

الفصل الثانى عشر

الأمراض المتسببة عن النباتات العشبية المتطفلة

Diseases Caused by Herbaceous Parasitic Plants on Tomato

سبب النباتات المتطفلة على المحاصيل أضرارًا كبيرة لعوائلها النباتية، ويوجد أكثر من ١٠٠٠ نوع من النباتات الرعمية تتبع ٧ عائلات تتطفل على نباتات زهرية أخرى مهمة اقتصاديًا. تنتج النباتات المتطفلة أزهارًا وبذورًا. ومن أهم النباتات المتطفلة على نبات الطماطم الهالوك (*Orobancha spp*) Broomrape. والحامول (*Cuscuta spp*) Dodder. ويتشربان فى أقطار غرب آسيا وشمال إفريقيا وجنوب أوروبا وأيضاً فى أمريكا الشمالية. تقوم هذه النباتات بسحب الماء والعادن والمركبات العضوية اللازمة لتغذيتها من النبات العائل مما يؤدي إلى ضعف نمو العائل نتيجة لتأثر العمليات الفسيولوجية المختلفة به.

تتميز نباتات الهالوك والحامول بخلوها من مادة الكلوروفيل ومن ثم لا يستطيعان تكوين غذائهما العضوى دون الاعتماد فى ذلك على النبات العائل. ومع ذلك توجد نباتات متطفلة أخرى لها أوراق خضراء أى تحتوى على كلورين لكن لا يوجد لها جذور، وبذلك تخلق المادة العضوية اللازمة لها عن طريق إتمام عملية التمثيل الضوئى وتمصل على الماء والمواد المعدنية اللازمة لها من العائل. ومن الأمثلة على ذلك نبات العدار (*Striga hermonthica*) ونوع الدبق (*Viscum sp*). وبعض أنواع الأوركيد.

تختلف طريقة وطبيعة التطفل تبعاً للنبات المتطفل. الهالوك مثلاً يتطفل تحت سطح التربة ويصيب الأجزاء الأرضية من العائل. أما الحامول فيتطفل من فوق سطح التربة ويصيب السوق أو الفروع فى العائل. وقد يكون التطفل خلاً حتى حيث يوجد معظم جسم الطفيل خارج العائل، وجزء صغير منه فقط داخل العائل. ويسمى النبات المتطفل فى هذه الحالة نبات ناقص التطفل مثل العدار والدبق، ويوجد أيضاً تطفل داخلى إلى أن كل جسم الطفيل يوجد داخل العائل ولا يظهر منه إلا أجزاؤه الزهرية فقط ويوجد ذلك فى بعض النباتات كاملة التطفل مثل الرافليزيا.

١- الهالوك Broomrape

لهالوك نبات زهرى متطفل إجبارياً يتبع عائلة Orobanchaceae ويوجد أساساً فى منطقة البحر المتوسط حيث توجد مساحات كبيرة مصابة به. ويوجد أيضاً فى مناطق أخرى ظروفها تشبه ظروف منطقة البحر المتوسط مثل كاليفورنيا بالولايات المتحدة الأمريكية وفى غرب استراليا وكوبا.

يتبع جنس الهالوك *Orobancha spp* حوالى ١٢٠ نوعاً تصيب عديد من العوائل فى جميع أنحاء العالم منها: البطاطس- الطماطم- البقوليات- الكرنب- البطيخ- الدخان ويصيب أيضاً عديد من الحشائش. ويسبب الهالوك أضراراً كبيرة حيث تتطفل بعض أنواعه على مدى واسع من العائلات النباتية منها - Solanaceae - Apiaceae - Cucurbitaceae - Aesteraceae - Fabaceae.

فى مصر يوجد بعض الأنواع من الهالوك تتطفل على الطماطم وقد تتطفل على محاصيل أخرى. ومن هذه الأنواع:



- O. crenata* ويتطفل على الطماطم والبقوليات وعديد من النبات الأخرى.
O. ramosa ويتطفل على الطماطم وهى أهم عائل له.
O. aegyptiaca ويصيب الطماطم والبطاطس أساسًا وتوجد محاصيل أخرى عائلة له.
O. cernua ويتطفل على الطماطم وعباد الشمس.

الشكل الظاهري للهالوك Broomrape morphology

الهالوك نبات زهري كامل التطفل على جذور العائل. يتكون الهالوك من شمراخ زهري حولي قد يكون مدعًا أحيانًا. الأوراق مختزلة خالية من الكلوروفيل وتظهر على هيئة حراشيف بنية اللون. الأزهار خنثى وحيدة العطر. الثمار علبة تنفتح مصراعيا وتحتوى على مئات من البذور الصغيرة الحجم ذات شكل كمثرى ولون بنى إلى أسود. بذور الهالوك يمكن أن تبقى كامنة فى التربة لعدة سنوات إلى أن تتشجع على الإنبات ببعض مركبات معيذ تنج بواسطة جذور النباتات الحية القريبة منها (Fig 1).

الوضع التقسييمى للهالوك Classification of Broomrape

Kingdom: Plantae

Phylum: Magnoliophyta

Class: Magnoliopsida

Order: Lamiales

Family: Orobanchaceae

Genus: *Orobanche*

Species: *O. aegyptiaca* Pers- *O. crenata* Forsk- *O. cernua* Loefl- *O. ramosa*

أعراض الإصابة بالهالوك Symptoms of broomrape infection

النباتات المصابة بالهالوك ضعيفة ومتقزمة إذا ما قورنت بالنباتات السليمة وتصفّر أوراقها وتظهر نموات الهالوك لسفراء بالقرب من قاعدة نبات الطماطم وعند إزالة التربة من حول النبات يمكن مشاهدة منطقة الاتصال بين الهالوك وجذور الطماطم. ثم بعد فترة قصيرة من نمو نبات الهالوك تنمو الأزهار البيضاء أو الملونة. بعد ذلك تجف نباتات الهالوك وحبس بنية اللون وتنتثر ثمارها وتنطق منها البذور وتختلط بالتربة بعد سقوطها عليها أو تحمل بواسطة الرياح إلى مسافات بعيدة.

تطفل الهالوك Broomrape pathogenicity

يمكن أن تبقى بذور الهالوك ساكنة فى التربة فى غياب العائل أكثر من ١٠ سنوات. وعند وجود العائل وأى محصول منبه لإنبات بذور الهالوك وتوفر الظروف الملائمة تبدأ البذرة فى الإنبات مكونة أنبوبة إنبات نحو فى اتجاه العائل القريب منها جدًا وتلتصق بجذوره وترسل ممصات إلى داخل الجذر وتتعلم فى الداخل إلى أن تص إلى الاسطوانة الوعائية وتقوم بامتصاص العناصر الغذائية اللازمة لها وأيضًا كمية الماء الضرورية لحياتها. وتكود عسما منتفخا نتيجة لامتصاص الغذاء ثم تخرج من هذا الجسم ممصات أخرى تتصل أيضًا بجذور العائل. هذا الجسم منتفخ يستطيل مكونا شمراخا زهريا - قد يتكون أكثر من شمراخ وتظهر هذه الشمراخ فوق سطح التربة وتنتفخ أزهارها ويتم الاخصاب وتتكون الثمار والبذور وتنضج البذور سريعًا.



يصل عدد البذور الناتجة من نبات واحد من الهالوك إلى أكثر من ٢٠٠ ألف بذرة.

المقاومة Control

هم طرق المقاومة العمل على تخفيض عدد بذور الهالوك في التربة إلى أقل مستوى يمكن الوصول إليه مع الإبقاء عن هذا المستوى للسنوات التالية ويتم ذلك بالآتي:

- ١ - إزالة الشماريخ الزهرية للهالوك باليد قبل نضجها وإعدامها.
- ٢ - استعمال المحصول الصائد. وقد استخدم الكتان في مصر كنبات صائد للهالوك حيث تفرز جذوره مواد تنبه إنذار بذور الهالوك.
- ٣ - تأخير ميعاد زراعة الطماطم.
- ٤ - زراعة أصناف مقاومة للهالوك.
- ٥ - تحفيز بذور الهالوك على الإنبات في غياب العائل وبالتالي تموت بادرته الهالوك النابتة قبل زراعة المحصول. وتعرف هذه الطريقة بالإنبات الانتحاري Suicidal germination وتتم باستعمال مركبات خاصة منها مادة Strigol المستخلصة من بذور القطن. وهي ذات فاعلية كبيرة في تحفيز إنبات بذور الهالوك.

المقاومة البيولوجية Biological control

توجد فطريات متطفلة على الهالوك منها *Sclerotium orobanche* و *Fusarium orobanche* وتوجد أيضاً حشرات متطفلة مثل *Phytozoma orobanchia* و *Tropinota squalidis* كذلك جنس *Agrotis sp*.

المقاومة الكيماوية Chemical control

تسمى التربة الملوثة وقبل زراعة البذرة أو الشتلة يستعمل مركب Metam sodium أو أحد المدخنات التجارية الأخرى التي تتبع مجموعة metam sodium وهو مصدر للمركبات العضوية الطيارة Volatile organic compounds - لذلك لا يلجأ إلى المدخنات إلا إذا كانت باقى استراتيجيات المقاومة غير متاحة أو غير ناجحة. كذلك يستعمل مبيد الحشائش Sencor DF (metribuzin) قبل زراعة الطماطم بأربعة أشهر حتى لا تضر النباتات. وتحتف جرعة المبيد باختلاف نوع التربة. في التربة المحتوية على مادة عضوية أقل من ٢٪ تستعمل الجرعة المنخفضة أما جرعة المرتفعة فتستعمل في التربة التي بها أكثر من ٢٪ مادة عضوية ولا يستعمل في التربة عالية القلوية أو الرملية الخفيفة.

أما بعد زراعة البذرة أو الشتلات يستعمل مبيد الحشائش Matrix 25DF (nimsulfuron) رشا على التربة. وإذا كانت هذه الحشائش قد ظهرت فوق سطح التربة يضاف إلى المبيد أحد الناشرات السطحية غير أيونية nonionic surfactant بمعدل ٠,٢٥٪ (٧/٧).

كذلك يستعمل مبيد الحشائش Sandea (halosulfuron)، لكن في حالة معاملة التربة بمبيدات حشرية تتبع Organophosphate insecticides لا يستعمل مبيد الحشائش Sandea ولا يستعمل أى مبيد حشري يتبع Organophosphate insecticides رشا على المجموع الخضري للنبات إلا بعد ٧ أيام من استعمال halosulfuron أو قبل ٢١ يوماً من استعماله.



٢- الحامول Dodder

يتبع الحامول جنس *Cuscuta* الذى ينتشر فى جميع مناطق العالم المعتدلة والحارة ونادرا ما يوجد فى المناطق الباردة ويوجد منه أكثر من ١٠٠ نوع نباتى متطفل تختلف فى ألوانها ما بين الأصفر والبرتقالى والأحمر لكن نادرا ما يوجد اللون الأخضر. يتطفل الحامول على عديد من النباتات تشمل محاصيل حقلية ومحاصيل بستانية منها البرسيم الحجازى- الكتان- البرسيم- البطاطس- الطماطم- الداليا- الكريز انثم- البيتونيا- الهيلينيوم وأنواع أخرى من النباتات المختلفة.

قديمًا كان يطلق على الحامول أسماء عديدة منها: شعر الشيطان Devil's hair - شعر الساحرة Witch's hair - أحشاء أبليس Devil's gut - الخيوط الذهبية Gold thread وغير ذلك من الأسماء.

الشكل الظاهرى للحامول Dodder morphology

الحامول نبات ذات ساق رفيعة لا تحمل أوراق لكن يوجد بها ندب دقيقة مسكان الأوراق المختزلة ويوجد بها نسبة قليلة جداً من الكلوروفيل. لكن بعض أنواع الحامول يمكن أن تقوم بعملية التمثيل الضوئى بدرجة بسيطة جداً مثل *C. reflexa*. بينما أنواع أخرى تعتمد فى تغذيتها اعتمادا كاملا على النبات العائل مثل *C. europaea*. ويختلف نمو وطول الحامول باختلاف مناطق نموه. فى المناطق الحارة قد يصل ارتفاعه إلى ارتفاع عروش الشجيرات أو يتول الأشجار. أما فى المناطق المعتدلة ينحصر طوله فى النباتات الحولية ذات الطول الخضرى القليل نسبيا. ويمكن أن يتلاصق الحامول مع نبات واحد أو عدة نباتات فى وقت واحد. وتتدرج ألوان أزهار الحامول من الأبيض إلى الـرى الفاتح أو الأصفر أو الكرىمى. هذه الأزهار توجد فى أوائل الصيف فى بعض أنواع الحامول وفى أنواع أخرى من الحامول توجد فى آخر الصيف.

بذور الحامول دقيقة جداً وتنتج بكميات وفيرة ولها غطاء بذرى صلب ويمكن أن تبقى فى التربة من ٥ - ١٠ سنوات أو أكثر.

الوضع التقسيمى للهامولك Classification of Broomrape

Kingdom: Plantae

Phylum: Magnoliophyta

Class: Magnoliopsida

Order: Solanales

Family: Convolvulaceae

Genus: *Cuscuta*

Species: *C. campestris* and *C. pentagona*

صنف جنس *Cuscuta* سابقاً تبع عائلة Cuscutaceae وكان هو الجنس الوحيد بهذه العائلة. والآن تم وضعه فى عائلة Convolvulaceae.



أعراض الإصابة بالحامل Symptoms of dodder infection

يظهر الطفيل فوق سطح التربة بشكل خيط ملتف حول سوق النبات العائل مرسلا ممصاته داخل أنسجة الساق لتعض الأنسجة الوعائية للطفيل بالأنسجة الوعائية للعائل. يعقب ذلك ذبول ساق الحامل في مكان اتصالها بالتربة ثم يعيش الطفيل بعد ذلك كلية على حساب النبات العائل ويمتص منه الماء والمواد الغذائية المجهزة ويكون الطفيل سيقان عديدة تنمو بسرعة وتلتف بدورها حول العائل ثم يزهر ويكون ثمار (Fig 2) بعد نضج الثمار تنفتح وتتساقط من البذور. تظهر الإصابة في أماكن متفرقة من الحقل وتزداد مساحتها أثناء نمو نباتات الطماطم. ونتيجة الإصابة بالحامل يضعف نبات الطماطم وتصغر أوراقه وتقل مقاومته للأمراض الفيروسية.

تطفل الحامل Dodder pathogenicity

تساقط بذور الحامل بعد نضجها في التربة وعند وجود رطوبة أرضية كافية تنبت البذور - يمكن أن تحتفظ هذه البذور بحيويتها من ١٠ إلى ٢٠ سنة- وتعطي أنابيب إنبات صفراء خيطية تظل أطرافها السفلى في التربة بينما تظهِر الأطراف الأخرى فوق سطح التربة. وتتحرك إلى أن تصل إلى ساق النبات العائل. (إذا لم تقابل أنابيب إنبات بذور الحامل عائلا مناسباً فإنها تموت). ثم ترسل ممصاتها داخل الساق للتغذية. يعقب ذلك ذبول ساق الحامل في مكان اتصالها بالتربة ويبقى كامل التطفل على العائل فوق سطح التربة.

المقاومة Control

- ١ - في الحقل الموبوء بالحامل يمنع زراعة محاصيل عائلة له لعدة سنوات.
- ٢ - منع استيراد أو زراعة بذور ملوثة ببذور الحامل.
- ٣ - الدورة الزراعية غير مؤثرة عامة في المقاومة وذلك لكثرة عوائله وأيضاً لأن حيوية بذوره يمكن أن تستمر فترة طويلة ومع ذلك عمل دورة زراعية مع محاصيل غير عائلة مثل القطن والأذرة والقمح والشعير والثوم يمكن أن تقلل تجمع بذور الحامل.
- ٤ - معظم إنبات بذور الحامل يتم في الربيع (من ١ مارس إلى منتصف مايو) لذلك تأخير الزراعة أو الشتل يمكن أن يساعد على تقليل المشكلة مع الحامل.
- ٥ - الطريقة المثلى لمقاومة الحامل هي القضاء على نبات الطماطم العائل مباشرة عند ملاحظة إصابته بالطفيل.
- ٦ - إذا لوحظ الحامل بعد تكوينه للأزهار يزال هو والنبات العائل من الحقل ويحرق لقتل البذور.
- ٧ - بعد العمل في الحقل المصاب بالحامل يجب التخلص من الملابس والأدوات العالق بها بذور الحامل قبل الدخول إلى حقول جديدة خالية من الإصابة.
- ٨ - توجد طماطم مقاومة للإصابة بالحامل وتمنع إنتاج بذوره منها PX 665 - CDS 233 - Heinz 9492.

المقاومة الحيوية Biological control

تتص حشرة *Melanagromyza cascutea* على الحامل ويمكن استخدامها في المقاومة الحيوية له.



المقاومة الكيماوية Chemical control

المبيد الكيماوى Prowl H20 (pendimethalin) ويستعمل قبل زراعة الشتلات فقط . يمكن أن يقلل إنبات ويزرع الحامول بنسبة ٨٠٪.

استعمال المبيد Matrix 25 DF (rimsulfuron) عندما تكون نباتات الطماطم فى طور البادرة يقلل نمو الحامول.

يستعمل مبيد الحشائش Dacthal (DCPA) فى مقاومة الحامول أثناء الربيع عندما تكون الطماطم المنزرعة بالبحر طولها من ٤ - ٦ بوصات والطماطم التى تم شتلها بعد ٤ - ٦ أسابيع من الشتل.

مشاكل الحشائش الخاصة بنباتات الطماطم Tomato Weed Problems

الحشائش مصدر من أخطر المصادر فى إصابة حقول الطماطم بالحشرات ومسببات الأمراض المختلفة حيث تعول وتأوى هذه الآفات. كذلك تنافس الحشائش نباتات الطماطم الموجودة فى نفس الحقل على الغذاء والماء وكسوء مما يؤدى إلى ضعف نباتات الطماطم وقلة المحصول. ومن الحشائش التى تسبب مشاكل فى حقول الطماطم:

Field bindweed: وهو حشيشة معمرة عميقة الجذور فى التربة ومن الصعب مقاومتها عندما تثبت هذه الجنفر. حشائش Nightshade family: ويتبعها مجموعة من الحشائش المختلفة مثل Black nightshade وHairy nightshade وCutleaf nightshade وGroundcherry وغيرها من الحشائش. هذه الحشائش حولية وتنمو فى طبقة السطحية للتربة على عمق من ١ - ٢ بوصة (٢.٥ - ٥ سم).

Nutsedge: وهى حشيشة معمرة يمكن أن تكون بذور ودرنات. يمكن للدرنات أن تبقى حيه فى التربة لعدة سنوات إلى أن تتحسن الظروف الملائمة لنموها. الدرنة الواحدة بها ٤ - ٧ براعم وكل برعم له القدرة على تكوين نبات. عادة ينمو برعم واحد فقط من الدرنة. لكن إذا أضر هذا البرعم وانتهى إما عن طريق العمليات الزراعية أو مبيدات الحشائش ينمو نبات جديد من برعم آخر موجود على نفس الدرنة. ونتيجة للضرر الذى تحدثه الحشائش فى حقول الطماطم يجب التخلص منها ويتم ذلك بالآتى:

أولاً: العمليات الزراعية Practical cultures

١ - التشميس قبل الزراعة: فى المناطق المعتدلة يمكن أن ترتفع درجة حرارة التربة المغطاة بشرايح البولي إيثيلين الشفاف حوالى ٦ - ١٣ م (٤٣ - ٥٥,٥ ف) عن التربة غير المغطاة وقد أدى هذا إلى تقليل كثافة تجمعات الفطر والبكتيريا من ٦٢ - ١٠٠٪. إذا تمت المعاملة قبل الزراعة. وقللت أيضا إنبات وظهور الحشائش بنسبة ٩٧ - ١٠٪ (Stapleton, 1986). هذه العملية يمكن أن تتم فى مصر فى شهور الصيف الحارة (يولية وأغسطس) بعد أن يُم رى الأرض ربا غزيراً ثم تغطى بشرايح البلاستيك الشفاف لمدة ٦ - ٨ أسابيع.

٢ - العزيق: يتم العزيق اليدوى ٣ مرات: الأولى بعد الشتل بحوالى ٢ - ٣ أسابيع لإزالة الحشائش الصغيرة. والثانية بعد ٢ - ٣ أسابيع من الأولى وتتم الثالثة بعد ٢ - ٣ أسابيع أخرى من الثانية وبذلك يتم التخلص من الحشائش وتغطية الأسمدة المضافة التى توضع فى باطن الخط. وبالعزيق تنتقل التربة من الريشة البطالة إلى الريشة العمالة والترديم على النباتات وتعديل وضعها.



٣ - الحرث العميق: كثير من أنواع الحشائش الحولية توجد فى الطبقة السطحية للتربة أى على عمق ٣-١ بوصة (٥،٢-٥ سم) كذلك بعض الحشائش المعمرة توجد درناتها على عمق ٤-٦ بوصات (١٠-١٥ سم). فإذا تم عرت الأرض بمحراث قلاب فإنه يتم دفن بذور أو درنات هذه الحشائش إلى عمق حوالى ١٢ بوصة (٣٠ سم) على الأقل وهذا العمق يؤدي إلى دفنها وتقليل ظهورها إلى أقصى درجة.

٤ - تغطية خطوط الزراعة بالبلاستيك الأسود: يتم ذلك فى العروة الشتوية أو الصيفية المبكرة مع وجود ثقب على مسافات منتظمة لزراعة الشتلات. وتتبع هذه الطريقة أيضاً فى الطماطم التى تنمو تحت الأنفاق البلاستيكية المنخفضة. هذه الطريقة أدت إلى انخفاض نمو الحشائش وتدفئة التربة حول الجذور وزيادة مقدرة الجذور على امتصاص الماء والمواد الغذائية مما أدى إلى التبرير فى الإنتاج. مع مراعاة إزالة هذه الأغذية فى جميع الحالات عندما يصل حجم النمو الخضرى فى نباتات الطماطم إلى أكثر من ٦٠٪.

ثاني: المقاومة الكيماوية Chemical control

١- فى الزراعة وقبل بزوغ الحشائش يمكن استعمال أى مبيد تجارى من المركب metam sodium كتدخين للتربة أو مبيد Dual Magnum (metolachlor).

٢- فى الزراعة وقبل بزوغ الحشائش يمكن استعمال Select Max (clethodim) ويستعمل فى الحشائش الحولية وإذا كانت الحشائش معمرة يجب تكرار المعاملة.

٣- كذلك يستعمل مبيد Sandea (halosulfuron) فى مقاومة الحشائش المعمرة فى الحقول المزروعة طماطم. وبعيداً مبيد Sencor 70% WP (ويتبع مجموعة metribuzin) أو Matrix 25DF (rimsulfuron) ويستعملان فى مقاومة الحشائش الحولية عريضة وضيقة الأوراق.

أضرار استعمال مبيدات الحشائش Herbicides Injury

١- أكثر مبيدات الحشائش ضرراً على حقول الطماطم مبيد الحشائش 2,4-D (2,4-Dichloro phenoxy acetic acid) حينما تتعرض هذه الحقول للأبخرة الناتجة عن استعماله فى الحقول المجاورة لها أو الرذاذ أيضاً استعمال الرشاشات التى تم استعمالها فى رش المبيد فى هذه الحقول وأعيد استعمالها فى رش مبيدات أخرى فى حقل الطماطم. وتبدأ الأعراض بانحناء وريقات النموات الطرفية وصغر حجم الأوراق والتفافها وتأخذ العروق اللون الأخضر الباهت وتتكون ظاهرة الجيوب Puffiness فى الثمار وأيضاً مرض Cat face وتخلو الثمار من البذور وتتشوه. ولجناب أضرار استعمال هذا المبيد:

- ١ - عدم استعمال المبيد فى الحقول المجاورة لحقل الطماطم عند اشتداد الرياح.
 - ٢ - عدم استعمال المبيد فى حقل ذات مستوى أعلى من حقل الطماطم.
 - ٣ - عند الرش بالمبيد فى الحقول المجاورة لحقل الطماطم تستعمل الرشاشات ذات الضغط المنخفض.
 - ٤ - عدم استعمال رشاشات هذا المبيد فى رش مبيدات أو أى مركبات فى حقل الطماطم.
- ألمبيد الحشائش Glyphosate عندما تتعرض نباتات الطماطم له أثناء التزهير أو ما قبل التزهير مباشرة يضر ذلك بمجموع الخضرى ضرر من متوسط إلى ضرر شديد وقد يؤدي إلى تساقط الأزهار ويقل عقد الثمار.





Broomrape



Fig (1)
Orobanche sp

Dodder

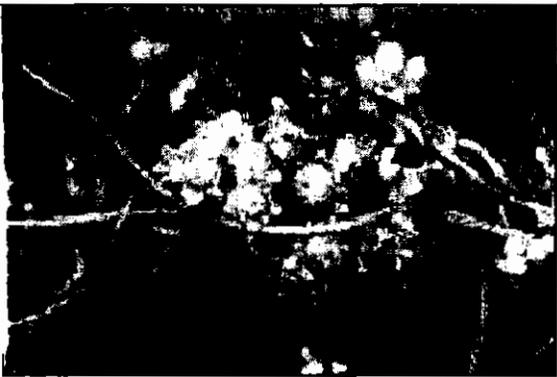


Fig (2)
Cuscuta sp



Herbicide Damage

Fig (3)
Herbicide damage on tomato plants



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صور ملونة



الفصل الرابع

Tomato Late Blight

Fig (1)

Life cycle of *P. infestans*
(a) Sporangiphores; (b) sporangia;
(c) sporangial contents dividing up
to form zoospores; (d) zoospores; (e)
germinating zoospores



Fig (2)

Late blight on tomato leaf



Fig (3)

Late blight lesions on susceptible tomato
stem





Fig (4)

Tomato late blight on green fruits



Fig (5)

Tomato late blight on red fruits

Tomato Buckeye

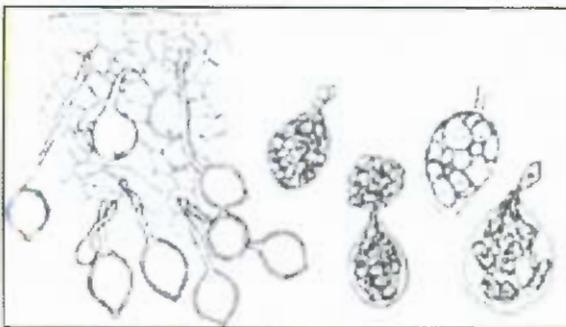


Fig (6)

Phytophthora parasitica, a common buckeye rot fungus: sporangiophores and sporangia in various stages of forming zoospores (drawing by Lenore Gray)



Fig (7)

Fruit lesions with concentric ring pattern typical of buckeye rot (Photo by P. Warren)



Tomato Early Blight and Collar Rot (caused by *A. solani*)

Fig (8)
Alternaria solani spores

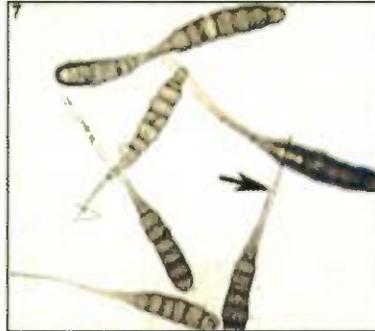


Fig (9)
Tomato collar rot on seedling stem



Fig (10)
Tomato Early Blight
Stem lesions caused by *A. solani*

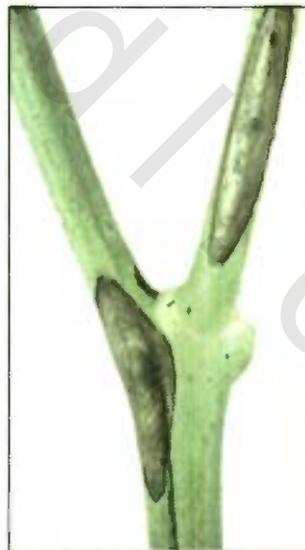




Fig (11)
Tomato early blight
Target- ring lesions leaf



Fig (12)
Tomato early blight on fruit and leaves

Alternaria Stem Canker (*A. alternata*)

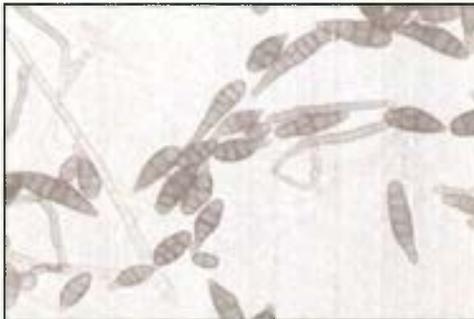


Fig (13)
Conidia and conidiophore of
A. alternata



Fig (14)
Alternaria stem canker



Alternaria tenuis

Fig (15)

Conidia and conidiophores of *A. tenuis*



Septoria Leaf Spot

Fig (16)

Pycnidia of *Septoria lycopersici*

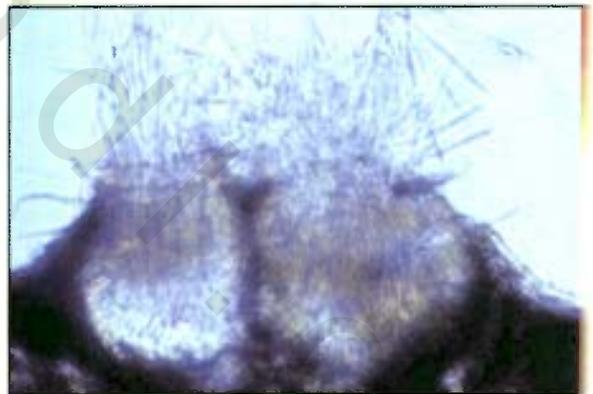


Fig (17)

Septoria lesions have tan or whitish centers





Black Leaf Mold

Pseudocercospora fuligena conidiophores and conidium



Fig (18)
Fascicle of divergent
conidiophores



Fig (19)
Solitary cylindrical-
obclavate conidium

Symptoms of Black Leaf Mold on Tomato Leaves



Fig (20)

Black sooty patches develop on both upper and lower leaf surfaces (left)
The soot-covered leaves wilt, dry, and usually remain hanging on the vine (right)



Tomato Leaf Mold

Fig (21)

Fulvia fulva the tomato leaf mold fungus as it might appear under a high-power microscope: (a) a fascicle of conidiophores emerging from the leaf surface; (b) conidia (drawing by Lenore Gray)

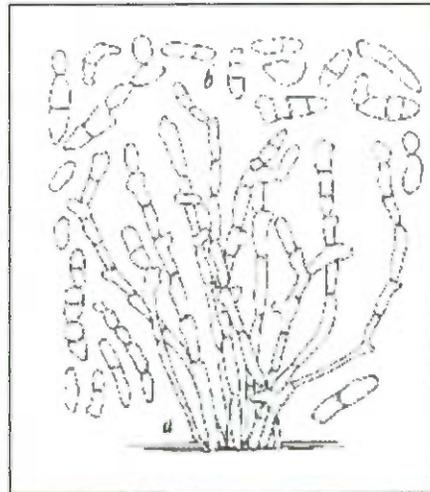


Fig (22)

Tomato leaf mold symptoms on upper leaf surface



Fig (23)

Tomato leaf mold symptoms on lower leaf surface





Tomato Leaf Mold



Fig (24)
Tomato leaf mold symptoms on fruit
and stem

Didymella Stem Rot



Fig (25)
Black stem cankers on seedling



Fig (26)
Large black stem canker



Tomato Target Spot

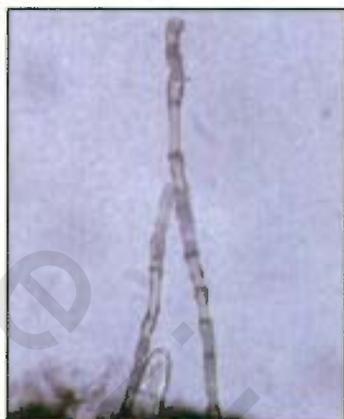


Fig (27)

Corynespora cassiicola; conidiophore with linked cylindrical cells

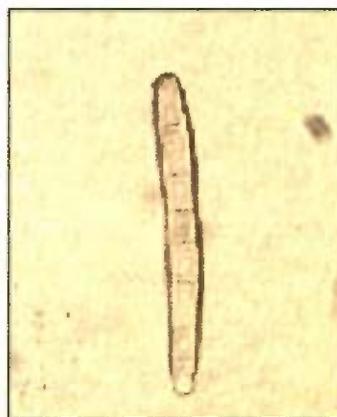


Fig (28)

C. cassiicola; conidium with pseudo-septa



Fig (29)

Symptom of target spot on tomato leaves



Fig (30)

Symptom of target spot on young fruit

Fig (31)

Target spot symptom on ripening fruit





Grey Leaf Spot



Fig (32)

Conidium spore of *Stemphylium*



Fig (33)

Stemphylium solani, *S. lycopersici*
symptoms on tomato leaf

Tomato Phoma Rot



Fig (34)

Tomato phoma rot on leaf



Fig (35)

Tomato phoma rot on fruit



Tomato Anthracnose



Fig (36)
Spores of *C. coccodes*



Fig (37)
Acervulus: conidia and conidiophores



Fig (38)
Sunken lesions, slightly paler than the healthy tissue, black fruiting bodies are visible on this closed lesion



Tomato Fusarium wilt



Fig (39)

Fusarium wilt of tomato. Note yellowing and death of leaves on one side of the stem

Verticillium and Fusarium Vascular Discoloration



Fig (40)

Dark brown vascular discoloration in tomato caused by Fusarium wilt (lower). Verticillium wilt (upper) causes a lighter tan discoloration of the vascular tissue



Tomato Verticillium Wilt

Fig (41)

V. Albo atrum conidiophore

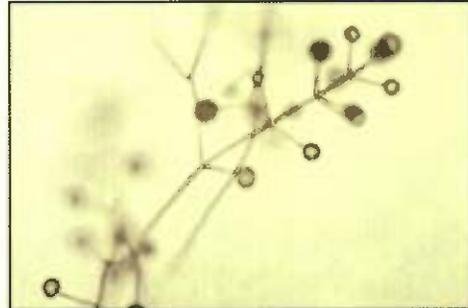


Fig (42)

V. dahliae: conidiophore and spores



Fig (43)

Typical V- shaped lesions on tomato leaves associated with Verticillium wilt





Tomato Crown and Root Rot



Fig (44)

Canker on stem at soil line



Fig (45)

Internal discoloration of the crown and root rot. (Note missing taproot)

White Mold on Tomato



Fig (46)

Black sclerotia in stem of infected tomato vines



Fig (47)

White mold on tomato fruit



Tomato Grey Mold

Fig (48)

Conidiphore and conidia of *B. cinerea*

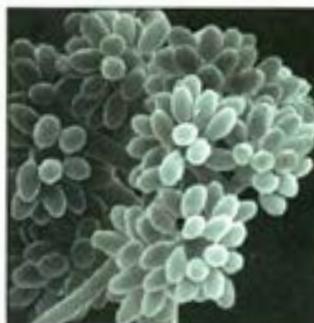


Fig (49)

Grey mould on flower



Fig (50)

Grey mould on tomato fruit



Fig (51)

Early symptoms of grey mould on pruning wound





Tomato Powdery Mildew

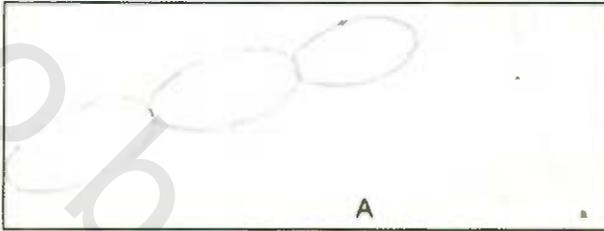


Fig (52)

Conidia (A) and conidiophore (B) of
Oidium neolycopersici



Fig (53)

Symptoms of *Oidium taurica* consist
of chlorotic spots on the upper leaf
surface and profuse fungal sporulation
on the lower surface (left photo). For
Oidium neolycopersici, Powdery white
colonies appear on the upper surface
(right photo)



Tomato Corky Root rot



Fig (54)

Tomato corky root rot



Tomato Southern Blight

Fig (55)

White mycelial growth and sclerotia
near the soil surface



Tomato Damping off

Fig (56)

Affected plants occur in batches in
nursery beds



Fig (57)

Seedlings affected by damping off





Sour Rot

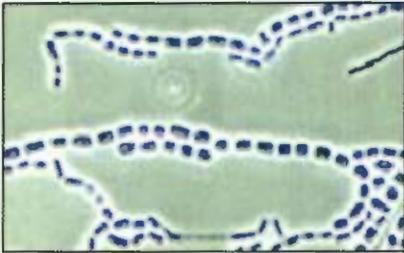


Fig (58)

Anthroconidium development in
Geotrichum candidum



Fig (59)

Tomato fruit with *Geotrichum* sour- rot

Rhizopus Rot on Tomato Fruit



Fig (60)

A carton of tomatoes with nested
Rhizopus rot (and some secondary
fungi)

Black Mold on Tomato Fruit

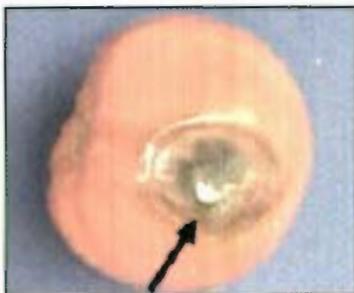


Fig (61)

A fruit with a fingernail wound (arrow)
that later developed into black mold



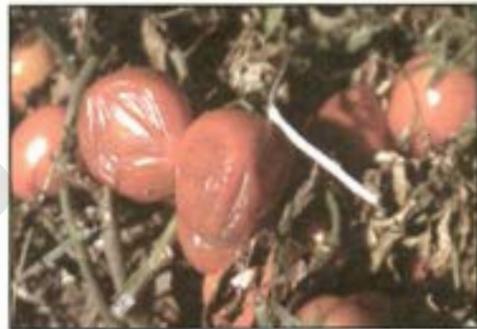
Tomato Soil Rot

Fig (62)
Soil rot on tomato fruit caused by
R. solani



Pythium Rot

Fig (63)
Pythium rot



Fusarium rot

Fig (64)
Fusarium originating from the stem-
scar





الفصل الخامس

Tomato Bacterial Wilt



Sudden & permanent wilt occur



Fig (1)

Brown discoloration of the vascular system



An ooze will flow from a cut infected stem (right tube)

Tomato Bacterial Soft Rot



Fig (2)

Vines wilt and die; the inner stem becomes brown and slimy



Fig (3)

Bacterial soft rot on tomato fruit



Fig (4)

Sliced tomato showed infected tissue with bacterial soft rot through the blossom end



Tomato Pith Necrosis

Fig (5)

The stem pith of tomato plant affected with pith necrosis turns dark brown and develops hollow cavities





Tomato Bacterial Spot



Fig (6)
Initial symptoms

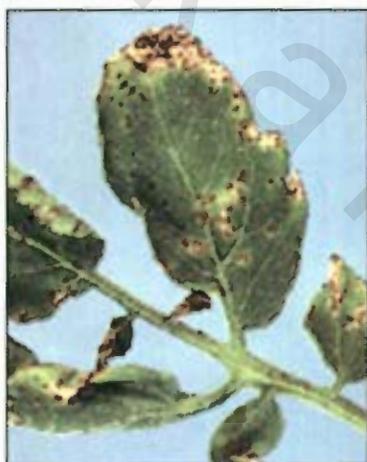


Fig (7)
Lesions may coalesce, causing blighted areas on leaves



Fig (8)
Immature fruit show brown, slightly sunken, scabby spots. Lesions on stems are elliptical in shape



Tomato Bacterial Speck

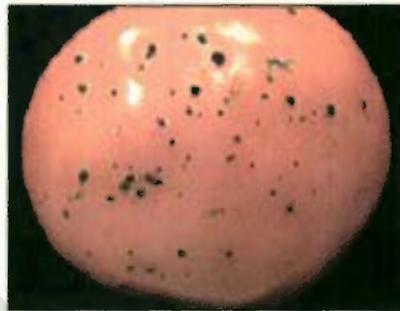
Fig (9)

Leaves from a greenhouse- grown tomato seedling infected with bacterial speck



Fig (10)

Fruit infected with bacterial speck



Bacterial Canker

Fig (11)

Bacterial canker symptoms on tomato leaflet, showing yellow border between live and dead tissue



Fig (12)

Bacterial canker symptoms on tomato fruit showing bird's eye. On leaflet, showing distinctive upward curling of leaf edges





Tomato Crown Gall



Fig (13)

Tomato infected with crown gall



الفصل السادس

Tomato Aster Yellows

Fig (1)
Infected and healthy tomato plants



Tomato Big Bud

Fig (2)
Enlarged buds and growth distortion
is characteristic of tomato big- bud
phytoplasma





Tomato Stolbur Phytoplasma



Absence of petals stamens and carpels



Mature flower



Sepal hypertrophy green petals and stamens



Leaf structure of sepals, absence of petals

Fig (3)



الفصل السابع

Tobacco Mosaic Virus

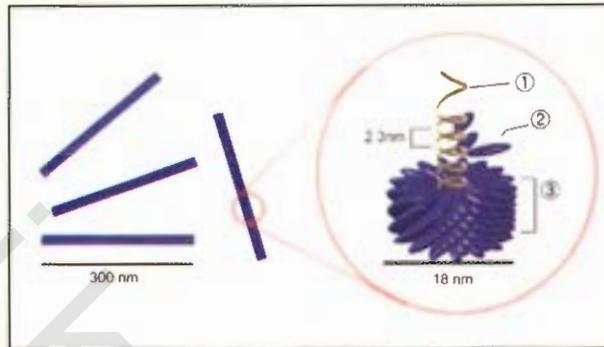


Fig (1)

1- Genomic RNA 2 - Capsomer
3 - Capsid



Fig (2)

Symptoms of tobacco mosaic virus on tomato

A- Symptoms on leaves

B- Gray wall symptoms

C- Necrotic spots on fruit



Tomato Mosaic Virus



Fig (3)

Leaf symptoms of tomato mosaic virus



Fig (4)

Fruit symptoms of tomato mosaic virus

Cucumber Mosaic Virus



Fig (5)

Healthy leaf (left) and infected leaf (right)

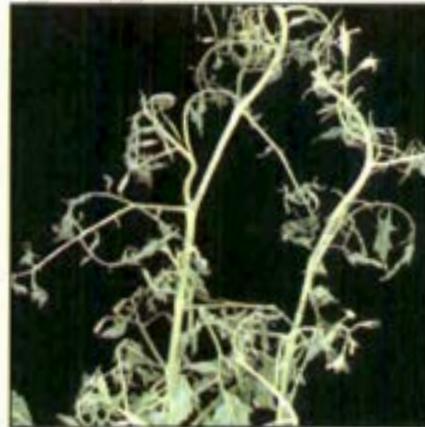


Fig (6)

Shoestring, tendril-like foliage



Tomato Yellow Leaf Curl Virus

Fig (7)

Infected plant (left) is yellowing and becoming stunted as compared to healthy plant (right)



Fig (8)

Leaf curling and erect growth



Tomato Yellow Leaf Curl Sardinia Virus

Fig (9)

Yellow leaf curl disease on tomato caused by yellow leaf curl Sardinia virus





Tomato Leaf Curl Virus



Fig (10)
Leaves curling and distortion



Fig (11)
(A) 21 days- leaves curling and early stages of interveinal yellowing



(B) 35 day- marked leaf curling and interveinal yellowing



(C) 56 day- plant distortion and loss of leaf development



Potato Virus Y



Fig (12)

Foliage shows mild roughness, faint mottling and slight distortion (upper photo). Later, the foliage may curl downward, giving the plant a drooping appearance (under photo)



Tobacco Etch Virus

Fig (13)

Leaves show mottling, crinkling, distortion and downward curling





Tomato Spotted Wilt Virus



Fig (14)

Purple flecking of young leaves caused by tomato spotted wilt



Fig (15)

Fruit symptoms of tomato spotted wilt

Tomato Alfalfa Mosaic Virus



Fig (16)

Foliage damaged by alfalfa mosaic virus



Fig (17)

Alfalfa mosaic virus symptoms on tomato fruits



Tomato Curly Top Virus

Fig (18)

Foliage damaged by beet curly top virus



Tomato Bushy Stunt Virus

Fig (19)

Upper leaves of plants infected by tomato bushy stunt virus are yellow and curled



Fig (20)

Tomato bushy stunt virus on tomato fruits





Tomato Mottle Virus



Fig (21)
Tomato mottle virus

Pseudo Curly Top Virus on Tomato Plant



Fig (22)
Infected tomato with healthy
comparison



Fig (23)
Top of plant infected with pseudo curly
top virus



Tomato Yellow Top Virus

Fig (24)
Drawed tomato plant





الفصل الثامن

Potato Spindle Tuber Viroid (PSTVd)



Fig (1)

Tomato infected with PSTVd showing purpling and chlorosis, down-curling, stunting and distortion

Tomato Apical Stunt Viroid (TASVd)



Fig (2)

Symptoms of tomato apical stunt viroid on tomato leaves



Tomato Chlorotic Dwarf Viroid (TCDVd)



Fig (3)
Greenhouse tomato plants infected
with TCDVd



Citrus Exocortis Viroid on Tomato Plants (CEVd)

Fig (4)
Tomato plants infected by CEVd





Tomato Bunchy Top Viroid (TBTVD)



Fig (5)
Symptoms of TBTVD on tomato plant

Tomato Planta Macho Viroid (TPMVd)



Fig (6)
Symptoms of tomato planta macho viroid on tomato plant



الفصل التاسع

Plant Pathogenic Nematodes

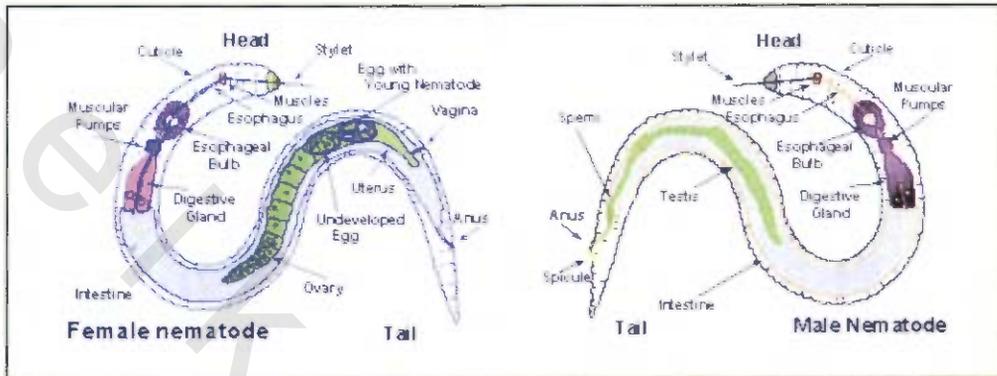


Fig (1)

Female and male nematodes

Root- Knot Nematode

Fig (2)

Adult female of the root-knot nematode (*Meloidogyne sp.*) with attached egg mass



Fig (3)

Adult male of root-knot nematode





Root-Knot Nematode



Fig (4)

Root system infected with *M. incognita*

Reniform Nematode



Fig (5)

Male and young female of reniform nematode. stages typically found in soil



Fig (6)

Life stages of reniform nematode. ranging from left to right is juvenile, young female with swollen body, and mature female in kidney shape



Sting Nematode

Fig (7)

The adult female of sting nematode

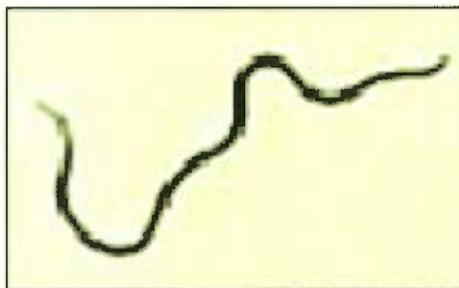
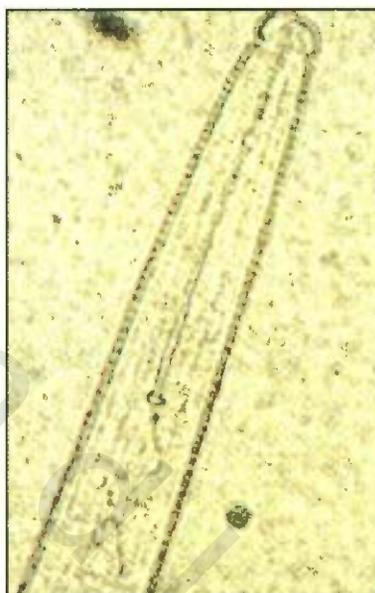


Fig (8)

Greatly enlarged adult female sting nematode showing slender, elongated stylet (center) used for reaching deep inside root tissue





Stubby Root Nematode

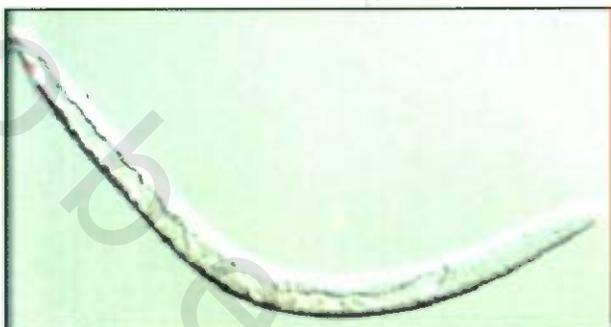


Fig (9)
Stubby root nematode

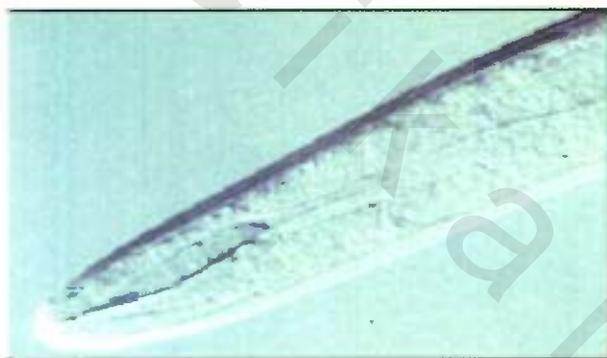


Fig (10)
Onchio style of stubby root nematode

Root Lesion Nematode

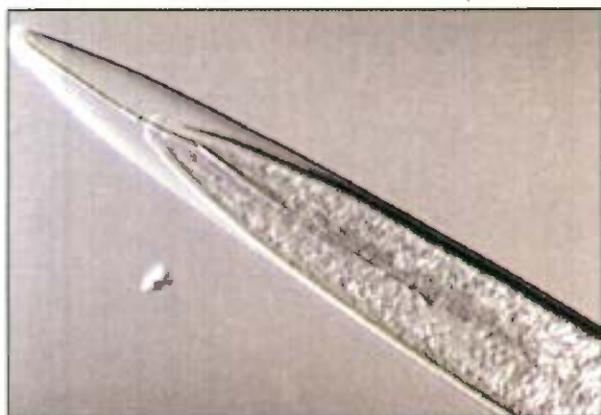


Fig (11)
Tomato root lesion nematode



الفصل العاشر

Whitefly

Fig (1)
Nymphs stage of whitefly



Fig (2)
Adult stage of whitefly



Aphids

Fig (3)
Green peach aphid colony





Thrips



Fig (4)
Western flower thrips

Cabbage Looper



Fig (5)
Cabbage looper moth



Fig (6)
Cabbage looper larva



Tomato Psyllid

Fig (7)

Adult stage of tomato psyllid



Fig (8)

Tomato psyllid nymphs on tomato leaf



Fig (9)

Psyllid sugar on tomato leaves





Tomato Pinworm

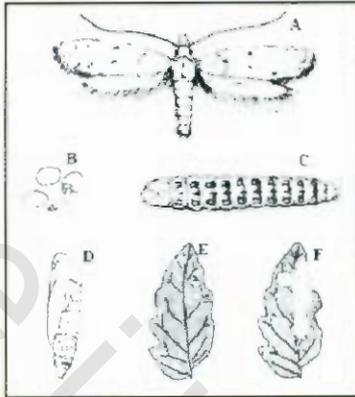


Fig (10)

Tomato Pinworm. A. Adult. B. Eggs and new larva. C. Larva. D. Pupa. E. Early damage. F. Later damage



Fig (11)

Larva of tomato pinworm

Flea Beetles



Fig (12)

Potato flea beetle



Fig (13)

Tobacco flea beetle



Fig (14)
Corn flea beetle



Fig (15)
Eggplant flea beetle



Tomato Fruitworms

Fig (16)
Life cycle of tomato fruitworm

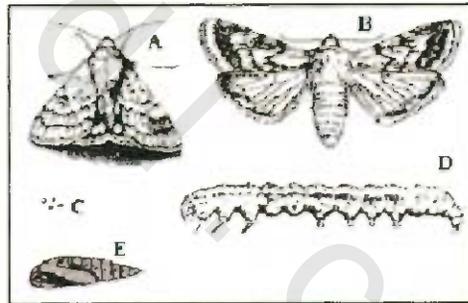
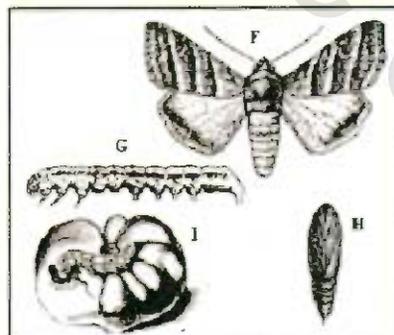


Fig (17)
Life cycle of tobacco budworm





Tomato and Tobacco Hornworms



Fig (18)
Adult tomato hornworm



Fig (19)
Adult tobacco hornworm

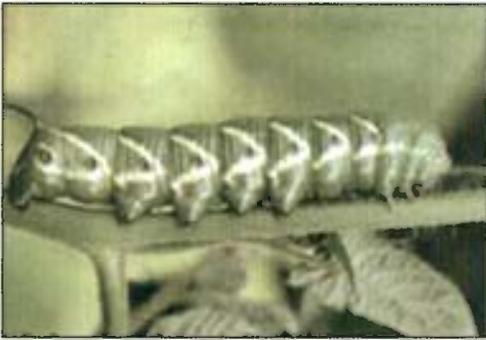


Fig (20)
Larva of tomato hornworm



Fig (21)
Larva of tobacco hornworm



Beet Leafhopper

Fig (22)
Adult beet leafhopper



Tomato Cutworms

Fig (23A)
Larva of black cutworm

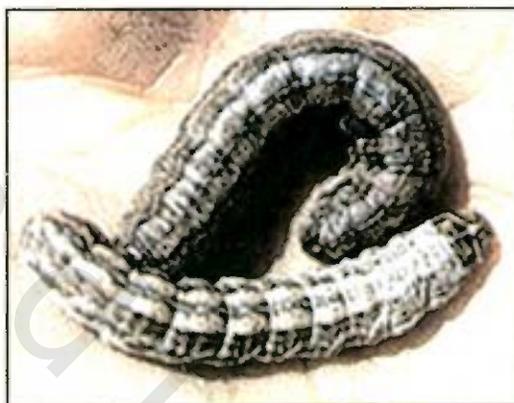


Fig (23B)
Moth of black cutworm





Fig (24A)
Larva of granulate cutworm



Fig (24B)
Moth of granulate cutworm



Fig (25A)
Larva of variegated cutworm



Fig (25B)
Moth of variegated cutworm



Tomato Cutworms Life Cycle

Fig (26)
Black cutworm

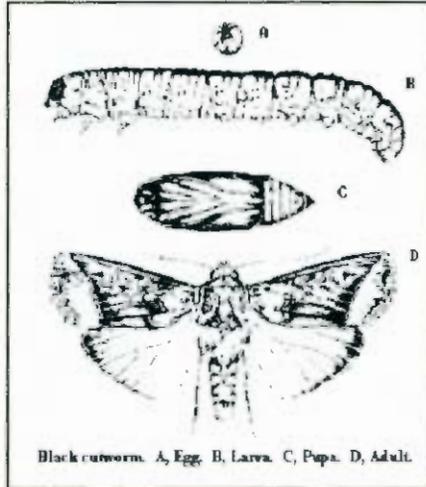


Fig (27)
Granulate cutworm

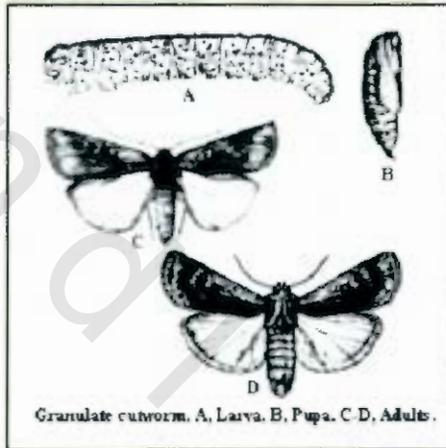
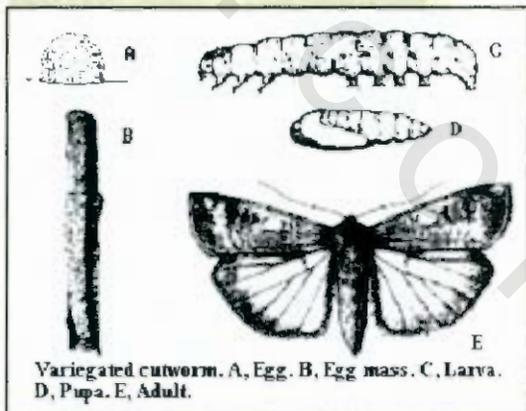


Fig (28)
Variegated cutworm





Cotton Leafworm



Fig (29A)

Larva of cotton leafworm



Fig (29B)

Moth of cotton leafworm

Potato Tuberworm



Fig (30A)

Larva of potato tuberworm



Fig (30B)

Moth of potato tuberworm



Vegetable Leafminer

Fig (31A)
Adult *L. sativae* (vegetable
leafminer)



Fig (31B)
Larva of *L. sativae*



Fig (31C)
Leafminer damage on greenhouse
tomato leaf



Mole Cricket

Fig (32)
Gryllotalpa gryllotalpa





Tomato Stink Bugs



Fig (33)

Adults of tomato stink bugs



Fig (34)

Tomato fruit infected with stink bugs

Spider Mite



Fig (35A)

Two spotted spider mite



Fig (35B)

Red spider mite



Tomato Borers

Fig (36)
Tuta absoluta moth



Fig (37)
Tuta absoluta larva



Fig (38)
Tuta absoluta infestation on fruits





الفصل الحادى عشر

Effect of Pesticides on Tomato Leaf



Fig (1)

Malathion damage on tomato leaf

Tomato Physiological Diseases



Fig (2)

Tomato fruits infected with BER
Tomato Blossom End Rot (BER)



Tomato Catface

Catfaced fruit with hole into fruit



Fig (3)

Fruit showing catfacing on blossom end



Tomato Fruit Cracking

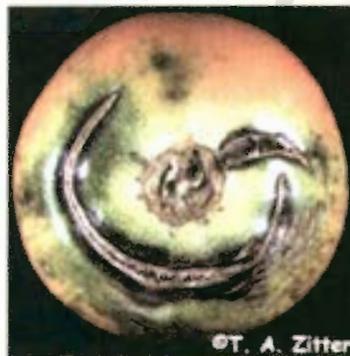
Fig (4A)

Radial cracking of tomato fruit



Fig (4B)

Concentric cracking of tomato fruit





Physiological Tomato Leaf Roll



Fig (5)

A) Severe physiological leaf roll symptoms on a tomato plant. B) Tomato plants with physiological leaf roll on the older (lower) leaves with normal new (top) growth that developed after air temperatures cooled. C) Some tomato cultivars are less susceptible to physiological leaf roll than others

Tomato Sun Scald



Fig (6)

Lethal sun scald. note sunken area



Puffiness



A) Fruit severely affected by puffiness. note large open areas



B) Note absence of seed in gel area caused by puffiness

Fig (7)

Yellow and Green Shoulders



A
Yellow shoulder



B
Green shoulder

Fig (8)



Internal White Tissue



Fig (9)

Internal white tissues

Tomato Fruit Pox

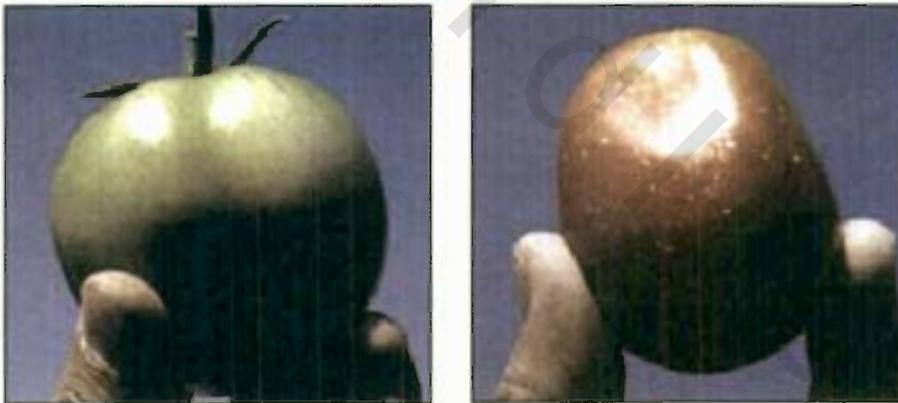


Fig (10)

White spots on tomato fruit



Tomato Gold Fleck



A Mottle spots on tomato fruit Fig (11) B Circular ring spot on tomato fruit

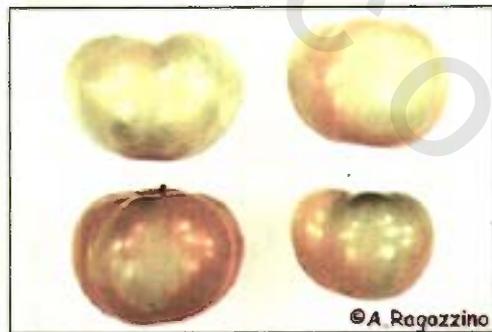
Irregular Ripening

Fig (12)
Irregular ripening on tomato fruits



Gray Wall

Fig (13)
Gray wall on tomato fruits





Cloudy Spots



Fig (14)

Cloudy spot on tomato fruit

Rain Check



Fig (15)

Rain check on tomato fruit

Zippering



Fig (16)

Zipper strip spots on tomato fruit

Dimpling



Fig (17)

Oviposition dimples persisting on ripe fruit



Symptoms of Elements Deficiency



Fig (18)

Nitrogen deficiency

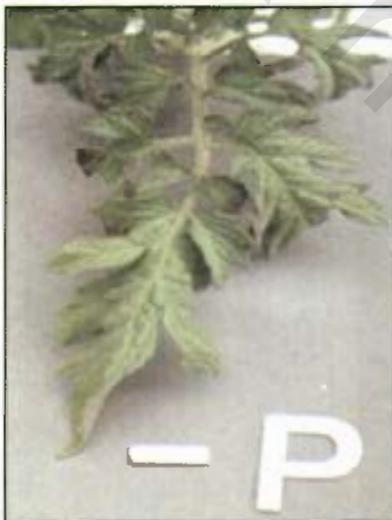


Fig (19A)



Fig (19B)

Phosphorus deficiency

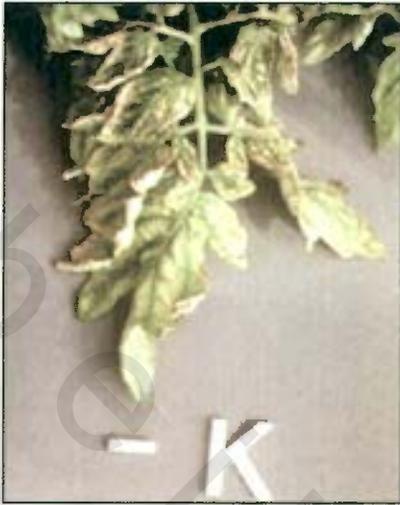


Fig (20)
Potassium deficiency



Fig (21)
Calcium deficiency

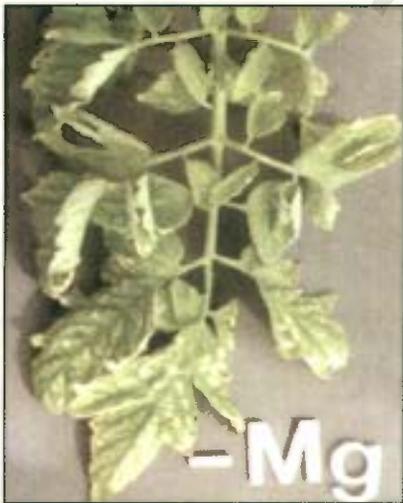


Fig (22)
Magnesium deficiency



Fig (23)
Sulfur deficiency



Fig (24)
Iron deficiency



Fig (25)
Copper deficiency

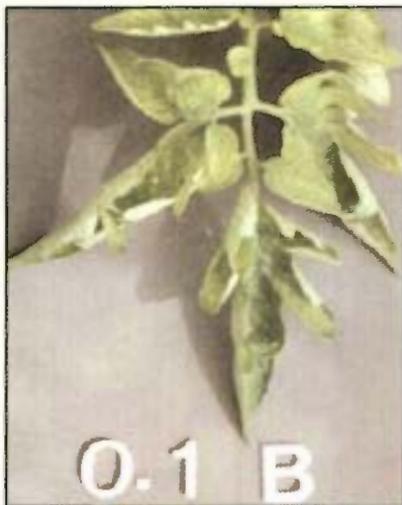


Fig (26)
Boron deficiency



Fig (27)
Zinc deficiency



Fig (28)
Manganese deficiency



Fig (29)
Molybdenum deficiency



Fig (30)
Chloride deficiency



الفصل الثاني عشر

Broomrape

Fig (1)
Orobanche sp



Dodder

Fig (2)
Cuscuta sp





Herbicide Damage



Fig (3)

Herbicide damage on tomato plants