Fungal, Bacterial and Nematological Problems of Citrus, Grape and Stone fruits in the Arab Countries

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Abstract

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Production status of citrus and grape vine in the Arab countries was briefly described. The distribution and the relative economic importance of the reported fungal, bacterial and nematological diseases of those fruit trees and that of stone fruits was discussed.

Citrus canker, reported from four Arab countries is potentially one of the most serious diseases. Citrus stubborn in contrast to greening, is of a wider distribution. Phytophthora group of diseases are certainly the most widely distributed and presently seem to be the most destructive. Mal secco, though geographically restricted has the signficance of being reported in countries of high status of production. The most important diseases on grape vine are powdery - and downy - - mildews as well as black rot. In general, the relative importance of the diseases on stone fruits varies in Arab countries, but brown fruit rot and twig canker as well as leaf curl seem to be the most serious. The slow decline nematode disease is the most widely distributed.

Facilities and methods of producing healthy seedlings are inadequate in most Arab countries. Morocco is an exception particularly in the production of citrus propagating materials.

1. Introduction

During the last 10 - 15 years, production of citrus and grape progressively increased in most Arab countries. In terms of production, Egypt, Morocco, Algeria, Syria, Iraq, Lebanon and Tunisia were leading (14, 16).

There is a growing interest in plant disease surveys within the Arab countries, but compilation of information in the form of distribution maps has been undertaken only recently. Attempt is made here to compile information and highlight the importance of fungal, bacterial and nematological diseases on citrus, grape and stone fruits. The status of nurseries and production of healthy seedlings is briefly discussed.

2. Diseases reported on citrus

a. Fungal diseases

Diseases that affect citrus in seedbed such as root rot and damping-off caused by *Rhizoctonia solani* Kuhn, *Pythium* spp. (e.g. *P. aphanidermatum* (Eds) Fitz which are common soil inhabitants or soil invadors are of general occurrence in most soils (40).

In nurseries and orchards, at least twenty fungal diseases were reported throughout the Arab countries (Table 1) (2, 9, 11, 12, 13, 17, 25, 27, 29, 30, 33, 37, 38, 44). Considering the potential degree of destructiveness and expenses of control, *Phytophthora* spp. *and Deuterophoma tracheiphila* (Penz) Sacc. (Mal secco of citrus) are perhaps the most important fungal diseases. *P. citrophthora* (Sm. & Sm.) Leon. is the most widely distributed. It was reported in at least twelve Arab countries (Table 1) and is probably present in many others (2, 9, 12, 20, 25, 29, 30, 33, 44). Reported damage included root rot, trunk gummosis, leaf and shoot blight as well as fruit rot. The fungus has, in addition to citrus, a wide host range and apparently variability among the different isolates is rare (40, 44). Thus, it may have a wider distribution than the records suggest. *P. hibernalis* Carne reported from Egypt and Palestine (25) causes leaf and twig blight as well as brown rot of fruits. Serious losses were reported on mandarine, sweet orange and lemon (40). *P. nicotianae* van Breda de Haan var. *Parasitica* (Dastur) Waterh. *(P. parasitica)* was reported from five Arab countries (Table 1) to cause root and fruit rot and has a wide host range, but physiological specialization which may not warrant existence of strains had been reported (2, 25, 44). Optimum temperature for disease incidence and development by the different *Phytopthora* spp. varies. It is near 20°C for *P. hibernalis*, 24 - 28° C for *P. citrophthora* and 30 - 32°C for *P. nicotianae* var. *parasitica* (44). Thus, other things being equal, the prevalence and severity of disease caused by one species or another in any one country or locality is likely to be influenced by the prevailing temperature.

Table 1. Distribution of fungal diseases reported on citrus in the Arab countries.

Disease	Distribution
Alternaria citri Ellis & Pierce (Alternaria leaf spot /fruit rot)	Egypt (9, 25), Iraq (8), Jordan (37), Morocco (11), Palestine (25), S. Arabia (2); Syria (33), UAE (17)
Armillaria mellea Vahl ex. Fr. (Armillaria root rot)	Libya (25)
Botryodiplodia theobromae Pat. (Die back of citrus twigs)	Palestine (25), S. Arabia (2), Sudan (25, 43), UAE (17)
Botryosphaeria ribis Cross & Dug. (Twig blight)	Lebanon (25)
Capnodium citri B. & Desm. (Sooty mold)	Egypt (25), Iraq (38), S. Arabia (2), Sudan (43), Syria (33), UAE (17), YAR (29, 30)
Cladosporium sp. (Fruit rot)	Jordan (37), Syria (20)
Deuterophoma tracheiphila Petri. (Mal secco of citrus)	Algeria (39), Jordan (37), Lebanon (39), Palestine (25, 39), Syria (20, 33, 39, 42), Tunisia (39), YAR (12)
Diaporthe citri Wolf. (melanose)	Egypt (25), Jordan (37), Morocco (25), Syria (20), Tunisia (12), UAE (17)
Diplodia sp. (gummosis)	Jordan (37)
Elsinoe fawcetti Bitancourt & Jenkins (Scab)	Palestine (25)
Fusarium sp. (root rot)	Egypt (25), Jordan (37), Lebanon, Palestine (25)
Ganoderma applanatum (Pers ex. S.F. Gray) Pat. *G. lucidum* (Layss. ex Fr.) Karst,	Morocco, Sudan (25) YAR (30),
Gonatobotrys sp. (Root rot)	Jordan (37)
Glomerella cingulata (Stonem) Spaulding & Schrenk, imperfect stage *Colletotrichum gloeosporioides* (Penz), (Anthracnose)	Egypt, Lebanon (25) S.Arabia *(2),* Sudan *(25),* Syria (20, 33), UAE (17), YAR (29, 30).
Phytophthora citrophthora (Sm. & Sm.) (Trunk base gummosis)	Algeria (44), Egypt (9, 25, 44), Iraq (38, 44), Jordan (37), Lebanon (25), Libya (12), Morocco (44), Palestine (25, 44), S. Arabia (2), Sudan (12), Syria (20, 33, 42), Tunisia (44)
P. hibernalis Carne. (Phytophthora blight)	Egypt, Palestine (25)
P. nicotianae van Breda de Haan var. *parasitica* (Dastur.) Waterhouse (= *P. parasitica*)	Jordan (37), Lebanon (25), Morocco, Palestine (25), S. Arabia (2).
Penicillium digitatum Sacc. Fruit green mold	All countries
P. italiucm Wehmer Fruit blue mold	All countries
Pleospora herbarum (Pers.) Rab.(Fruit rot)	Syria (20)
Sphaeropsis tumefaciens Hedges (Knot of citrus branches and twigs)	Egypt (13)

D. tracheiphila Petri was reported in seven Arab countries (Table 1) (12, 20, 25, 31, 33, 37, 39, 42). The disease is known to be highly destructive particularly when infection starts at the base of the tree or roots as compared to that of canopy. Lemon is the most affected and sour orange as well as citron are important hosts. Optimum temperature for disease development is 20 - 25°C. At higher temperature the spread of the disease in most hosts is greatly reduced (39).

b. Bacterial diseases

Pseudomonas syringae p.v. *syringae* van Hall, citrus blast and black pit , was reported from Egypt and Palestine (25). The pathogen was also reported from other Arab countries (see bacterial diseases on stone fruits). Grapefruit and oranges are most suceptible to blast and lemon to black pit. However, damage caused by this disease seems to be restricted (28, 40).

Spiroplasma citri Saglio, citrus stubborn, was reported from Algeria, Egypt, Lebanon, Libya, Morocco, Palestine, Saudi Arabia, Syria and Tunisia (23). There are strong indications of the presence of the disease in the Sudan (22). Important citrus hosts are grape fruit, tangarine, sweet orange and rarely lemon. The disease was also reported on numerous hosts other than citruses. Stubborn is transmitted by two species of leafhoppers, *Neoaliturus haematoceps* and *N. tenellus* (22).

Xanthomonas campestris (Pam.) Dows. pv. *citri* (Hesse) Dye., the causal organism of citrus canker, was reported from Oman, UAE, Yemen (North and South) (15) and doubtful in Iraq and Saudi Arabia. Although the disease was reported from all continents but has not been observed in the Mediterranean region (15, 28), presumably because of the stringent safeguard measures against the disease. The damage caused by the disease on the various citrus varieties depends upon host susceptibility, weather conditions and the prevailing race (15, 28). Three races of the pathogen were identified; Cancrosis A (Asian), Cancrosis B (Argentine) and MLC (Maxican Lime Cancrosis). In the Arab countries, where the disease is present, races have not been identified, except in UAE where Cancrosis A had been proposed (15).

Greening, one of the most serious citrus diseases in the world, is associated with a bacterium-like organism (Greening Organism G.O.) though Kock's postulates have not been fulfilled. The two known form of the disease: the African, found in Africa south of the Sahara, and the Asian in some Asian countries, are transmitted by two species of psylla vectors. At first, the vector of the Asian form - *Diaphorina citri* was reported in south west Saudi Arabia and that of the African form *Trioza erytreae* in the highlands of North Yemen. Later the two vectors were found in Abha - Saudi Arabia (22).

3. Diseases reported on grape vine

a. Fungal diseases

Two common diseases affect grape vine in the Arab countries. Powdery mildew (*Uncinula necator* (Schw.) Burr., reported from all Arab countries that grow grape (25). It causes serious damage and even complete crop failure, espe-

cially when preventive measures are not employed (31).

Downy mildew *Plasmopara viticola* (Berk. & Curt.) Berl & de Toni) was reported on grape vine in at least ten Arab countries (Table 2). Distribution within a given country varies from one year to another, and is dependent upon environmental conditions. It is more severe in humid, coastal and mountainous areas, and becomes less important in the inner dryer areas, where powdery mildew usually predominate. Grape vine varieties, El Biod and Ghanez were reported to be very susceptible and Alicante, Grenach and Cinsault were tolerant to the disease in Morocco (11).

Guignardia bidwelli (Ell.) Viala & Ravaz (Black rot) was reported from Iraq (8) Morocco (25) and Syria (18). The disease is favored by moist weather. Rapid infection takes place at 27°C, less infection at 21°C and no disease at 32°C.

Several other fungi, to cause or associated with, grape vine diseases on branches, leaves or roots were reported from many Arab countries (Table 2).

b. Bacterial diseases

Agrobacterium tumefaciens (Smith & Townsend) Conn. (Crown gall), was reported from Jordan (37), Lebanon, and Syria (25, 33). The pathogen is widely distributed and has an extended host range (23, 28).

4. Diseases reported on stone fruits

a. Fungal diseases

A list of fungal diseases on stone fruits and their distribution is given in Table 3. Brown fruit rot and twig canker, caused by *Monilinia fructigena* (Wint.) Honey, and *M. laxa* (Aderh. et Ruhl.) Honey is perhaps the most important disease on stone fruit trees, particularly apricot, in many Arab countries (9, 11, 18, 20, 25, 26, 33, 37). Total destruction of flowers was reported, especially in mild humid springs (20). The characteristic canker on branches and twigs leads to severe decline unless proper measures are taken on time.

Taphrina deformans (Berk.) Tul. the causal pathogen of leaf curl disease on stone fruits has been reported on peach in all Arab countries where this tree is cultivated (2, 7, 9, 11, 20, 26, 29, 30, 33, 34, 37). It causes a premature defoliation of old trees, and in severe cases, it might destroy a whole nursery (21, 34). The fungus was reported on Almond (2, 9, 11, 18, 20, 26, 29, 30, 33, 37) but disease severity was less pronounced. It was also reported to infect apricot in Jordan (37) and in the coastal mountainous areas of Syria where varieties seem to differ in their susceptibility to the pathogen; local «Kellabi» being most susceptible (Bayaa-unpublished). *Taphrina pruni* (Fck) Tul. the cause of plum-pocket disease was recorded on plum in the coastal mountainous areas of Syria (5, 19) and in Jordan (37).

Stigmina carpophila (Lev.) Ellis., stone fruit shot-hole, is widely distributed on almost all stone fruit trees in the Arab world (2, 9, 10, 11, 18, 20, 25, 29, 30, 33, 37) (Table 3). Reported damage included leaf and fruit spots, bud withering and twig cankers. Cuprous compounds were recommended for checking the disease.

Two species of *Polystigmina, P. ochraceum* (Wahl.) Sacc. red leaf blotch and *P. rubra* (Desm.) Sacc. brown leaf blotch were reported on almond and plum in three Arab countries

Table 2. Fungal diseases reported on grape vine in the Arab countries.

Disease	Distribution
Aspergillus niger V. Tiegh (Black mold rot)	Egypt (25), Jordan (35) Palestine (25), Syria (unpublished)
Botryodiplodia theobromae Pat.(Die back of grape vine)	Egypt (24)
Botrytis cinerea Pers. (Fruit grey mold)	Egypt (25), Jordan (37)
Cephalosporium sp. (root rot)	Jordan (37)
Cladosporium herbarum (Pers.) Link ex Gray	Egypt (25)
Curvularia lunata (Wakker) Boedijin	Egypt (25)
Epicoccum sp.	Egypt (25)
Cercospora spp.	Egypt, Iraq (25)
(leaf spot)	Jordan (37), Sudan (25)
Eutypa armeniacae Hansford & Carter imperfect stage *Cytosporina* sp. = *Cryptosporella viticola* Shear. (Dead arm)	Iraq (8), Syria (not confirmed)
Fusarium sp. (Root rot)	Jordan (37), Syria (33)
Gloeosporium ampelophagum (pass.) Sacc. (Anthracnosis)	Iraq (8), Lebanon (22), Syria (33)
Guignardia bidwelli (Ell.)	Iraq (8), Morocco (25)
Viala & Ravas (black rot)	Syria (18)
Monochaet sp. isolated from branches	Syria (18)
Phaeoramularia dissiliens (Duby.) Deighton (Leaf spot)	YAR (29, 30)
Phialophora sp. (Black arm disease)	Syria (4)
Phoma sp. isolated from branches	Jordan (37)
Pleospora sp. isolated from branches	Jordan (37), Syria (18)
Plasmopara viticola (Berk & Curt.)	Egypt (25), Iraq (8),
Berl. & de Toni	Jordan (35), Lebanon (25),
(Downy mildew)	Morocco (11), Palestine (25), S. Arabia (2), Syria (33), Tunisia (25), YAR (29, 30)
Pseudocercospora (Lev.) Speg. (Leaf spot)	S. Arabia (2), YAR (29)
Pseudopeziza sp. (Grape vine leaf fire blight)	S. Arabia (2)
Stagnospora sp. isolated from branches	Syria (18)
Torula sp. isolated from branches	Jordan (37)
Uncinula necator (Schus). Burr. (Powdery mildew)	All Arab countries (25)

Table 3. Distribution of fungal diseases reported on stone fruits in the Arab countries.

Disease	Distribution
Botryodiplodia sp. (Twig blight)	Syria (18)
Botrytis cinerea Pers. (Grey mold)	Jordan (37), Syria (20)
Coniothyrium fuckelli Sacc. (Stem canker)	YAR (29, 30)
Cytospora sp. (Stem & Twig canker)	Morocco (11), Syria (18)
Fusarium sp. (Root rot)	Egypt (1), Jordan (37), Syria (33)
Fusicladium carpophilum (Thum)Oudem = *Cladosporium carpophilum)* (Scab)	Jordan(37), Syria (18, 20, 33)
Fusicoccum amygdali Del. (Almond canker)	Tunisia (26)
Monilinia fructigena (Wint.) Honey (Brown rot)	Egypt (9), Morocco (11), Jordan (35), Syria (18, 20, 33) Tunisia (26)
M. laxa(Aderh & Ruhl.)Honey (Brown rot)	Morocco (11), Syria (18, 20), Tunisia (26)
Papulaspora sp. (root rot)	Syria (33)
Pestalotia sp. (Blight, stem canker)	Jordan (37)
Phyllactinia guttata (Wall. ex Fr.) L. (Powdery mildew)	Jordan (37)
Podosphaera clandestina (Wall. ex Fr.) Lev. (Powdery mildew)	Jordan (37)
P. oxycanthae (DC.) de By. var. *Tridactyla* Salm. (Powdery mildew)	Egypt (9), Jordan (37), Libya (32), S. Arabia (2), Syria (18, 20, 33), YAR (29, 30)
Polystigmina ochraceum (Waht) Sacc.(Red leaf blotch of almond & plum)	Jordan (37), Syria (18, 20)
Polystigmina rubra (Desm.) Sacc. (Brown leaf blotch of almond)	Syria (18, 20)
Rhizoctonia solani Kuhn (Root rot)	Egypt (1), Jordan (37), Syria (33)
Septoria sp. (leaf spot)	Syria (33)
Sphaerotheca pannosa Wahl.) Leu. var. *Persicae* Woron. (Powdery mildew)	Egypt (9), Jordan (37), Libya (32), S. Arabia (2), Syria (20, 33), YAR (29, 30)
Stigmina carpophila (Lev.) Ellis = *Clasterosporium carpophilum* (Lev.) Aderh. (Shot hole)	Egypt (9), Jordan (37), Morocco (11), Syria (10, 18, 20, 33), Tunisia (26), YAR (29, 30)
Taphrina deformans(Berk.)Tul. (Peach & apricot leaf curl)	Egypt (9), Jordan (37), Iraq (7), Morocco (11), S. Arabia (2), Syria (20, 33, 34), Tunisia (26), YAR (29, 30)
Taphrina pruni (Fck.) Tul. (Plum pocket disease)	Jordan (37), Syria (5, 19, 20, 33)
Tranzschelia Pruni-spinosa (Pers.) Diet. (rust)	Egypt (9), Jordan (37) S. Arabia (2), Syria (20, 33) Tunisia (26), YAR (29, 30)
Verticillium dahliae Kleb. (Wilt)	Syria (3, 20, 33)

(18, 20, 37). They are sporadic and of minor economic importance.

Rust caused by *Tranzschelia* spp. of which *T. prunispinosae* (Pers.) Diet. was reported on almost all stone fruit species (2, 9, 18, 20, 25, 29, 30, 33, 37). Defoliation due to the disease is important in some years, especially in nurseries and in humid areas. The alternate host (*Anemone* sp.) has been reported in Syria (6).

Different species causing powdery mildew on stone fruits were reported from the region: *Phyllactinia* sp., *P. guttata* (Wall. ex Fr.) L., *Podosphaera clandestina)* Wall. ex Fr.) Lev., *P. oxycanthae* (DC) de By. Var. *tridactyla* (Wall.) Salm., *Shpaerotheca pannosa* (Wahl.) Lev. var. *Persicae* Woron, (Table 3). They cause heavy losses in nurseries, and are responsible for the deterioration of fruit quality especially in the case of nectarine and peaches.

Wilt, caused by *Verticillium dahliae* Kleb. was reported on almost all stone fruit species grown in Syria (3, 20, 33) and is probably present in some other Arab countries. Symptoms become obvious particularly during summer; trees lose their vigor gradually and succumb suddenly, and discoloration of vascular system was frequently reported. Evidence indicated that the pathogen could be introduced into some fields through (i) infected seedlings and propagating materials, (ii) application of a non-fermented manure, (iii) planting stone

Table 4. Distribution of nematological diseases reported on citrus, grape vine and stone fruit in the Arab countries.

1. On Citrus

Nematode /Disease	Distribution
Amplimerlinius macrurus (Goodey) siddiqi	Jordan (37)
Coslenchus ostatus (De Man) Siddiqi	Jordan (37)
Criconema sp. (ring nematode)	S. Arabia (2)
Crossonema sp.	Jordan (37)
Helicotylenchus sp. (Spiral nematode)	Egypt (12), Jordan (37), Libya (12), S.Arabia (2) UAE (13)
H. abonaamai Siddiqi (Spiral nematode)	Jordan (37)
H. digonicus Perry (Spiral nematode)	Jordan (37)

Table 4. (cont'd)

Nematode/Disease	Distribution
H. pseudorobustus (Steiner) Golden (Spiral nematode)	Jordan (37)
Hemicriconemoides spp. (Sheath nematode)	Jordan (37), Libya (12), S. Arabia (2)
H. Coccophilus (Loos) Chitwood & Birchfield	Jordan (37)
Hemicy cliophora sp.	Egypt (25)
Hoplolaimus sp. (Lance nematode)	Egypt (25), Jordan (37), S. Arabia (2)
Longidorus sp. (Needle nematode)	Egypt (25), Jordan (37) S. Arabia (2)
L. africanus Marny	Jordan (37)
L. siddiqi Abdul-Eid	Jordan (37)
Macroposthonia sp. (Ring nematode)	Jordan (37)
M. xenoplax (Raski) De Graisse & Loof	Jordan (37)
Meloidogyne sp.	Egypt (12), YAR (12)
Paratrichodorus sp.	Jordan (37), Libya (12) S. Arabia (2)
P. minor (Colbran) Siddiqi	Jordan (37)
Paratylenchus sp. (Pin nematode)	Jordan (37), UAE (13),
Pratylenchus sp. (Root lesion nematode)	Egypt (12), Jordan (37), Libya, Morocco (12), S. Arabia (2), UAE (13)
P. neglectus (Rench) *Fillipjeu* Sch. Steck.	Jordan (37)
Scutellenema bradys Steiner & Lehew	UAE (13)
Trichodorus sp. (Stubby nematode)	Egypt (25), Jordan (37)
T. sparsus Szczygiel	Jordan (37)
Tylenchorhynchus sp. (Stunt nematode)	Egypt (12), Jordan (37), S. Arabia (2)
T. clarus Allen	Jordan (37)
T. dubius (Buetschli) Filipjev	Jordan (37)
Tylenchulus semipentrans Gobb. (Slow decline)	Egypt (25), Jordan (37), Libya (12), S. Arabia (12), Sudan (46), Syria (12) YAR (12), UAE (13)
Xiphenema sp. (Dagger nematode)	Egypt (25), Jordan (37), UAE (13)
X. index Thorne & Allen	Jordan (37)
X. insigne Loos	Jordan (37)
X. pachtaicum (Tulaganov) Kirjanova	Jordan (37)
Zygotylenchus guevarai (Tobar Jumenez), Baraum & Loof	Jordan (37)
2. On Grape Vine	
Criconema sp. (Ring nematode)	S. Arabia (2)
Criconemoides informis (Micol.) Taylor	Jordan (37)

Table 4. (cont'd)

Nematode/Disease	Distribution
(Ring nematode)	
Criconemoides informis (Micol.) Taylor (Ring nematode)	Jordan (37)
Helicotylenchus sp. (Spiral nematode)	Egypt (25), Jordan (37)
H. digonicus Perry (Spiral nematode)	Jordan (37)
Hemicrioconemoides sp. (Sheath nematode)	S. Arabia (2)
Hemicyliophora sp.	Jordan (37)
Hoplolaimus sp. (Lance nematode)	S. Arabia (2)
Longidorus sp. (Needle nematode)	S. Arabia (2)
Macroposthonia sp. (Ring nematode)	Jordan (37)
M. rustica (Micol) De Griss & Loof. (Ring nematode)	Jordan (37)
Meloidogyne sp. (Root knot)	Egypt (25), Jordan (37),
Merlinius sp.	Jordan (37)
M. nanus (Allen) Siddiqi	Jordan (37)
M. rugosus (Siddiqi) Siddiqi	Jordan (37).
Paratrichodorus sp. (Stubby nematode)	S. Arabia (2)
Tylenchorhynchus sp. (Stylet nematode)	Egypt (25), S. Arabia (2)
T. clarus Allen	Jordan (37)
Xiphinema index Thorn & Allen(Dagger nematode)	Jordan (37)
X. pachtacium (Tulaganov) Kirjanova	Jordan (37)
X. Vuittenezi Luc, Lima, Weischer & Flegg	Jordan (37)
3. On Stone Fruits	
Criconemoides sp. (Ring nematode)	Jordan (37)
Helicotylenchus sp. (Spiral nematode)	Jordan (37)
H. pseudorobustus (Steiner) Golden (Spiral nematode)	Jordan (37)
H. tunisiensis Siddiqi	Jordan (37)
Hemicriconemoides sp. (Sheath nematode)	S. Arabia (2)
Heterodera sp. (Cyst nematode)	S. Arabia (2)
Macroposthonia xenoplax (Rashki)De Grisse & Loof	Jordan (35)
Pratylenchus sp. (Root lesion)	Jordan (35)
Tylenchorhynchus sp. (Stylet nematode)	Jordan (35)

fruit trees on sites previously grown to cotton or *Verticillium* susceptible vegetables and other hosts (Bayaa-unpublished).

Species of *Fusarium, Rhizoctonia, Pythium* and *Papulaspora* were often reported to cause root rots on seedlings and on well established plantations (1, 33, 37), in some Arab countries (Table 3).

Four fungal genera have been reported to be implicated in stem canker and (or) twig blight on stone fruits in some Arab countries: *Cytospora* spp. on apricot in Jordan (37) and Syria (18), on cherry in Morocco (11); *Botryodiplodia* sp. on apricot in Syria (18), *Coniothyrium fuckelli* Sacc. on apricot in YAR (29, 30), *Coniothyrium* sp. *C. olivaceum* on almond in YAR and Syria (18, 29, 30), *Fusicocum amygdali* Del. on almond in Tunisia (26).

Scab (*Fusicladium carpophilum* (Thum) Oudem seems to be less widely distributed than other diseases on stone fruits in the Arab countries (18, 20, 37).

Grey mold (*Botrytis cinerea* Pers.) is the most destructive fungus during marketing and storage of fruits. Anthracnosis of almond (*Gloeosporium amygdalinium* Brizi) has been exclusively recorded from Tunisia (26).

b. Bacterial diseases

At least four bacterial pathogens that can infect stone fruits were reported from some Arab countries, though not necessarily on species of those hosts. *A. tumefaciens*, in addition to the previously mentioned places of report on grape vine, was also reported from Algeria, Egypt, Libya, Syria and Saudi Arabia (23, 28, 33). *Erwinia amylovora* (Burill) Winslow (fire blight) reported from Egypt but doubtful in Lebanon and Saudi Arabia (23, 28). *P. syringae* p.v. *syringae,* apart from the confirmed report on citrus in two Arab countries the pathogen was reported from Algeria, Lebanon, Morocco and Tunisia (23). *Xanthomonas campestris* p.v. *pruni* (Smith) Dye (Leaf and fruit spot and stem canker) was reported from Lebanon and Saudi Arabia (23).

5. Nematological diseases

About 209 species of nematodes have been reported on citrus roots world-wide but only 16 species are known to be important parasites. Actual pathogenicity of only nine species have been demonstrated (38). Three genera, namely *Hemicycliophora, Paratylenchus* and *Tylenchulus,* to which those species belong were reported in some Arab countries but the most important species of all was *Tylenchulus semipenetrans*, the citrus nematode, which causes slow decline, and reported in most Arab countries (2, 13, 22, 28, 31, 35, 42). Most of the nematode species reported on citrus were reported on grape, but few were reported on stone fruits (table 4) (2, 35).

6. Seedling production and sanitation

Nurseries in Arab countries are run mostly by the public sectors, but private sectors play important role and in some countries a major one. The standard of the service varies from one country to another and in the majority it is not satisfactory (12). The most important shortcomings can be summarized in:

a. Failure to establish mother trees that are absolutely free from diseases. In many Arab countries there is no unified national source for budwood. Usually it is taken from orchards attached to the nurseries or from neighbouring orchards within the locality. In most Arab countries the source of the budwood is not certified and the resulting trees are not examined for freedom of diseases. However, Morocco is an outstanding exceptional Arab country in this respect, particularly in case of citrus (12). All nurseries of citrus are run by government or firms abided by stringent governmental supervision. Budwood is exclusively supplied by the government through the «National Scheme for Budwood Production». Disease-free mother trees orchards are established near the production regions. Morocco does not normally export nor import budwood.

b. In several Arab countries root stocks are distributed to farmers for planting in the permanent sites and later graphted by uncertified budwood of their own choice.

c. Some Arab countries import seedlings from sources of inadequate standards of sanitary measures. At entry points, pre-entry examination, if done, is confined to meeting the health conditions of the seedlings according to what is specified by the accompanied health certificates. Diagnosis of diseases is based on obvious symptoms without the necessary laboratory examination.

7. Discussion and conclusions

Of all fungal, bacterial and nematological diseases on citrus, citrus canker, reported so far from four neighbouring Arab countries, is the most important in view of the potential capacity of destructiveness (28). Control of the disease may include eradication of infected trees or even orchards as had happened elsewhere in several countries such as Brazil in 1957 (15). Possibilities of the spread to other Arab countries that are still free from the disease cannot be ruled out. Accordingly, importation policies with respect to presence or absence of the disease in the exporting countries should be reconsidered. Importation of citrus fruits for consumption purposes should be subject to certification as well as examination at entry points in order to intercept the disease. Citrus plant parts that are meant for agricultural purposes should be subjected to strict quarantine measures. A valuable, adequately illustrated, study in which procedures for detection, pathogenicity testing and suggestions to contain the disease was made in UAE (15). Citrus stubborn had already been reported in almost all major citrus producing Arab countries. Thus, it has become imperative to find the true implication of the disease. Greening, largely considerd a bacterial disease, is very restricted in distribution. Further spread in new areas is likely to be determined by the prevailing temperature suitable for the survival of the vectors (22).

The group of Phytophthora diseases on citrus are perhaps second in importance in view of the spread and effect but there is a general awareness of the value of the root stock and importance of the cultural practices, phytosanitary measures

and precautions in picking and packing of fruits all targeted towards restricting disease spread.

Mal secco, though restricted geographically, is reported from most of the major citrus producing Arab countries. It is noticed that although the disease is reported from most of the Mediterranean countries, Morocco seems to be still free from the disease. Certainly the cautious importation policy of citrus and the standard of sanitation have paid. Other fungal and bacterial diseases can be controlled by proper management of orchards as perfection of the cultural practices, pruning, phytosanitary measures such as removal, burning or ploughing in of fallen infected plant parts, and where appropriate properly timed protective chemical spray.

Powdery mildew is the most significant fungal disease on grape in view of spread and economic importance. In most Arab countries weather conditions are more favourable to the incidence and development of powdery mildew than the two other similarly important diseases, downy mildew and black rot. Phytosanitary measures targeted towards the reduction of the seasonal spread of the three diseases are major effective control measures.

Brown fruit rot and twig canker is perhaps, the most destructive fungal disease which threaten stone fruit production. Where conidia are formed on overwintered organs, orchard hygiene become an obvious important non chemical method of control. Disease transmission was suggested to be through overwintered fungus on bud scales or bark of host and chemical control was reported to be effective (21).

Some fungal diseases on stone fruits such as *Verticillium* wilt in Syria and many others may have a special local significance. *A. tumefaciens,* a common pathogen on grape vine and stone fruit, was reported on the former three Arab countries. Similarily *P. syringae* p.v. *syringae* a common pathogen on citrus and stone fruits was reported on citrus from two Arab countries. Perhaps, the presence of the two pathogens and many others, in several other Arab countries (23) stimulates some work.

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الملخص

ابراهيم، جعفر، بسام بياعة. 1989. الأمراض الفطرية والبكتيرية والثعبانية التي تعتري أشجار الحمضيات واللوزيات وكرمة العنب في الدول العربية. مجلة وقاية النبات العربية 7: 197 - 190.

تصف المقالة بإيجاز حالة الانتاج في بيارات الحمضيات وكروم العنب في الأقطار العربية. وتستعرض قوائم التوزيع والأهمية الاقتصادية للأمراض الفطرية والبكتيرية والثعبانية المسجلة في الدول العربية على تلك الأشجار، بالإضافة إلى تلك المسجلة على أشجار اللوزيات. يعتبر تقرح الحمضيات المسجل في أربع دول عربية حتى الآن أخطر أمراض هذه الشجرة، كما يعتبر مرض العناد (الستوبورن) أكثر انتشاراً مقارنة بمرض الاخضرار، وتعدّ مجموعة الأمراض التي تحدثها أنواع تتبع جنس *Phytophthora* المجموعة الأكثر انتشاراً والمحدثة لخسائر فادحة، كما أن مرض جفاف أفرع الحمضيات (مالسيكو) بالرغم من محدودية توزيعه الجغرافي، موجود في الدول الأكثر انتاجاً. وتعتبر أمراض البياض الدقيقي والزغبي والتعفن الأسود أهم الأمراض التي تصيب كرمة العنب في الدول العربية. وتتباين الأهمية النسبية للأمراض التي تصيب أشجار اللوزيات بين الدول العربية، ويبدو أن مرضي العفن البني وتجعد الأوراق هما الأكثر أهمية. وبالنسبة للديدان الثعبانية، تعتبر نيماتودا التدهور البطيء الأوسع انتشاراً. أن التقنيات اللازمة لإنتاج غراس سليمة غير كافية في الدول العربية، باستثناء المغرب، وبخاصة فيما يتعلق بإنتاج مواد إكثار سليمة للحمضيات.

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