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FUSARIUM SPECIES OF TURKEY

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ABSTRACT

In this study, the researches which were made with **Fusarium** species in Turkey were reviewed and it was indicated that 28 **Fusarium** species were determinated in 34 plant species.

INTRODUCTION

Fusarium species form the most widespread fungi groups in nature. They live in several forms on organic materials in every kind of soil from the poles to the equator (Maraite et al., 1973; Kranz et al., 1977).

Some of the species are real parasites. These fungus species are determined as the pathogen in the all organs of wild and cultivated plants. The symptoms differ according to the organs and species of the plants. However, the most visible symptoms appear as root rots or wilts.

Some **Fusarium** species as **F. avenaceum, F. culmorum, F. moniliforme, F. equiseti** are able to infect many plants without distinguishing the plant species. Some species are specialized in the genus of, species of, even varieties of the certain plants. For example, **F. coeruleum, F. eumartii** and **F. sambucinum** are specialized in potato, **F. buharicum** in cotton, **F. xyllarioides** in coffee.

Although the Fusarium species appear on the several plants organs, the main place where they are present, is the soil. They get into the plants by this way. They can live in soil for many years because they produce the resistant spores in the soil.

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They absorb nourishment from the exudes of the roots and of the wounds and the juice of xylem. Carbon sources and some mineral salts provide their main nutrient needs. Because of they dont need more oxygene, they can live in soil 3-40 cm depth. The suitable pH for their growth is 5-7, the optimum temperature is 24-32 ^{0}C (Beckman et al., 1981).

By decomposing several organic materials into its compounds, they can form many different enzimes, can produce toxins and some hormons which are harmfull to the humans and animals (Chirappa and Zammarano, 1975; Beckman et al., 1981).

Many **Fusarium** species form their sexuel reproduction organs in the spesific conditions and according to these characters; for example **F. eumartii, F.javanicum** and **F. solani** take part in Nectria genus, **F. acuminatum, F. avenaceum, F. equiseti, F. graminearum, F. lateritium, F. moniliforme, F. sambucinum, F. stilboides** and **F. xyllarioides** in Gibberella genus; **F. decemcellulare** in Calonectria genus (Kranz et al., 1977).

The seperation of **Fusarium** species is usually made relatively to the morphological characters. Because of these characters are different according to the time and place and because of some characters appear only in spesific conditions, the classification and determination of this genus is rather difficult and cause different opinions between many scientists.

Many scientists excepted the first classification which had been made by Wollenweber (1916-1935, 1931, 1943) and Reinking (1935), at least the main principles did not change (Kranz et al., 1977).

It was suggested that some researchers from Soviet Union agreed with Wollenweber in the term of the main characters, but they made some differences in the term of grouping and separating to taxonomic categories. However, Synder and Hansen (1940) advanced a rather different and simplified system. Now, this system which had been valid for Synder and in ABD, was adopted by Matuo (1961) in Japon, Messiaen and Cassini (1968) in France. At first, also Gordon (1952) accepted this system which include 9 species, but then he tried to make a better system between Wollenweber's and Synder's system (Kranz et al., 1977; Gerlach, 1970) and Booth (1971) defended that 9 species system did not suit to the rules of the classification and determined that it was possible to separate as 50-60 species. Booth (1971) examined **Fusarium** species in 12 different sections as Arachnites, Martiella, Ephisphaeria, Sporotrichiella, Spicarioides, Arthrosporiella, Coccophilum, Lateritium, Liseola, Elegans, Gibbosum and Discolor. The taxonomy of **Fusarium** genus is still complex.

During the determination of **Fusarium** species, it is also important to know the infection on the host plants, if they are isolated freshly and they are held in light at 25^0 C, they show their typycal characters in agar medium. Macroscopic and microscopic characters are paid attention to separate from each other the sections and the species in sections.

Macroscopic characters: The diameter of the colony; the state of aerial mycelium, the colour of the culture, sclerotial plectenchyma; the type of spore masses.

Microscopic characters: The shape of the phialide (Simple or polyphialide), whether the microconidia are present or not, if they are present, how they arise; the shape, width, lenght and septate number of the macroconidia, whether they have thin or thick wall, the shape of their apex cells, they have the foot cells or not; the chlamydospores are present or not and the way of the chlamydospores formation.

The fungi from **Fusarium** genus had been established by several researches in their studies which included the determination of the fungi flora in the soil, seeds and plants and the determination of the pathogen in Turkey and these were researched with their different characters.

The results of these researches concerning the cultivated plants were not well organised and published in different places, were tried to be summarised in this study.

RESULTS

Fusarium species which were isolated from the different organs of the cultivated plants, were given below according to the plant groups and the year order.

1. The **Fusarium** species isolated from the vegetable

Bremer (1948, 1954) informed that he found **Fusarium** sp. in onions, **F. bulbigenum** var. **lycopersici** in tomato, **Fusarium** sp. in eggplants, **F. vasinfectum** in peppers, **Fusarium** sp. in cucumbers, melons, watermelons, carrots and asparagus, **F. vasinfectum** in okra, **F. solani** in beans.

In tomato; **F. oxyśporum, F. equiseti, F. solani** in Çukurova Region (Karahan, 1960); **F. solani** in İzmir, Manisa, Aydın, Denizli, Muğla, Kütahya and Balıkesir; **F. cxysporum** in Uşak and Çanakkale (Özalp, 1962); **F. equiseti** in Ankara (Gürcan, 1968); **F. solani** in Aegean Region, **F. oxysporum** and **F. semitectum** in Uşak, Çanakkale and İzmir (Bornova) (Özalp and Bağcı, 1968); **F. oxysporum, F. semitectum, F. redolens, F. oxysporum** f. sp. **lycopersici, F. longipes, F. moniliforme** in İzmir, **F. oxysporum** f. sp. **lycopersici** in İzmir and Manisa (Filiz, 1985).

In melon; **F. equiseti,** in Ankara (İren and Soran, 1973), **Fusarium** sp. in Ankara (Soran, 1973); **F. oxysporum** f. sp. **melonis** in Aegean Region (Evcil and Yalçın, 1977); **F. oxysporum, F. tabacinum, F. equiseti** in Edirne, **F. solani** in Ankara, **F. culmorum in** Sakarya (Soran, 1979); **F. oxysporum, F. solani, F. equiseti** in Centrol Anatolia Region (Karahan et al., 1981).

In watermelon; **F. oxysporum** in Aegean Region (Qureshi and Yıldız, 1982); **F. oxysporum** in İzmir, Manisa and Aydın (Filiz, 1989).

In cucumber; **F. oxysporum; F. oxysporum** f.sp. **cucumerinum, F. equiseti, F. solani, Fusarium** sp in Aegean Region (Yıldız and Delen, 1977).

In pepper; **F. oxysporum** in Ankara and Konya (Gürcün, 1968); **F. solani** (Bora, 1976); **Furasium** sp in Diyarbakır and Elazığ (Ulukuş and Sağır, 1979).

In bean; **F. acuminatum, F. culmorum, F. equiseti, F. oxyporum F. redolens, F. solani** in Adana and İçel (Soran, 1981).

In cabbage and radish; **F. oxysporum** f. sp. **conglutinans** inTurkey (Karaca, 1963).

In eggplant; **F. solani** (Bora, 1977).

In leek; **Fusarium** sp. (Akdoğan, 1963).

2. The **Fusarium** species isolated from the cereals and legumes.

Bremer (1948) informed that he found **F. oxysporum, F. equiseti** and **F. culmorum** in wheats, barley, rye and oats, **F. gramineum** in corns, **Fusarium** sp. in broad beans, **F. solani** in peas in Turkey.

In wheat; **F. avenaceum, F. flocciferum, F. oxysporum, F. equiseti** and **Fusarium** sp (Yılmazdemir, 1976); **F. acuminatum, F. equiseti, F. dimerum, F. oxysporum, F. solani** in Ankara (Soran and Damgacı, 1980); **Fusarium** sp. in Central Anatolia (Kınacı, 1984); **Fusarium** sp, in Çukurova Region (Biçici and Çınar, 1988).

In rice; **F. acuminatum, F. concolor, F. culmorum, F. equiseti, F. lateritium, F. moniliforme, F. nivale, F. oxysporum, F. sambucinum, F. semitectum, F. solani** in Aydın, Denizli and İzmir (Fesli, 1975); **F. moniliforme** in Aegean Region (Copçu, 1982).

In corn; **F. moniliforme, F. graminearum, F. culmorum, F. oxysporum** in Samsun (Hatat ve Maden, 1988); **F. equiseti, F. graminearum, F. moniliforme** in Edirne and its surroundings (Soran and Asan, 1989).

In chickpea; **F. oxysporum, F. acuminatum** in Ankara, Afyon, Burdur, Çorum, Eskişehir and Kütahya (Soran, 1975); **F. equiseti, F. moniliforme, F. oxysporum, F. sambucinum** in Turkey (Maden, 1985.

In lentil; **F. oxysporum, F. acuminatum, F. solani** and **F. redolens** in Ankara and its surroundings (Soran, 1979); **F. acuminatum** and **F. oxysporum** in Southeast Anatolia (Sağır, 1988).

3. **Fusarium** species isolated from the industrial and ornamental plants.

3.1. The industrial plants

Bremer (1948, 1954), informed that he found **F. culmorum** and **F. oxysporum** in sugar beet, **F. solani** in potato, **Fusarium** sp. in sesame, **F. vasinfectum** in cotton, **F. lini** in flax, **Fusarium** sp. in tabacco, anise and tulip, **F. oxysporum** var. gladioli in gladiolus, **F. bulbigenum** in narcissus, **Fusarium** sp, in carnation ornament pea and cactus, **F. oxysporum, F. lateritium** and **F. culmorum** in callistephus **Fusarium** sp, in chrysanthemum in Turkey.

In cotton; **F. oxysporum** f. sp. **vasinfectum F. oxysporum, Fusarium** sp., **F. solani, F. equiseti** and **F.compactum** in İzmir and Manisa (Karaca and Ceylan, 1968); **Fusarium** sp. in Aegean Region (Esentepe et al., 1977).

In soyabean; **Fusarium** spp. in Samsun and Ordu (Ayaydın et al., 1984). **Fusarium** sp. in Çukurova Region (Çınar and Biçici, 1984); **F. moniliforme, F. lateritium** (Esentepe et al., 1985); **F. solani, F. sporotrichioides, F. semitectum, F. lateritium** in Çukurova Region (Çınar et al., 1986); **F. moniliforme, F. solani, F. semitectum, F. oxysporum, F. equiseti, F. graminearum** in Adana, Antalya, Amasya, Bursa, Hatay, İçel and Samsun (Erzurum and İren, 1987).

In potato; **F. coeruleum, F. raseum, F. sulphureum** in Ürgüp and Nevşehir (Karel and Karahan, 1962); **F. sulphureum, F. solani, F. oxypsporum, Fusarium** sp., **F. solani** var. **coeruleum, F. culmorum, F. sambucinum** (Gülsoy, 1978); **F. sulphureum** in Bolu **F. oxysporum, F. solani** in Sakarya (Gülsoy, 1982).

In peanuts; **Fusarium** sp. peanuts in Aegeon Region (Karcılıoğlu, et al., 1978).

In tobacco; **Fusarium** sp. in İzmir, Manisa and İzmir (Bora, 1970).

In sesame; **Fusarium** sp. in İzmir, Manisa and Aydın (Karcılıoğlu et al., 1985).

3.2 Ornamental plants

In aster; **Fusarium** sp. in Ankara (Gürcan, 1970).

In carnation; **Fusarium** sp. in İzmir (Sezgin, 1982); **F. culmorum, F. oxysporum, F. equiseti,** and **F. solani** in Aegean Region (Sezgin et al., 1984); **F. oxysporum, F. equiseti, F. acuminatum** and **F. culmorum** in İstanbul and its surroundings (Özer and Soran, 1990 a).

In gladiolus; **F. oxysporum, F. solani, F. equiseti** in Aegean Region (Sezgin et al., 1984); **F. oxysporum, F. equiseti** in Istanbul and its surroundings (Özer and Soran, 1990a).

In ıris; **Fusarium** sp. in Aegean Region (Sezgin et al., 1984); **Fusarium** sp. in Silivri-Çeltik (Özer and Soran, 1990 b).

In callistephus; **Fusarium** sp. in Aegean Region (Sezgin et al., 1984).

In tulip; **F. oxysporum** in Aegean Region (Sezgin et al., 1984); **F. oxysporum, F. acuminatum, F.equ iseti, F. culmorum** in İstanbul and its surroundings (Özer and Soran, 1990 a).

In hyacinth; **F. oxysporum** in İstanbul and lits surroundings (Özer and Soran, 1990 a).

In freesia; **Fusarium** sp. in Aegean Region (Sezgin et al., 1984) **F. oxysporum** in İstanbul and its surroundings (Özer and Soran, 1990 a).

In narcissus; **Fusarium** sp. in İstanbul and its surroundings (Özer and Soran, 1990b).

4. **Fusarium** species isolated from the fruit trees.

Bremer (1954) informed that he found **Fusarium** sp. in apple **F. orthoceras** in strawberry, **F. lateritium** var. **mori** in mulberry in Turkey.

In banana; **F. oxysporum, F. semitectum, F. solani, F. acuminatum, F. moniliforme** in the Mediterranean (Turan, 1977).

In strawberry; **Fusarium** sp. in the Mediterranean Region (Turan and Dinç, 1981), **Fusarium** sp. in Çukurova Region (Çınar and Pala, 1988).

In pear; **F. acuminatum, F. equiseti, F. sambucinum, F. semitectum, F. xylarioides** in Ankara (Gürer and Maden, 1988).

5. Other Plants

In tea; **F. acuminatum** in Rize (Gürcan, 1975).

In grass; **Fusarium** spp. in Turkey (Kilit et al., 1988).

In cumin; **Fusarium** spp. in the Central Anatolia Region (Kocatürk, 1988).

DISCUSSION

When the studies which are made with **Fusarium** species are examined, it is seen that **Fusarium** species are not determined in some plant species. This is due to the difficulty of the species determination. In the identification, the nutrient media are very important. **Fusarium** species can not form every reproduction organ in every nutrient medium. This may create mistakes. To be sure that all their reproduction organs are present or not, the use of the natural nutrient media are suggested. In addition, it is also important whether the isolated species are pathogen or not. Because, **Fusarium** species can be present as saprophytein soil. To determinate the pathogen species, the selection of the method is the first step. The number of the isolate used also influence the results.

Until today, 28 **Fusarium** species were found in 54 plant species, in Turkey. When the all plants are examined we have the opinion that except a few species, approximately 60 species must be present in Turkey.

ÖZET

Bu çalışmada, Türkiye'de bugüne kadar **Fusarium** türleri ile yapılan çalışmalar incelenmiş ve 54 bitki türünde 28 **Fusarium** türünün saptandığı belirlenmiştir.

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