British Journal of Global Ecology and Sustainable Development
Volume-07, Aug., 2022
ISSN (E): 2754-9291

EPIDEMIOLOGICAL STUDY OF EARLY BLIGHT ALTERNARIA SOLANI IN TOMATO

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Abstract

Tomato Lycopersicon esculentum Mill is one of the most productive crops belong to the family Solanaceae in the world and may be exposed to many diseases, including the fungus caused by the fungus Alternaria solani, the main cause of early blight, as one of the most important symptoms of this spray is the fall of the leaves of the entire plant in severe cases, as well as stem rot and fruit fall and one of the most important factors Affecting the epidemiology of the disease is the influence of its severity according to many environmental factors and weather conditions, including temperature, humidity, and seasons of the year. It is vital to have dry and warm weather with temperatures ranging from 25 to 30 degrees Celsius and relative humidity levels of greater than 60%. Infection is more common during the wet season. Early blight is possible in tomato crops when stressed by a nitrogen shortage The black coloring of the mycelium increases its vulnerability to lysis, letting it to survive in the soil for several years.. Plant varieties can reduce the epidemiology of the disease , Alternaria solani, the organism that causes potato and tomato early blight, flourished in vitro at ideal pH levels of 6 – 7 and temperatures ranging from 25 – 30 °C.

Keywords :- epidemiological , tomato , early blight ,

Introduction

(Pritesh et al. 2011) the Solanaceae family crop Lycopersicon esculentum Mill (tomato) is the most widely produced vegetable in the world. According to(Hadian et al., 2011), it is the most frequently farmed tropical vegetable crop on the globe. The attack of different bacterial, viral, and fungal diseases on tomato crop resulted in a massive loss of productivity (Devi et al. 2017؛. Roy et al 2019,. Rex et al. in 2019, and Verma et al. 2018(all documented a few common tomato diseases such as early blight, wilt, late blight, damping off, bacterial wilt, and TMV.

The main disease symptom caused by the fungus Alternaria solani (Ellis & Martin) Sorauer is early blight (EB). This disease, which can cause complete defoliation in severe cases, is most damaging to tomato (Solanum lycopersicum L. [Peralta et al.

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2005,syn. L. esculentum Mill.]) in areas with heavy rainfall, high humidity, and relatively high temperatures (24-29oC). Epidemics can also occur in semiarid climates where nightly dews are frequent and prolonged (Rotem and Reichert 1964). Aside from the leaf symptoms known as EB, A. solani causes other less economically important tomato symptoms such as collar rot (basal stem lesions at the seedling stage), stem lesions in the adult plant stage, and fruit rot (Walker 1952) .Yield losses of up to 79 percent have been reported in Canada, India, the United States, and Nigeria as a result of EB damage (Gwary and Nahunnaro 1998). Collar rot can result in 20 to 40% seedling losses in the field (Sherf and MacNab 1986).Control measures include a three- to five-year crop rotation, fungicide applications on a regular basis, and the use of disease-free transplants (Madden et al. 1978; Sherf and MacNab1986). Fungicide treatments are generally the most effective control measures, but they are not economically feasible in all parts of the world and may be ineffective under epidemic-friendly weather conditions (Herriot et al. 1986) .Resistant cultivars have the potential to be the most cost-effective control measure because they can extend fungicide spray intervals while still controlling the disease (Madden et al. 1978;;Keinath et al. 1996). The lack of effective resistance genes in cultivated tomato (Vloutoglou 1999), quantitative expression, and polygenic inheritance of resistance have hampered progress in EB resistance breeding (Thirthamalappa and Lohithaswa 2000).

The impact of different seasons on the epidemiology of early blight (Kumar and Barnwal 2017) mentioned in their study research was conducted to determine the influence of sowing dates and meteorological conditions on the severity of tomato early blight. Seeds were seeded on nine different dates (November 11, 18, 25, and December 2, 9, 16, 23, 30, and January 6), with the crop sown on November 11 having the lowest percent disease severity of 19.3%. The crop grown on the aforementioned day also produced the most fruit (233.5 q/ha). In contrast, the crop sowed on January 6 had the highest disease severity of 34.7 percent and the lowest fruit production of 182.4 q/ha. Late sowing, as evidenced by the data, favored disease development. During the 2013-14 Rabi season, temperatures ranged from 6.8 to 22.9oC, relative humidity ranged from 60.6 to 82.3 percent, sunlight hours ranged from 8.2 to 8.7 hr, and rainfall ranged from 0.2 to 0.5 mm, all of which appeared to favor disease development.

The results of the study conducted by (Hassan et al 2019).The study attempted to investigate the association between climate change and illness severity in order to forecast disease severity in future seasons. Disease severity was measured at three governorates over three growth seasons: summer (May-Aug), autumn (Jul-Oct), and winter (Nov-Mar) (Behira, Ismailia, and Assuit). The severity of tomato early blight disease has been forecasted using regression calculated accumulative disease severity data from (2007/2008) to (2015/2016) seasons, as well as average max and min temperature and humidity during these seasons. Early blight disease had the highest value during the season (2017/2018), while it had the lowest value during the season (2016/2017).

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Furthermore, significant disease severity was assessed during the summer growth season compared to the autumn and winter growing seasons; nevertheless, the winter growing season had the lowest severity and the autumn growing season had moderate severity. Influence of environmental conditions on the severity of early blight disease during seasons (2007/2008) – (2015/2016), in Behira governorate, the highest disease severity was observed in season (2010-2011), and the lowest disease severity was observed in season (2012-2013), whereas in Ismailia governorate, the highest disease severity was estimated in season (2010-2011), and the lowest in season (2012-2013).

(2013-2014), However, in Assuit governorate, the maximum value of sickness was in season (2010-2011), and the lowest value was in season (2013-2014). For forecasting, there are substantial variations in illness severity across seasons (2020/2030), (2030/2040), and (2040/ 2050) compared to seasons (2008/2018) and their relationship with climate change in the governorates studied. With a slight change in maximum or minimum temperatures and percentage of relative humidity, the severity of tomato early blight disease may increase from 11.8 percent to 15.4 percent during (2008/2018) seasons to (2040/ 2050) seasons in Behira governorate, from 18.8 percent during (2008/2018) seasons to 36.3 percent (2040/ 2050) seasons in Ismailia governorate, and from 18.8 percent during (2008/2018) seasons to 40.4 percent (2040/ 2050) seasons in Assuit governorate .

Disease progression and the disease life cycle

Early blight, caused by the pathogenic fungus Alternaria solani, is the most damaging disease, causing large losses in both quantity and quality of fruit supply (Tomazoni et al. 2016; S. Perveen et al. 2019).

The fungus survives by feeding on contaminated seeds and agricultural detritus. Infected debris and contaminated seeds are the principal sources of inoculum for disease growth in crops. Under damp and humid circumstances, fungus infected host tissue produces a large number of spores. Wind and rain splashing transport spores from plant to plant. Warm temperatures and prolonged leaf wetness promote disease growth in affected crops.

Early blight has a probability of succeeding in tomato crops under stress conditions involving a shortage of nitrogen (Soltanpour and Harrison, 1974). A.solani's disease cycle on its host plant begins effectively in free moisture/humid conditions at a wide range of temperatures. Following successful germination of conidia, one or more germ tubes are formed, which pierce the host by aspersoria or enter through wounds, stomata via developing hyphae (Perez and Martinez, 1999; Agrios, 2005).

To successfully penetrate fungal hyphae into the host plant, an optimal temperature of 10° to 25° C is necessary (Sherf and MacNab, 1986). The infection releases several enzymes that destroy the host cell wall, as well as a variety of toxins that kill the host cells and make nutrients available to the pathogen freed from the host cells (Rotem, 1994). After 2–3 days of infection, infection lesions become evident, and spore generation starts after 3–5 days; this relatively short disease cycle supports Alternaria

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solani's polycyclic infection (Sherf and MacNab 1986) . and three different stages are included in the life cycle of A. solani including soil, seed and air borne stages Fungus is adapted to adverse environmental conditions by the thick wall of conidia (Foolad and Merk, 2008). Main hosts of A. solani are the crops belonging to Solanaceae family viz. tomato, potato, eggplant, and pepper (Neergaard 1945; Ellis and Gibson 1975).

Ellis and Martin initially described necrotrophic fungus (Alternaria solani), which belong to the fungi Imperfecti (Deuteromycotina), genus Alternaria, class Hyphomycetes, and order Hyphales (Agrios, 2005). The Alternaria genus contains three commercially significant plant pathogens: Alternaria solani, Alternata, and Alternata brassicicola. It is the huge spored fungus group with simple conidiophores on which individual conidia are formed separately (Neergaard, 1945). Alterneria has transverse and longitudinally septate conidia, as well as multinucleated cells. Alterneria solani has dark-colored melanized cells (Rotem, 1994) .

The fungus can be found in soil, alternative hosts, seed, and plant detritus in the form of mycelia or conidia, and can be used as a primary inoculum source throughout the winter. Conidia have a thick cell wall, which aids the fungus in adapting to changing environmental conditions (Foolad et al. 2008)

Symptoms of Disease

This disease can injure all of the tomato's aerial components, including the stem, leaf, and fruit, at any stage of growth (Blancard, 2012). The pathogen infects every part of the plant, beginning with the leaf and progressing to the stem and fruit (Johnson et al., 2018) .Lesions on immature tomato seedlings can completely girdle the stem, resulting in "collar rot," which can cause diminished plant vigour or mortality (Gleason and Edmonds, 2006; Kemmitt,2012) .Infected fruits drop before reaching maturity, and those that do reach maturity become unmarketable (Chaerani and Voorrips, 2006) Early blight disease symptom feature black necrotic lesions with concentric circles (Mamgain et al., 2013; Bessadat et al., 2017) A. solani infects all aboveground portions of plants and several names have been given to the various symptoms, which sometimes leads to misunderstanding (Sherf and MacNab 1986). Symptoms of A. solani infection on foliage are known as early blight (EB), on fruits as fruit rot, on seedling stems as collar rot, and on adult plant stems as stem lesions (Walker, 1952). Older leaves are infected initially, and illness spreads higher as the plants age (Sherf and MacNab 1986).

Small black and necrotic lesions emerge on the older leaves at first, and as the lesions become larger, they create concentric rings that are frequently encircled by a yellowish zone. A. solani causes premature defoliation, which weakens the plants and exposes the fruit to sunscald damage (Sherf and MacNab 1986). Partial girdling of seedling stems develops, and when the stem is totally girdled by the lesion, the plant dies. Semi-ripe fruits are more susceptible to A. solani than matured ones (Mehta et al., 1975).

The diseased fruits drop before reaching maturity, while the fruits that reach maturity become unmarketable (Chaerani and Voorrips, 2006)

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Disease-Resistant Plant Varieties

Mentions (Al-safadi et.al , 2012) In this study, 10 local tomato cultivars were tested in pots under glasshouse conditions (242 C) for resistance to early blight disease caused by the fungus Alternaria solani. The severity of the disease was graded on a scale of 1 to 9. The results revealed that cultivars Bosfer and Daher aljabal had a high level of resistance to early blight, but cultivars Dara, Gerdi, Haragel, and Magdal Mawash were moderately to extremely sensitive to the disease. Furthermore, cultivars Wardiat, Breh, and Baskanta shown considerable disease resistance. The discovered resistant cultivars have the potential to be useful in breeding operations.

Six tomato types were tested for the presence of the early blight disease. There were no resistant varieties discovered. In terms of severity, Roma had the highest susceptibility (70.50 percent) of the six tomato cultivars tested, while Nagina had the lowest (29.38 percent). In vitro and under tunnel cultivation, the efficacy of three fungicides (Topsin M, Bavistin, and Ridomil Gold MZ) at 1 g/L, 2 g/L, and 3 g/L concentrations, as well as two bio-agents (Trichoderma harzianum and T. viridae), was studied against A. solani. In an in vitro study, Ridomil Gold MZ inhibited A. solani (47.06 percent) at 2 g/L, but Topsin M was more effective (64.71 percent) at 3 g/L. T. harzianum had the highest inhibition percentage (67.78%) of the two bioagents, whereas T. viridae had the lowest (59.63 percent). Early blight of tomato was dramatically decreased under tunnel cultivation by foliar sprays of Topsin M and T. harzianium at 3 g/L and 108 conidia/mL concentrations, respectively, when compared to untreated plants. Farmers might be advised to practice resistance source, combination of management strategies, and avoidance of environmental hazards based on the findings of the current study. As a result of the pathogen-friendly environment, there is a large increase in tomato yield (Chohan et .al ,2015)

Spread the disease

Dry and warm weather with temperatures ranging from 25 to 30 degrees Celsius and relative humidity levels of more than 60% are necessary. During the rainy season, infection is more likely. Early blight is possible in tomato crops under stress circumstances with a nitrogen deficiency (Soltanpour and Harrison, 1974) The mycelium's dark coloration boosts its susceptibility to lysis, allowing it to live in the soil for several years (Kemmitt, G., 2002). Pathogens may thrive from season to season on horsenettle and nightshade, as well as volunteer tomato and potato in moderate regions (Kemmitt, G., 2002) . Melanin, a dark pigment found in hyphal cells, shields hyphae and spores from environmental stress and permits them to grow in soil for extended periods of time (Rotem, J., 1994) Alternaria solani's dark-colored melanized cells protect the fungus from severe environmental conditions and provide resistance to hydrolytic enzymes and microorganisms (Rotem 1994)]. During the fruiting period, plants are more vulnerable to blight infection (Cerkauskas, 2005; Momel and Pemezny, 2006). Alternaria solani, the organism responsible for potato and tomato early blight, thrived in vitro at optimal pH values of 6 – 7 and temperatures of 25 – 30 °C (Al-hussaen KM. 2012). Conidia generated in the spring serve as main inoculum,

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being spread by splash or wind to the lower leaves, where they germinate and induce infection (Rotem J. 1994) .The major factors of A. solani secondary dissemination include rain, wind, and insects. When it feeds on diseased plant leaves, the Leptinotarsa decemlineata (Colorado potato beetle) works as a vector of fungal spread (Rands RD. 1917a)

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