Review of Plant Studies
2014 Vol. 1, No. 2, pp. 39-48
ISSN(e): 2410-2970
ISSN(p): 2412-365X
DOI: 10.18488/journal.69/2014.1.2/69.2.39.48

SURVEY ON ECONOMICAL IMPORTANT FUNGAL DISEASES OF TOMATO IN SUB-ZOBA HAMEMALO OF ERITREA

Syed Danish Yaseen Naqvi[1†] --- Awet Tesfalem[2] --- Bereket Tesfazghi[3] --- Gezae Asfeha[4] --- Ruta Mangesteab[5]

[1]*Assistant Professor, Department of Plant Protection, Hamelmalo Agricultural College, Hamelmalo, Eritrea*

[2,3,4,5]*Graduate students Department of Plant Protection, Hamelmalo Agricultural College, Hamelmalo, Eritrea*

ABSTRACT

Hamelmalo region. Through the survey, 4 diseases namely, early blight, late blight, powdery mildew and wilt and 2 insects: Helicoverpa armigera and Tuta absoluta were recorded. The main objective of the study was to undertake survey for the incidence of early blight and powdery mildew of tomato caused by Alternaria solani and Oidium neolycopersici respectively. The maximum disease incidence due to early blight was 56.28% in F_5 and minimum was 19.05% in seven days interval during survey whereas in case of powdery mildew the maximum and minimum was 38.96% in F_2 and 13.43% in F_5 respectively. Overall average for higher leaf infection in early blight and powdery mildew of tomato were recorded 41.85% and 34.63%, respectively. The average of disease complex incidence of 71.6% and 62.60% was recorded in F_6 and F_4, respectively.

Keywords: Diseases, Early blight, Powdery mildew, Survey, Tomato.

Contribution/ Originality

This study contributes about incidence and severity of tomato diseases in Sub zoba Hamelmalo of Eritrea. Research conducted about the insect pest and diseases occurrence in tomato in this area. This study can be used for further reference for future research work in particular area.

1. INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill) belongs to the genus *Lycopersicon* which is a member of the Solanaceae (nightshade) family [1]. The tomato plant, in its protected state, is a herbaceous perennial. It is considered to be a frost-tender annual [1]. Tomato is the second most important vegetable crop next to potato. In Eritrea, tomato serves as a cash crop for many farmers.

† Corresponding author

The importance of tomato, both as vegetable food and cash crop cannot be over-emphasized. It is a vegetable crop of considerable economic importance in Eritrea. High yields of tomato result in high incomes to farmers especially in areas such as Anseba, Gashbarka, and Asmara when it is cultivated on large scale particularly in the lean season. Tomato can be used as vegetable silse served with rice, banni and salads. Its principal use in Eritrea, however, is in soups and stews/caprito. In Eritrea, the areas of high tomato production concentrations are in Hamelmao, Keren, Elabred, Hagaz and Zoba Maekel. Tomato is an important component in the diets of majority of Eritreans. The tomato fruit has been found to have considerable health benefits. For its nutritional values, proximate analysis shows that fresh (ripe) tomato contains; 13mg Ca; 27mg P; 0.5mg Fe; 3mg Na; 244mg K; 900 (I.U) of Vitamin A; 0.6mg Thiamine; 0.4mg Riboflavin; 0.7mg Niacin; and 233mg Ascorbic acid [1]. The major constraints to production in Eritrea are; pest and diseases, seed, rainfall, marketing, postharvest losses etc. Amongst the production constraints, pest and diseases are the major ones. In recent years, tomato diseases suspected to be caused by fungi and nematodes were reported in some zone in the Anseba region of Eritrea (personal communication). In Eritrea, tomato is vulnerable to infection by number of diseases, the most important of which are the fungal diseases such as early blight (*Alternaria solani*), powdery mildew (*Erysiphe* spp.), late blight (*Phytophothera infestans*), fusarial wilt (*Fusarium oxysporum spp. lycopercisi*), Buck eye rot (*Phytopthora parasitica*), Crown and root rot (*Fusarium oxysporum fsp radicis lycopercisi*) and Bacterial wilt (*Pseudomonas solanacerium*), in addition to root knot nematode (*Meloidogyne incognita*) (Bereket personal communication). Other economically important biotic constraints include African bollworm *(Helicoverpa armigera)* and whitefly *(Bemissia tabbacci)* which is a vector of the virus causing leaf curl. The early blight and powdery mildew diseases of tomato caused by *Alternaria solani* and *Levillula taurica* are most devastating diseases of tomato and can reduce yields of the crop significantly and above all, largely air borne. Pimentel and Perkins [2] for example, estimated total world food losses at about 45% due to diseases. The Commonwealth Agricultural Bureaux in their thirty-ninth annual report of 1968 estimated that losses due to diseases alone in the tropics are of the order of 10-13% [3]. It is quite necessary to conduct a survey of the disease so that its distribution and extent of spread can be understood and hot spots can be located. The estimation of crop loss is an important parameter in determining the economic importance of the disease and in order to develop threshold for determining, as to when cost effective management practices should be deployed to contain the possible epidemics in future.

2. MATERIALS AND METHOD

Tomato growing areas of Hamelmalo were surveyed during November 2013 to March 2014. The parameters, which were given particular emphasis, were the incidence and prevalence of diseases. For survey, methodologies of James [4], and were followed. Average size of each site was about 4.5 m^2. During surveys, information was collected on the basis of different fungal

diseases. For estimation of leaf and fruit area insect pest and diseases, the whole plant was considered as 100 and thereby the infected plants was determined by eye estimation for Percent of Disease Incidence (PDI) by the scale of Anonymous [5] for early blight of tomato, for powdery mildew. In each field, plants were assessed for fungal diseases of the foliage and insect pests. Identities of the diseases were confirmed using standard references [6-8]. The surveys were conducted in collaboration with the farmers of Hamelmalo.

2.1. Selection of Locations

The present investigations were carried out both in the laboratory and field during 2013-2014. All the surveys were conducted at Hamelmalo sub-zone while laboratory experiments (identification of insect pest and diseases) were undertaken at Department of Plant Protection. Random samples were collected from different locations. Hamelmalo Agricultural College is located, in Zoba Anseba about 12km north of Keren with its geographical position of 15^0 54.16"N and $38^0$27.38"E and at altitude of 1286m above the sea level. Average annual rainfall in the region is 436mm and the average temperature is the range 7-42^0C [9].

2.2. Sampling

While sampling the specimen factors such as host condition, growth stage, disease development, were taken into consideration. Representative samples, based on visual symptoms of the disease were drawn from each field at random as per methods described. At least 10-25 % of the fields were covered. Sampling for smaller units, that were less than 4.5 m^2 was done along the diagonals of the fields at regular intervals (weekly). For selected areas; a group of 11 plants was drawn following an inverted W pattern. The sampling sites were approximately equidistant from each other along the sampling pathway. At each site, a specified number of plants at specified distance on the row were carefully examined and sampled.

2.3. Diseases Identification

Prevalence of the fungal diseases was based on the following marks of identification and symptom of damage (Fig 3.1, 3.2, 3.3, 3.4 and 3.5).

Figure-3.1. Symptoms caused by *Alternaria* solani on tomato leaves and on tomato fruit [10].

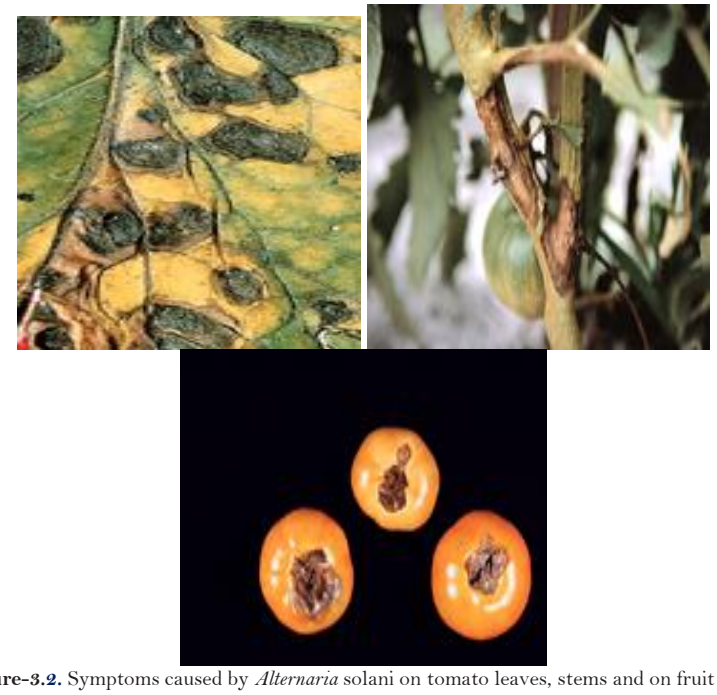

Figure-3.2. Symptoms caused by *Alternaria* solani on tomato leaves, stems and on fruit [11].

Figure-3.3. *Alternaria solani* conidia with transverse septa transverse as well as longitudinal.

Figure-3.4. Symptoms caused by powdery mildew fungi on tomato leaves and chain of conidia fungi [12, 13].

Figure-3.5. Fusarium wilt of tomato caused by *Fusarium oxysporum* f. sp. *lycopersici*: wilted tomato plants in the field [14].

2.4. Data Collection for Disease Intensity of Early Blight and Powdery Mildew of Tomato

Detailed survey on the incidence of the disease of tomato was carried out in Hamelmalo sub-zone. The most commonly grown varieties of tomatoes are Sanmarzano, chico3, Roma VF, Riogrande and marglobe [15]. The observations were recorded from February 17th to March 3rd 2014 with regard to the important fungal diseases found. Early blight and powdery mildew was assessed on 77 randomly selected plants from seven plots of each field. Early blight and powdery mildew was assessed on randomly selected plants as follows: Percent Disease Incidence (PDI) = {(Number of infected plants/Total number of plants) x100}.

2.5. Statistical Analysis of the Result

Data collected from six different fields in Hamelmalo sub- zone each field was visited three times at an interval of one week. All the collected data were subjected to analysis of variance at an end of the study. GENSTAT software application was used for the task.

3. RESULTS AND DISCUSSION

The result of prevalence of tomato disease and insect pests are shown in Table 4.1. Symptoms of the most commonly observed disease in prevalence were early blight, late

blight, wilt and powdery mildew which are caused by the fungus *Alternaria solani*, *phytophtora infestance*, *Fusarium* spp. and *Oidium neolycopersici* respectively. The most commonly insect pests were African boll worm (*Helicoverpa armigera)*, white fly and fruit borer *Tuta absoluta.*

Among all the insect pests and disease which are mentioned powdery mildew, early blight and *Tuta absoluta* were found more severe.

3.1. Collection and Identification of Insect Pest and Fungal Disease of Tomato

The disease samples (specimen) showing typical symptoms of early blight, wilt, late blight, powdery mildew, African Boll Worm, fruit borer *Tuta absoluta* of tomato was collected from Hamelmalo sub-zone during the survey enlist in Table 4.1.

Table-4.1. Insect pest and diseases found at different growth stages of tomato in Hamelmalo region.

S. No.	Growth stage	Insect pest and diseases	Causal organisms	Remarks
1	Leaf stage	Early blight	*Alternaria solani*	Severe
2	Leaf stage	Late blight	*Phytophthora infestance*	Minor
3	Leaf stage	Powdery mildew	*Oidium neolycopersici*	Severe
4	Seed ling	Wilt	*Fusarium oxysporum*	Minor
5	Fruit stage	Fruit borer	*Helicoverpa armigera*	Minor
6	Fruit stage	Tuta insect	*Tuta absoluta*	Severe

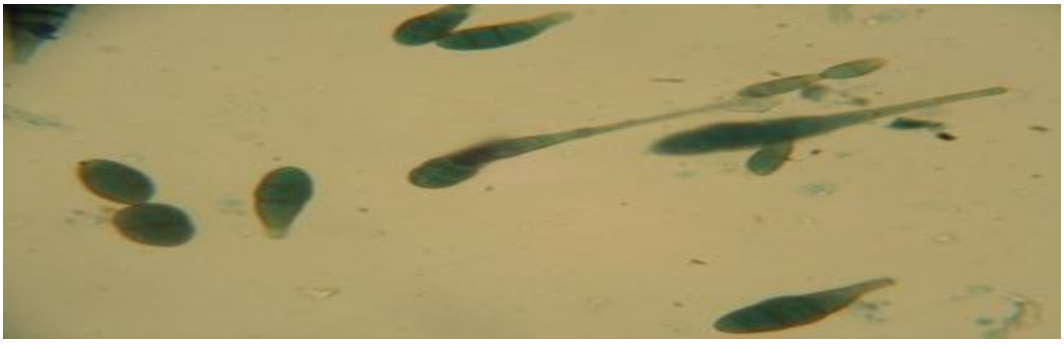

Figure-4.1. A conidium of *A. solani* showing a long beak at the tip

Figure-4.2. Tomato leaf showing the characteristics symptoms of powdery mildew diseases

3.2. Prevalence of Disease Complex (DC) Observed at Different Villages (Field) in Hamelmalo Sub-Zone during the November 2013 to March 2014 Survey

The results of DC of tomato plant are shown in Table 4.2. DC is prevalent in all farms of the field in Hamelmalo region. The incidence percentage of DC in Hamelmalo region F_1, F_2, F_5, F_3, F_6 and F_4 is 60.17, 51.95, 46.75, 45.89, 45.89 and 45.02% on week one (phase first) observation at 17th February 2014.

In Hamelmalo region six farms were surveyed in 2014 incidence percentage ranged from 45.02% (F_4, weak 1) to 87.01% (F_6, weak 3). In the second phase week two at 24th February 2014 maximum DC percentage of 81.82% was recorded at F_5 and F_6 and minimum DC percentage of 59.31% at F_3 and F_4 field was recorded (Table4.2). In third phase at 3rd March 2014 minimum DC percentage of 77.06% was recorded in F_2 field and maximum 87.01% in F_6 followed by 83.55, 83.55, 81.82 and 79.22% in F_3, F_4, F_5 and F_1 respectively.

Overall maximum DC incidence was recorded in F_6 (Tsebab) 71.60% and minimum in F_4 (Abderes) 62.60%. Incidence percentage of DC may be depending on growth stage and prevailing climatic conditions for the incidence and development of disease [16]. Occurrence and distribution patterns of disease complex are indicative of complex nature of the diseases and its epidemiology was also influenced by date of sowing, genotype, race and biotype of pathogens and coincidence with precipitation and suitable temperature regimes. These observations were well in conformity with earlier studies conducted by several workers [6, 17].

Table-4.2. Percent Disease Incidence due to disease complex (powdery mildew and early blight of tomato).

Fields	W1 DC	W2 DC	W3 DC	Average
F1 (HAC)	60.17	69.26	79.22	69.60
F2 (Genfelom)	51.95	62.77	77.06	63.90
F3(Awrari)	45.89	59.31	83.55	62.90
F4(Abderes)	45.02	59.31	83.55	62.60
F5(Awater)	46.75	81.82	81.82	70.10
F6(Tsebab)	45.89	81.82	87.01	71.60
L.S.D				13.42
C.V				11.00

3.3. Disease Incidence Due to Early Blight of Tomato

Six fields in different regions were surveyed. The result of the survey showed that early blight was presented in all locations surveyed in Table 4.3 and the highest incidence of 27.27% and 25.11% in F_3(Awrari) and F_4(Abderes) respectively in first week observation at 17thFebruary 2014 followed by 23.81 (F_5), 22.08 (F_6), 19.91 (F_3) and 19.05% (F_2). In second observation 24th February 2014 (week two) maximum disease incidence due to early blight *(Alternaria solani)* 56.28 and 49.35 percent in F_5(Awater) and F_6(Tsebab) respectively. In the last phase of observation recorded at 3rd March 2014 disease incidence of early blight the lowest was 32.90% in

F_2 (Genfelom) and highest was 52.38% in F_6 (Tsebab) followed by 45.45(F_5), 45.02 (F_4), 45.02 (F_3) and 34.63 percent in (F_1).

The survey has provided base line information on the incidence and distribution of tomato early blight in Hamelmalo region. The maximum disease incidence of early blight was found in F_3, F_5 and F_6 in seven-day interval from 17th February 2014 to 3rd March 2014 i.e. 27.27, 56.28 and 52.38 percent week1, week2 and week3 respectively. Our results corroborate the findings of Datar and Mayee [6].

Table-4.3. Early blight PDI at foliar stage in different fields surveyed in tomato fields

Fields	W1 EB	W2 EB	W3 EB	Average
F1 (HAC)	19.91	28.14	34.63	27.56
F2 (Genfelom)	19.05	24.68	32.90	25.54
F3(Awrari)	27.27	31.17	45.02	34.49
F4(Abderes)	25.11	31.17	45.02	33.77
F5(Awater)	23.81	56.28	45.45	41.85
F6(Tsebab)	22.08	49.35	52.38	41.27
L.S.D				13.17
C.V				22.50

3.4. Disease Incidence Due to Powdery Mildew

During the survey six different fields in Hamelmalo region were surveyed and in all the fields powdery mildew prevalence was severe as shown in Table 4.4. The highest powdery mildew incidence in the first week observation at 17th February 2014 was 32.03% in F_2 (Genfelom) followed by 31.60 (F_1), 18.61 (F_6), 17.75 (F_5), 14.29 (F_4) and 13.42% (F_3). In the second week observation at 24th February 2014 maximum disease incidence due to powdery mildew (*Oidium neolycopersici*) was 33.77 and 32.90 percent in F_1 (HAC) and F_2 (Genfelom) respectively. In the third week observation which recorded at 3rd March 2014 disease incidence of powdery mildew was found to be the lowest in F_3(Awrari) (29.44%) and the highest 38.96% in F_2 (Genfelom) followed by 35.06 (F_1), 30.70 (F_6) and 29.00% (F_5).

Table-4.4. Disease incidence due to powdery mildew.

Fields	W1 PW	W2 PW	W3 PW	AVER
F1 (HAC)	31.60	33.77	35.06	33.48
F2 (Genfelom)	32.03	32.90	38.96	34.63
F3(Awrari)	13.42	21.65	29.44	21.50
F4(Abderes)	14.29	21.65	29.44	21.79
F5(Awater)	17.75	19.91	29.00	22.22
F6(Tsebab)	18.61	26.84	30.74	25.40
L.S.D				4.92
C.V				10.20

The survey clearly gives information on incidence and distribution of tomato powdery mildew *(Oidium neolycopersici*) in Hamelmalo sub-zone. The maximum and minimum disease

incidence of powdery mildew was found in F_2 (Genfelom) 38.96% and in F_3 (Awrari) 13.42% respectively. Our results corroborate the findings of Hossain, et al. [17] also reported range of incidence of PMDI from 1.0 to over 20 percent.

Sometimes, the disease information of the study on incidence agreed with the reviewed literature. According to Das [18], about 15-20% in general and 30-50% in severe case of fruit rots of vegetables were caused seriously due to blight. It was mostly similar to the record of study against the disease in the study areas. But, no detailed research findings on disease records were done keenly in Hamelmalo regions previously. Stated that the amount of crop losses to a particular disease varied from place to place because of the existence of different races, biotypes, or strains of the pathogen. So, the incidence of tomato diseases can differ in the different locations of Hamelmalo.

REFERENCES

[1] I. B. Nonnecke, *Vegetable production*. New York: Van Nostrand Reinhold Press Ltd, 1989.

[2] D. Pimentel and J. H. Perkins, "Pest control cultural and environmental aspects," *Ann. Assoc. Ado. Sci. Washington D.C.*, pp. 243. Available: http://www.growtomatoes.com/world.production.statistics http://www.worldseed.org/isf/seed-healthtesting.html, 1980.

[3] CAB, "Commonwealth agricultural bureau 1968," 39th Annual Report 1967– 1968. London, 1968.

[4] W. C. James, "A manual of disease assessment keys for plant diseases," *Canada Deptt. Agric. Publication No. 1458*, p. 80, 1971.

[5] Anonymous, "Annual report," Asian Vegetable Research and Development Centre, 1974.

[6] V. V. Datar and C. D. Mayee, "Assessment of loss in tomato yield due to early blight," *Indian Phytopathology*, vol. 34, pp. 191-195, 1981.

[7] C. D. Mayee and V. V. Datar, *Phytopathometry. Technical bulletin-1 (Specialbulletin-3)*. Parbhani, Maharashtra, India: Marathwada Agricultural University, 1986.

[8] Michelle Seidl, P. Emlab, and K. Mycologist, "Microorganism of the month," *Oidium Spp*, 2009.

[9] Anonymous, "Annual average rainfall report zoba anseba branch," Ministry of Agriculture, 1997.

[10] S. B. Locke, "Resistance to early blight and septoria leaf spot in the genus lycoperiscon," *Phytopathology*, vol. 39, pp. 829-836, 1949.

[11] P. K. Basu, "Existeance of chlamydospores of alternaria porrii f. sp. Solani as over wintering propagules in soil," *Phytopathology*, vol. 61, pp. 1347-1350, 1997.

[12] A. Lebeda, B. Mieslerova, L. Luhova, and K. Milickova, "Resistance mechanism in lycopersicun sp. To tomato powdery mildew (Oidium Neolycopersici)," *Plant Prod. Sci.*, vol. 38, pp. 141-144, 2002.

[13] H. E. Jones, J. M. Whipps, B. J. Thomas, T. L. W. Carvet, and S. J. Gurv, "Initial events in the colonization of tomato by oidium lycopersici, a distinct powdery mildew fungus of lycopersicon species," *Can. J. Bot.*, vol. 78, pp. 1361-1366, 2000.

[14] G. N. Agrios, *Plant pathology, department of plant pathology University of Florida*, 5th ed. USA: Elsevier Academic Press 30 Corporate Drive, Suite 400, Burlington, MA 01803, 2005.

[15] M. Mario, "Research and development program me horticultural crops, Asmara," p. 10, 1997.

[16] S. M. Douglas, "Powdery mildew of tomato. The connecticut agricultural experimental station. PP037 (11/03R)." Available: http://www.caes.state.ct.us/FactSheetFiles/Plantpathology/fsppo37f.htm, 2003.

[17] M. T. Hossain, S. M. M. Hossain, M. A. Bakr, A. K. M. Matiar Rahman, and S. N. Uddin, "Survey on major diseases of vegetable and fruit crops in chittagong region," *Bangladesh J. Agril. Res.*, vol. 35, pp. 423-429, 2010.

[18] B. H. Das, "Studies on phomopsis in the fruit of brinjal," M. S. Thesis Submitted to the Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh, 1998.

