International Journal of Agricultural Science Research Vol. 4(5), pp. 092-097, May 2015
Available online at http://academeresearchjournals.org/journal/ijasr
ISSN 2327-3321 ©2015 Academe Research Journals

Full Length Research Paper

Dominant pathogenic of *Lycopersicum esculentum Mill*

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Accepted 15 April, 2015

The composition of pathogenic fungi of the staple agricultural crop - tomato plant (*Lycopersicum esculentum Mill*) is discussed in this paper. 32 species and 6 forms of fungi have been totally identified. 7 species of fungi involved in forming of consortium on leaves of tomato plants have been specified as well. The long-term monitoring has shown that the dominant pathogenic fungus *Fusarium sp. nov.* spread to tomato plants causes the greatest damage and economic losses. Favorable and unfavorable weather conditions of its spread and development have been ascertained. Experiments clarified that *Fusarium sp. nov.* widely-spread to tomato plants (Lycopersicum esculentum Mill) significantly differs from the other species of genus *Fusarium* in its symptoms, morphological-anatomical structures, aggressiveness and injuriousness. It can completely destroy the certain varieties of tomato plants in separate localities within a day. The disease causes the drying of leaves, the fruit rot and the early drying of plants from flowering to harvesting periods. The areal of its spread has been ascertained. Besides Georgia, the disease was observed in agrocenoses of Artvin in the Republic of Turkey. The biological method such as the antagonistic fungus *Trichoderma lignorum* against the pathogen proved to be the most effective among the agro-technical, sanitary – hygienic, chemical, biological and other types of controls used against *Fusarium* species. In particular, soil should be treated with 4% of the suspension of *Trichoderma lignorum*. It is also necessary to select the disease resistant varieties.

Key words: Tomatoes, disease, Fusarium, variety, wilt, consortium.

INTRODUCTION

Georgia has always been the country of agriculture and despite this, its development was paid less attention, but nowadays agriculture has taken the first place among the country's priorities. Although, the south-western part of Georgia is the region of the subtropical crops, the development of the production of vegetable crops, especially tomato plants (*Lycopersicum esculentum Mill*) is considered to be an urgent task in recent years. However, unfortunately, the production of tomatoes is impeded by the different pests, especially fungi together with other factors. The orography of the region and the edaphic - climatic conditions (frequent rain, warm humid temperature, excess of soil moisture, etc.) can forward the wide spread and development of disease-causing agents. In most cases, tomato plants are reduced to a minimum by the impact of fungi and bacteria which can also completely destroy tomato plants in some localities. In this regard, it should be noted that *Fusarium sp. nov.* is the novel variety which is characterized by its large aggression. In particular, it causes the withering of leaves, the rapid swelling of roots, the fruits falling off and rotting, the wilting of an entire plant for the period of ripeness. The same data were noted by various researchers (Etebarian, 1992; Sutton, 1982). According to their data, the members of the genus - *Fusarium* spreading to tomato plants are able to reduce not only the harvest, but also to wither an entire plant in the different parts of the world.

Research objectives

The objectives of this study were to isolate and determine the composition of pathogenic fungi spreading to tomato plants in agrocenoses of the coastal zone of Georgia and the neighboring Artvin (Turkish Republic) and to reveal

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the most widely-spread, harmful and dominant species among them, to ascertain the area of its development – spread, to analyze the favorable factors, and the formation of consortium. In addition, it was important to develop the environmentally safe pest control.

MATERIALS AND METHODS

The objects of research were various varieties of tomato plants (*Lycopersicum esculentum Mill*) and pathogenic fungi inhabited on them in agrocenoses of the coastal zone of Georgia and its neighboring Artvin (Turkish Republic).

The materials were collected by using the well-known methods (Bilay et al., 1982; Velikanov et al., 1980; Dudka et al., 1982; Mishustin et al., 1987; Foster et al., 2004; Bilay, 1977). The routing and stationary methods were used to explore the study areas. The symptoms such as rot, mummification, wilting, spotting, necrosis, mold, galls, canker, deformation, chlorosis, mosaic, etc., were recorded. During the study, upper and lower parts of infected plants were collected and labeled. The following procedures such as the cameral and laboratorial treatments, a collection of preserved plant specimens, mounting, storage, the assessment of states of the infected plants were carried out to process the collected specimens. The dissemination and development of diseases were analyzed. The identification of fungi were carried out by using the modern identification guides (Hawksworth, 1974; Khokhryakov et al., 1984; Watanabe, 2000).

RESULTS AND DISCUSSION

A total of 32 species and 6 forms of fungi have been identified on tomatoes *L. esculentum* as a result of phytopathological and mycological studies from the different localities (the coastal agrocenosis of Georgia) and its neighboring Artvin (Republic of Turkey) in the production regions. Pathogenic fungi, identified in the research areas, cause the greatest damage and economic losses. A new variety of *Fusarium sp. nov.* which belongs to the genus *Fusarium* differs from them by its injuriousness. The causal agent of *Fusarium* wilt of tomato plants was studied to genus level in Georgia so far (Kanchaveli, 1987; Shainidze, 1999). There is little information available on its injuriousness. We did not encounter this species on tomato plants while conducting a study of mycobiota of Adjara for 20 years (Shainidze, 1999). Nowadays it is a widespread and aggressive fungus not only in the coastal agrocenosis of Georgia but also in Artvin (Republic of Turkey). It seems that *Fusarium* has the ability to produce the new varieties and physiological races in the process of evolution. The fungus is the most adaptable and resistant to the soil and has the special plasticity to environmental conditions, persists many years in the soil and can use the various substrates for food. Almost similar findings were made by foreign researchers (Sokyrko, 2009; Giants et al., 1980).

The studies have shown that the aggressive pathology of tomato plant tissue indicates on spreading the novel species of *Fusarium* to tomato plants in our weather conditions. The laboratorial studies showed that the disease-causing fungus is characterized by rapid growth in the pure culture. On tomato-dextrose medium, fungus forms the mucous colony and later, it is covered with the thick, aerial hyphae of mycelium, white to light purple in color. Macroconidia are spindle-shaped, less elliptical (20-65×2.5-5 mm), with pointed tip at both ends with five-septate (by determinant 3-5 septate less); whereas microconidia are non-septate, elliptical, less cylindric (20-21.3×1.5-3 mm) (by determinant, microconidias are oval, colorless and one-two-celled); and chlamydospores are colorless and onecelled (5-15 mm) (Figure 1).

Long-term observations have shown that the first signs of infection appear before ripening the fruit. The symptoms appear on older leaves and then they turn yellow, wilt and die. Yellowed and wilted leaflets drop early. A plant wilts and dies rapidly in a case of the strong development of disease. An entire plant may wilt in hot, cloudy and wet weather conditions (28-32°C) within a day (Figures 2 and 3).

The root system of the diseased plant gradually turns brown and the tap-root begins to rot off (Figure 4). The brownish spots appear on the stem close to the soil surface (Figure 5). If the main stem is cut, dark brown streaks may be seen running lengthwise through the stem. This discoloration often extends far up the stem and is especially noticeable in a petiole scar (Figure 5).

The observations have shown that the disease is not initially seen on the fruits. Then water-soaked spot appears on basal ends of the unripe fruits and they begin to fall off. However, this process can be visible before the symptoms appear. Infected fruits become soft and wet, and then they rot. Their surfaces are covered with grayish-black mycelium and they remain on the trees for a long time. Sometimes, infected fruits can be covered with different colored mycelia (Figure 6). Therefore, the consortium of fungi causing the fruit rot is formed by 7 species of fungi participating in it (*Aspergilus niger Thiegh., Mucor sp., Phytophtora infestans De Bary, Penicilium citrinum Thom., Botritis cinerea Pers., Alternaria solani Ell. Et Mort; RhIzopus nigricans Ehr* and others).

Observations have shown that the formation of the consortium begins when air and soil temperatures are 24 to -30°C, and an optimum temperature is about 27°C. High humidity (90-95%) hastens the formation of the consortium. At present, the studies are being continued to detect the initiator fungus taking part in the formation of a consortium and to determine the relationship between the fungi taking part in it.

As a result of the study of specialization of *Fusarium sp. nov.* by the way of the artificial inoculation, it has been

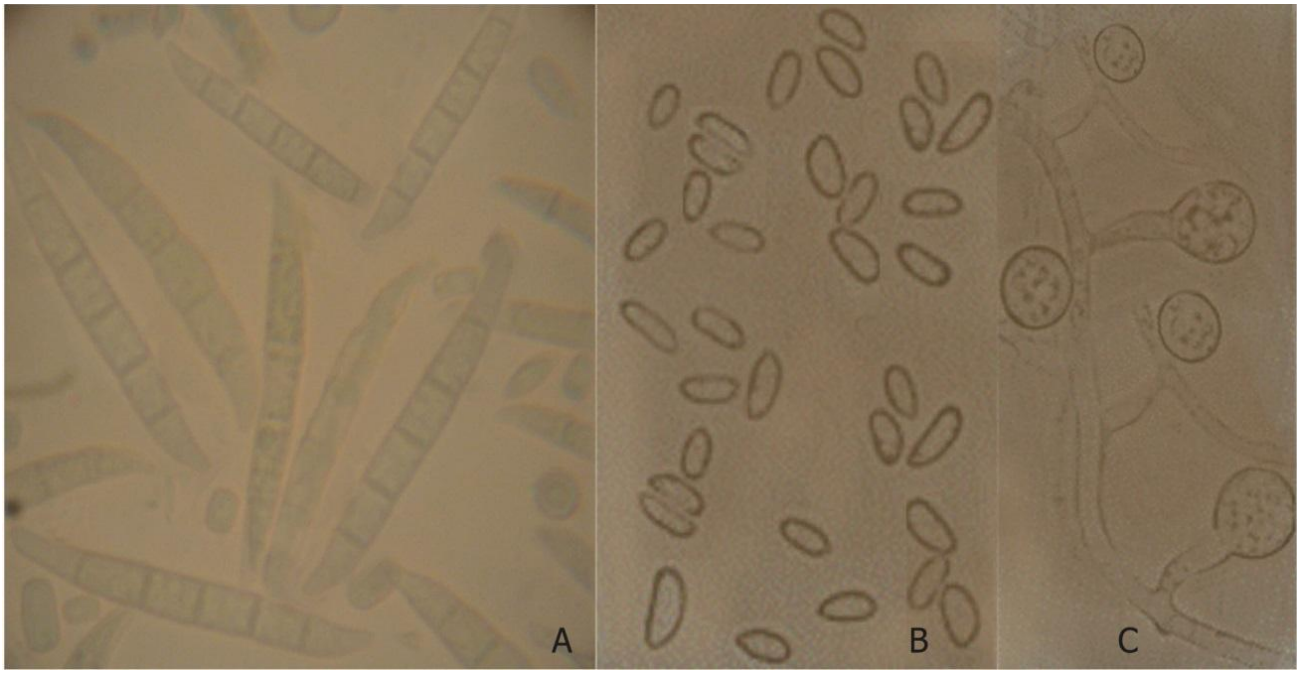

Figure 1. Spores of *Fusarium sp. nov.* (A) Macroconidia, (B) Microconidia, and (C) Chlamydospores.

Figure 2. The yellowness of leaves caused by *Fusarium sp. nov*.

Figure 3. Symptoms of *Fusarium* wilt on the leaves of tomato plants in open field.

Figure 4. Root rot caused by *Fusarium sp. nov*.

Figure 5. Browning of the vascular system on stem.

Figure 6. Fruit rot caused by *Fusarium sp. nov*.

found that the fungus has a wide range of specialization. The local macrocarpous cultivars – PINK, etc., appeared to be less resistant to diseases, but the microcarpous cultivars were relatively resistant.

Records made on the spread of *Fusarium* disease have shown that if the distribution of disease varied between 10-15% in 2008-2009 in Georgia, spread of disease increased in 80-85% in the summer of 2012-2013, but the disease reached 100% in separate localities where the local, macrocarpous cultivars, especially Georgian pink had been planted for many years.

The disease has also been observed in certain places, as well as in the agrocenoses of neighboring Artvin (Turkey). We believe that such a high level of disease was conditioned by high air and soil temperatures (28-32°C), frequent rains and high humidity (85-90%) in summer of 2012-2013, which were favourable for growth and distribution of fungi.

The biological method used against Fusarium proved to be the most effective among the agro-technical, sanitary – hygienic, chemical, biological and other types of controls. In particular, the antagonist fungus *Trichoderma lignorum* was used against pathogens. Soil was tilled with 4% of the suspension (400 gm of *T. lignorum* per 10 L in 5 m^2 area) prior to planting the tomatoes. In this case, the percentage of infection of plant was 5.3% in a nursery garden and 4.6% in a field. The biological efficiency was equal to 80.1 and 71.7. In the control variant, the percentage of infection of plant (without introducing the antagonist into it) was 62.0% in a nursery and 57.0% in a

field.

The experimental results have shown that the harvest and economic efficiency respectively are increasing, which were equal to 27.2% in a nursery garden and 19.6% in a field.

Conclusion

Fusarium sp. is the widely spread, dominant injurious species among 32 fungal species identified on tomato plants (*Lycopersicum esculentum Mill*). It significantly differs from *Fusarium sp.* and *Fusarium oxysporum f. sp. radicis-lycopersici* in its symptoms, shape and size of spores, aggressiveness, areal of its wide-spread and economic losses caused by it which points to the new variety of *Fusarium oxysporum f. sp. lycopersici*. It can completely destroy the certain varieties of tomato plants in separate localities within a day. The disease causes the drying of leaves, the rot of fruits and the early drying of plants from flowering to harvesting periods. The monitoring has shown that high soil temperature (28-32°C), frequent rains and high air humidity (85-90%) are favorable for the development and distribution of the disease.

The biological method used against Fusarium proved to be the most effective among the agro-technical, sanitary – hygienic, chemical, biological and other types of controls. In particular, the antagonist fungus *T. lignorum* was used against pathogens. Soil was tilled with 4% of the suspension prior to planting the tomatoes. Also, it was necessary for the resistant varieties to be selected.

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