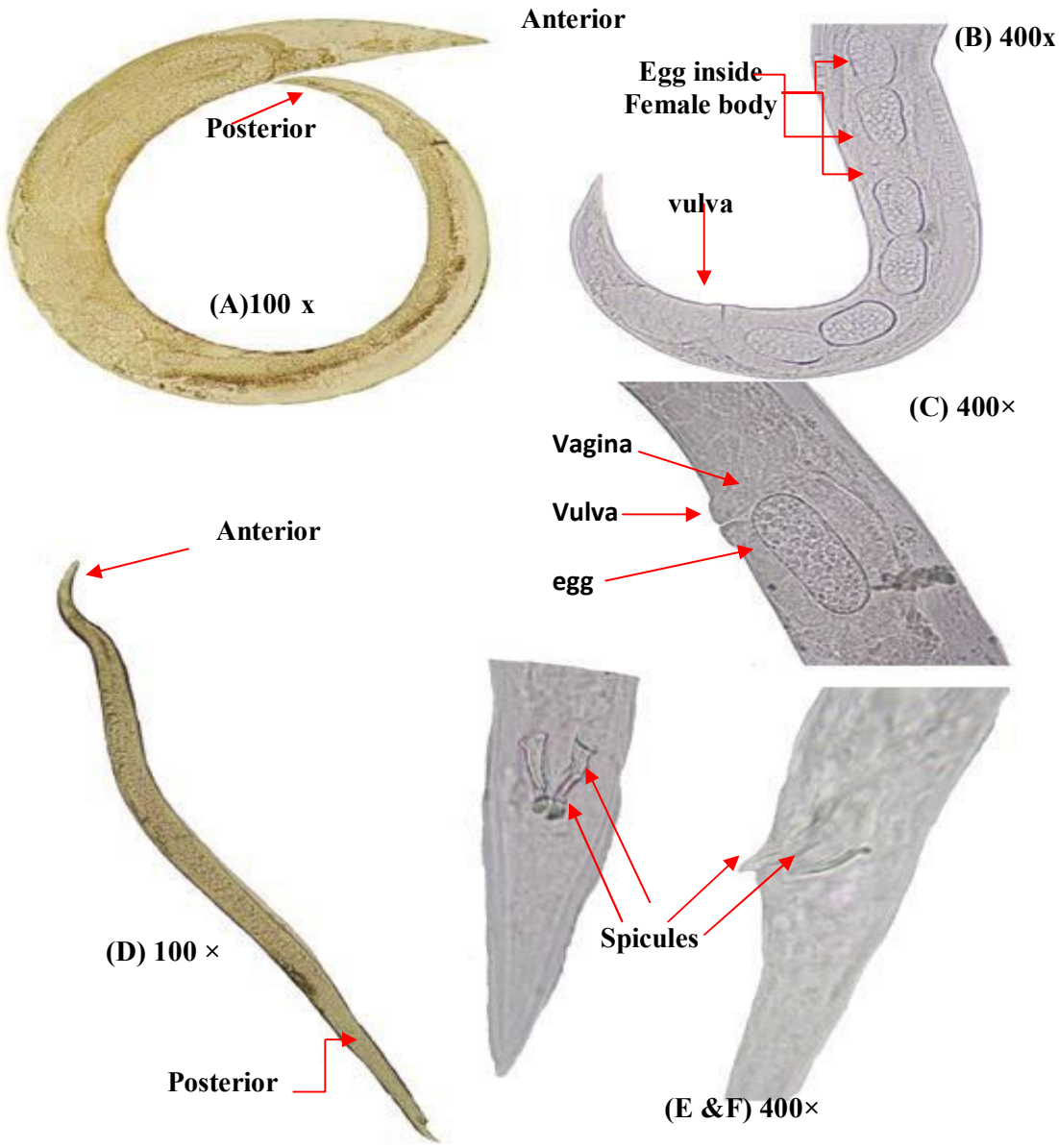

Figure (2): Mature female of *A. tritici* (A), posterior end of the female show Vulva, vagina and eggs inside body (B & C), mature male (D), Posterior portion of male prominent spicules (E& F).

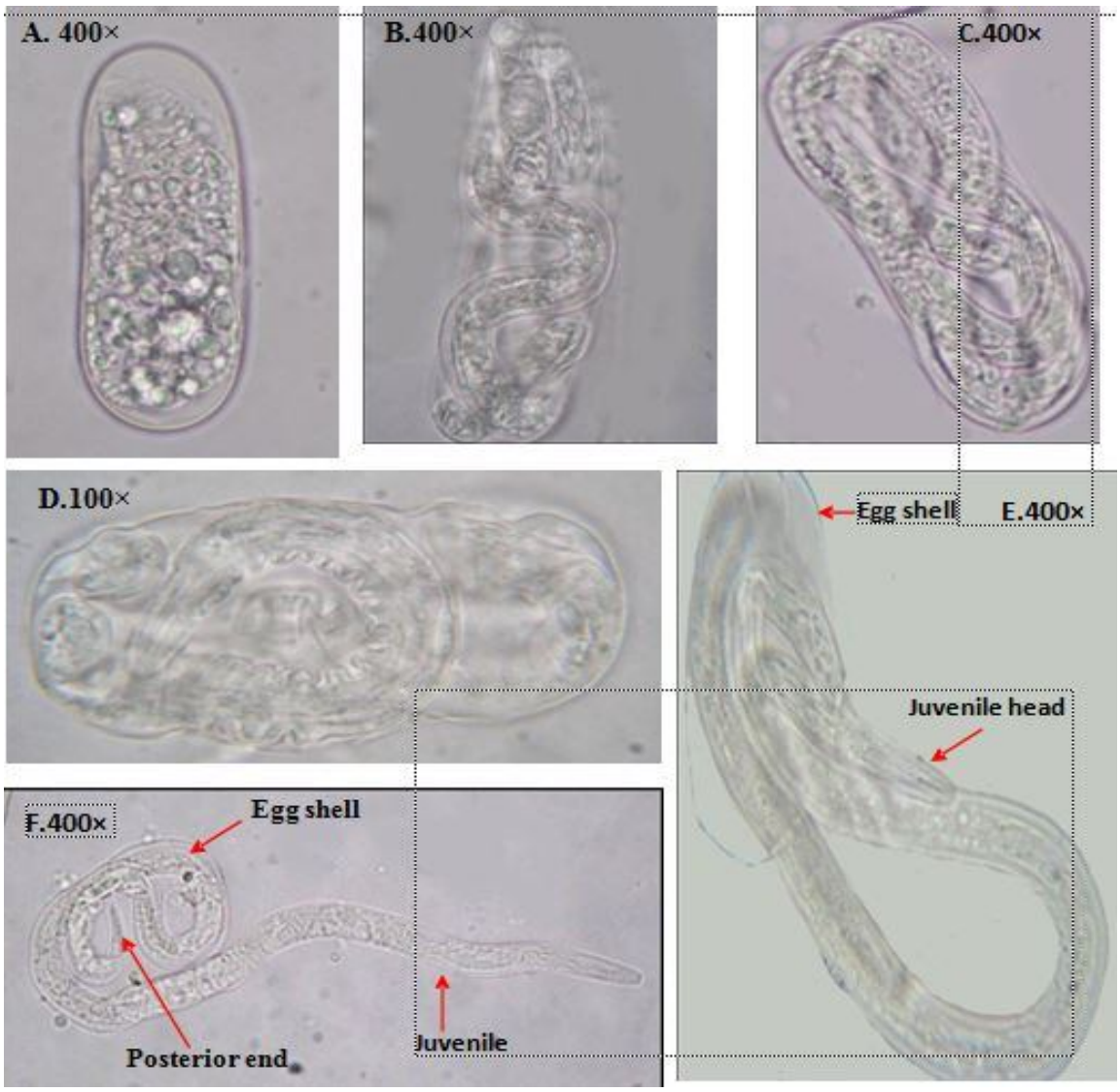

Figure (3) Eggs in different embryogenesis A, B, C &D. Juveniles emerging from eggs E&F, (400×).

This results explain the effects of host and environmental conditions on the dimensions of *A. tritici*. Females begin to laying Eggs after their copulation with males which were observed in 25-Aprile to 15 May inside green galls (Fig. 4). This warm duration might be suitable to laying eggs. Great number of juveniles hatched from eggs (Fig.4- E&F) and eggs in different stage of embryogenesis (Fig.4- A,B,C&D.) were found inside green galls at this period(Fig. 4).

Figure (4) Female, male, juveniles, eggs from green galls opened in distil water under stereomicroscope (200×).

Great numbers of J_2 released from dry galls (Fig. 5) invade leaves after climbing stems. Initial symptoms observed when wheat seedlings reached 5-13 cm (Fig. 6, A&B). AL- Beldawi *et al*., (1977) indicate that symptoms occurred when seedlings length reach 15-20 cm. little crinkling of leaves then

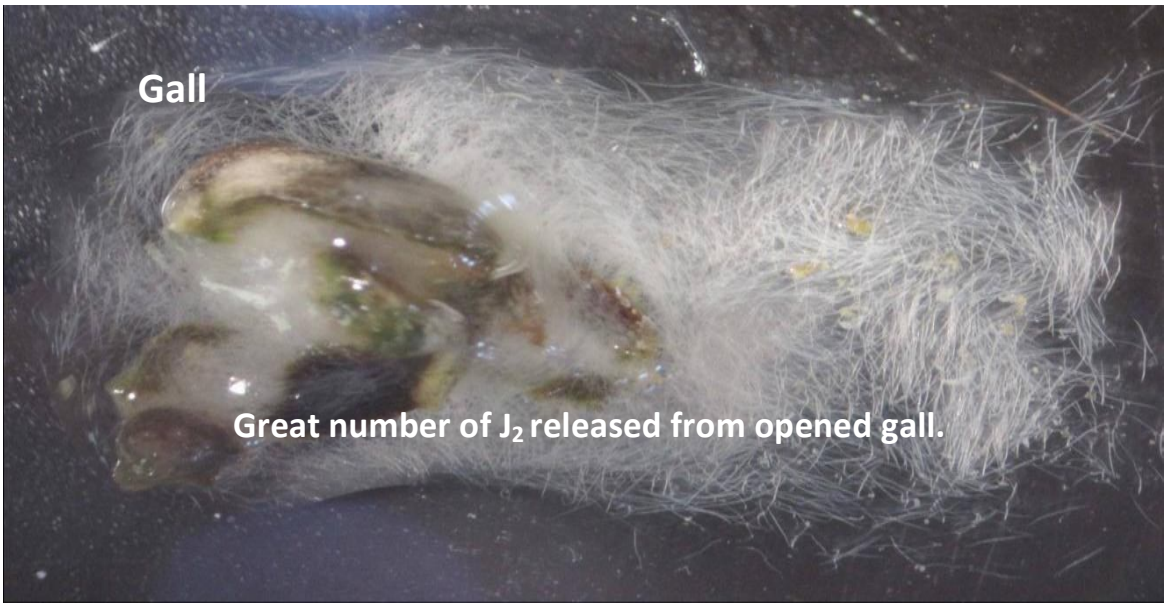

Figure (5) Opened gall under Stereomicroscope (200×) in distilled water

Figure (6) Initial symptoms of ear-cockle disease

Later, severe infection caused leaf rolling, curling (Fig.7, A, B) and twisted, seedling stems become thicker at the bases and distorted with shortened internodes than healthy ones (Fig.7, C).

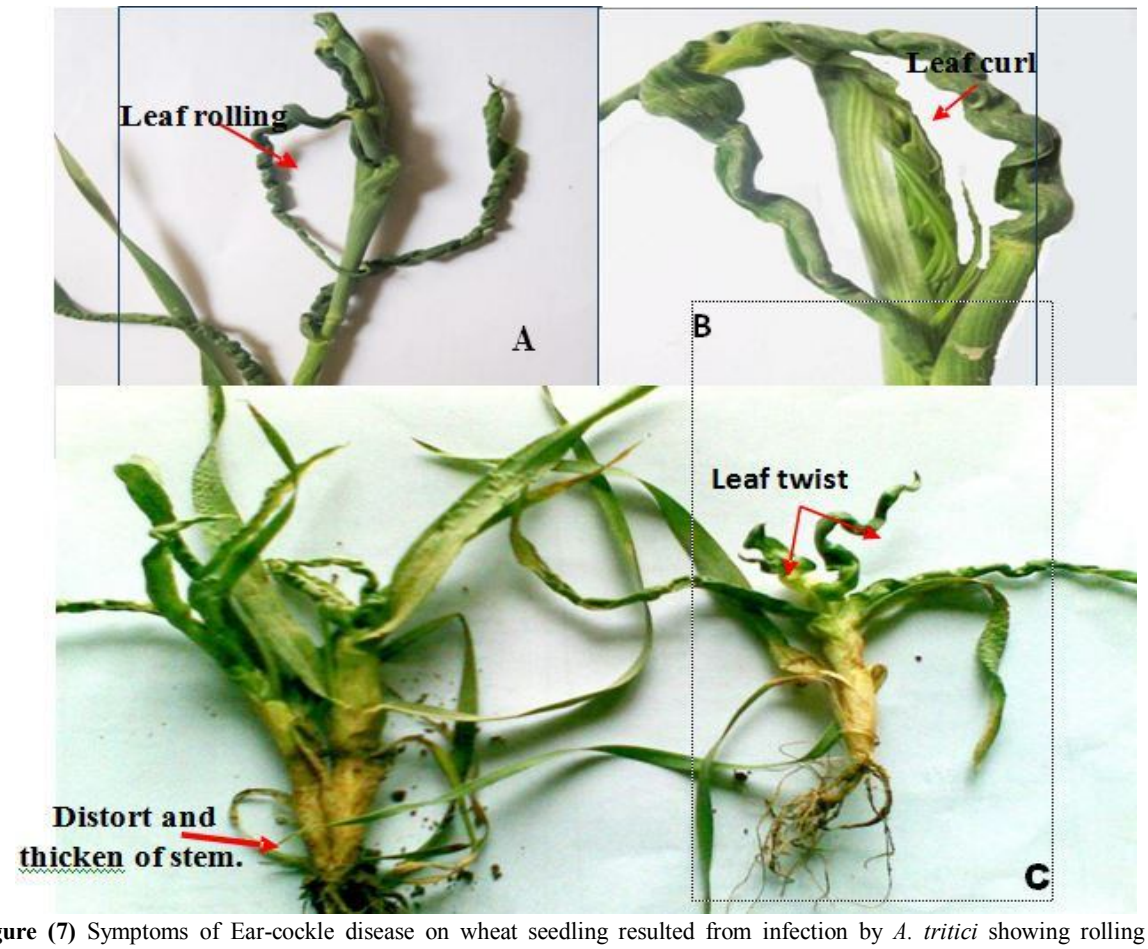

Figure (7) Symptoms of Ear-cockle disease on wheat seedling resulted from infection by *A. tritici* showing rolling A, curling B and distort and thickened stems C.

Slightly infected leaves grow normal with small blisters (small swelling) in both sides of midrib (Fig. 8), these symptoms are comported with that mentioned by Filipjev *et al.,* (1941).

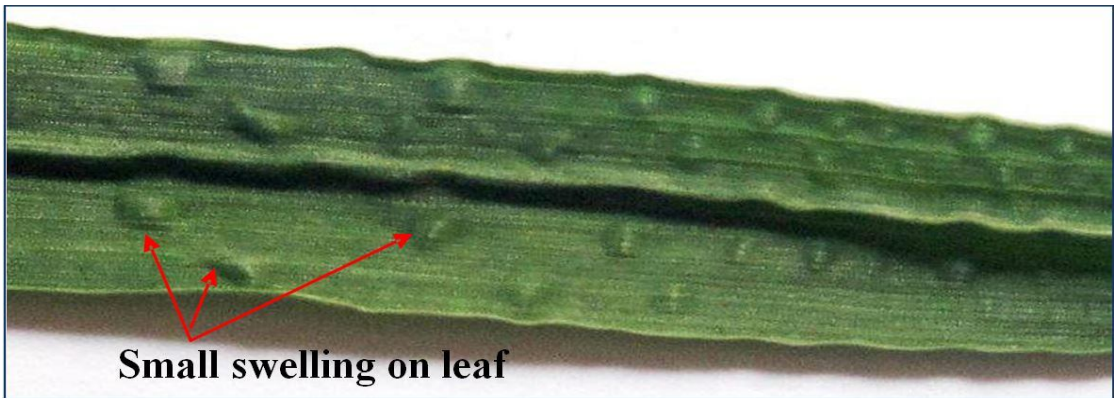

Figure (8) Symptoms of Ear-cockle disease on wheat seedling result from infection by *A. tritici* showing small blisters on leaf.

Galls formed instead of many or several seeds in certain spikes with green shiny to dark brown or black in color when dried (Fig.9). Infected spikes were awn less in certain infection or awns move away from the spike rachis of which become shorter or may be distorted (Fig. 10) these symptoms were also reported by (Kort, 1972 and Esser et al., 1991).

Figure (9) Dry galls and healthy wheat seeds.

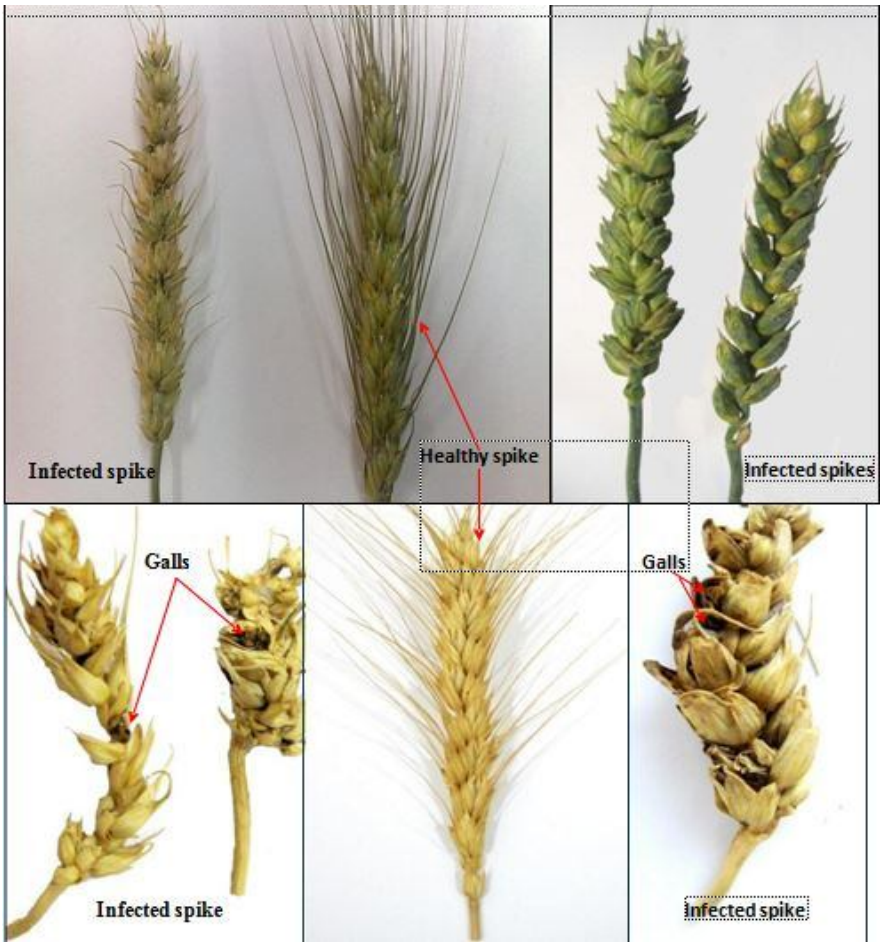

Figure (10) Symptoms of wheat green& dry spike due to infection by *A. tritici.*

Some wheat spikes observed look like healthy ones but when rubbing, many galls were found contained great number of nematode juveniles this Galls formed with different sizes (large, moderate and small) each one contained 25000, 12600 and 4000 J_2 respectively with 11.6, 2.5, and 1.4 mg/gall in weight respectively (Table, 2).

Table (2) Juveniles density in different size of galls caused by *A. tritici*

Size of galls	Small	Moderate	**Large**
Weight of galls (mg)	1.4 bc	2.5 b	11.6 a
J_2 density per galls	4000 c	12600 b	25000 a

*each value is means of 10 replications (galls) in each type (small, moderate, and large).
*means followed by different letters are significantly different based on Duncan's Multiple Range test (P=0.05).

Some galls contained few numbers of adults these results was demonstrated by Ami *et al.,* (2004) . J_2 population in single gall may contain over 10000 dormant juveniles (Kort, 1972) or 90000 J_2 in black galls (Limber, 1973), whereas large galls may contain up to 90000 nematodes (Esser *et al*., 1991). Thus, number of juveniles/gall depend on many factors such as wheat cultivar, gall size, environment conditions and soil biosphere in addition to their behavior in different geographical regions. Severe infections cause death of entire plants and tillers sometimes resume its growth or failed to complete growth, heading and seed formation or semi sterile spike are formed.

Stunting symptoms also observed by *A. tritici* These results were confirmed by (Swarup and Sosa-Moss, 1990).

In general *A.tritici* was completed its life cycle during 135- 160 days at the end of May (Fig. 11). This duration more than 103 days recorded by Gokte and Swamp (1987) . Therefore, duration of life cycle of *A. tritici* depends on many factors such as cultivar, Geographical region, environmental conditions, nematode race and planting date.

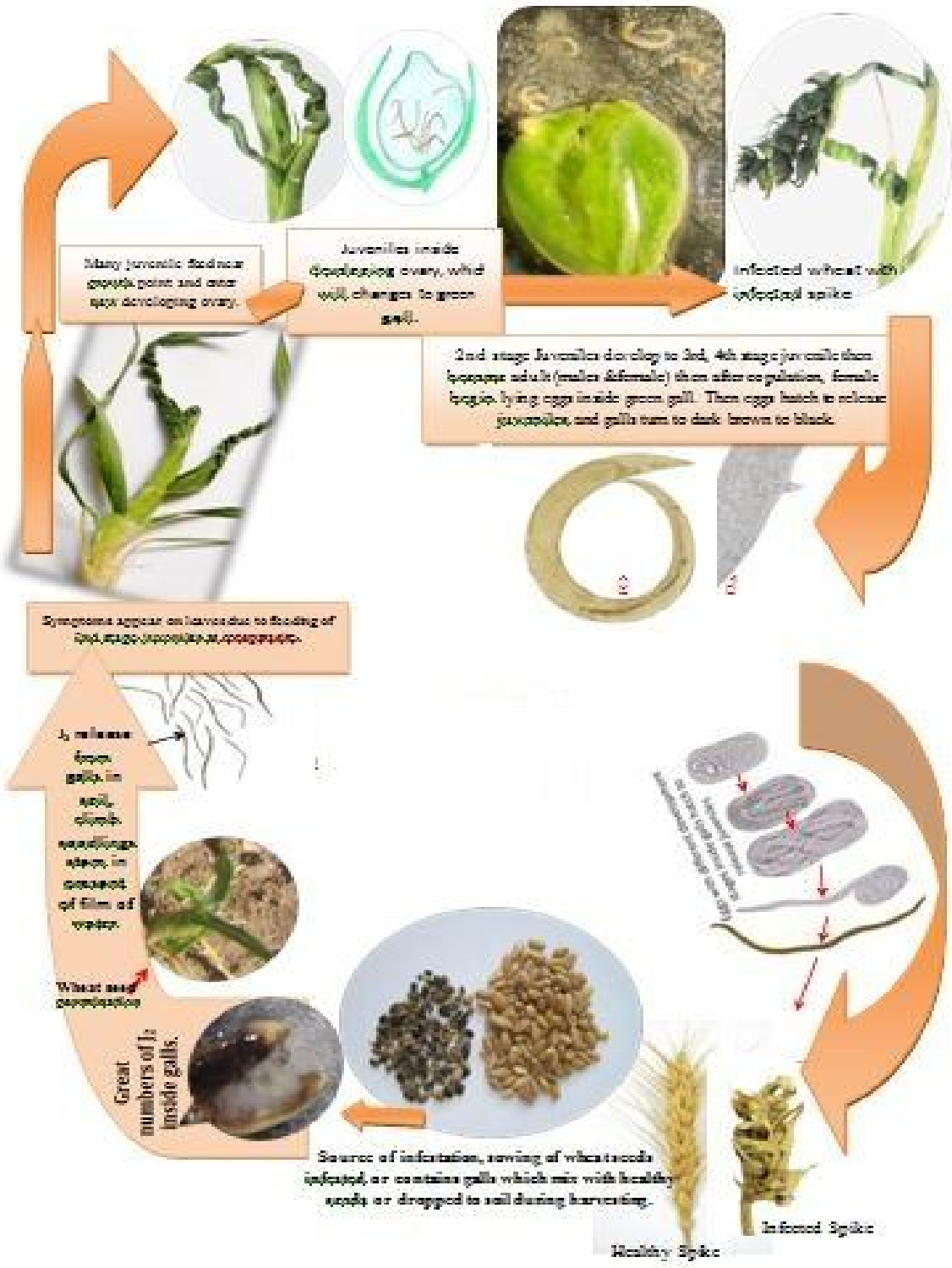

Figure (11) Life cycle of *A.tritici* on Wheat (Cham-6 c.v.)

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نيماتودا تثألل حبوب الحنطة *Anguina tritici* في محافظة دهوك – أقليم كوردستان العراق وحياتيتها

الخلاصة

تضمنت هذه الدراسة مسح عدد من حقول الحنطة في محافظة دهوك للموسم الزراعي 2010و 2011 للتحري عن مدى إصابتها بنيماتودا تثألل حبوب الحنطة *Anguina tritci* وهي حقول سهل السليفاني (دوبان) و حقول قرية كمكا وتلك المحيطة بمدينة سميل و قرية باختمي والطريق بين قرية كورا و كمكا ، و قد سجلت أعلى نسب للإصابة خلال الموسم الزراعي 2010 حيث كانت 11 و 10.4% في حقول الحنطة في قرية كمكا و باختمي على التوالي فيما سجلت اقلها (0.56%) في حقول قرية باختمي خلال الموسم 2011 .

كما تبين أن هذه النيماتودا أكملت دورة حياتها في 135-165 يوماً تحت ظروف الحقل في فاكولتي الزراعة والغابات (سميل) /جامعة دهوك . بلغ متوسط الطول والعرض في الإناث و الذكور2400 × 132,55 مايكرون و 1790× 82,19 مايكرون على التوالي و في كل من يافعات الطور الثاني و البيوض 490 × 24,9 مايكرون و 94,5 × 38,7 مايكرون علي التوالي أيضاً.

نيماتۆدا پووچەل بوونا دانەوێلەي *Anguina tritici* ل پاريزگەها دهوك–هەرێما كوردستانا عيراق و ڤەكولينا ژيانزانيا وێ

كورتي

ئەم لێكۆلينەوەيە گەران بە دواي نەخۆشي پووچەل بووني دانەوێلە بە هۆي نيماتۆداي *Anguina tritic* دەگرێتەوە لە پاريزگاي دهۆك لە چەند ناوچەيێك لە وەزي چاندني 2010و2011 و لە وانەش دەشتي سليڤاني(دوبان) ,گووندي كەمەكا ,دەور و بەري شارۆچكەي سێميل , گووندي باختمێ و رێگاي كورا بۆ كەمەكا و زۆربەي كێلگەكان رێژەيەك تووشبوونيان هەبۆ, بەرزترين رێژەي تووشبوون لە لە وەرزي2010 لەكێلگەكاني كەمەكا 11٪ و لە كيلگەكاني باختمێ 10.4٪ بەلام كەمترين رێژە 0.56 ٪ تومار كراوە لە باختمێ لە 2011.

لە لێكولينەوە ژيانزاني بۆ *Anguina tritici* و وەرگرتي هەندێك پێوانا دەركەوت كە سووري ژياني لە كێلگەي كولێژي چاندن و دارستان لە سێميل لە 135–165 رۆژ دەخايەنێت و رێژەي درێژي و پاني مێ (2400 × 132.55مايكرۆن) و نێر (1790 × 82.19 مايكرۆن) و هەرزەكار(490 × 24.9مايكرۆن) و هێلكە (94.5 ,38.7 مايكرۆن)