Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(6): 2012-2015
Received: 22-08-2020
Accepted: 24-10-2020

Ragupathi KP
Ph.D. Scholar, Dept. of Seed Science & Technology, TNAU, Coimbatore, Tamil Nadu, India

PR Renganayaki
Professor and Head, Dept. of Seed Science & Technology, TNAU, Coimbatore, Tamil Nadu, India

S Sundareswaran
Director, Directorate of Seed Center, TNAU, Coimbatore, Tamil Nadu, India

S Mohan Kumar
Director, CPMB & B, TNAU, Coimbatore, Tamil Nadu, India

A Kamalakannan
Professor, Dept. of Plant Pathology, TNAU, Coimbatore, Tamil Nadu, India

Corresponding Author:
Ragupathi KP
Ph.D. Scholar, Dept. of Seed Science & Technology, TNAU, Coimbatore, Tamil Nadu, India

Tomato early blight (*Alternaria solani*): Location and transmission

Ragupathi KP, PR Renganayaki, S Sundareswaran, S Mohan Kumar and A Kamalakannan

DOI: https://doi.org/10.22271/phyto.2020.v9.i6ac.13260

Abstract
Tomato is one of the popular vegetable crops grown in India and Tamilnadu. Early blight is the most important disease of tomato caused by *Alternaria solani* which is seed borne in nature can reduce the seed germination and yield up to 70%. Current study is on the location and transmission of *Alternaria solani* in tomato seeds. A total of 100 seed samples were collected from seed producers and farmers across Tamilnadu. Seed was extracted from the collected fruits and subjected to various seed health testing methods. Five samples showing higher incidence of seed borne fungi were selected for studying the location and transmission of the pathogen. The results revealed that, *Alternaria solani* percentage of infection was detected to be higher under Standard Blotter Method (18%). Locality of *Alternaria solani* ranged up to 35% in seed coat, 48% in cotyledons and 17% in embryonic axis and the field experiments shown 42% seed to seed transmission of the pathogen.

Keywords: Tomato, *Alternaria solani*, seed borne, transmission

Introduction
Tomato is the world's second most consumed vegetable after potato. Tomato is one of the popular vegetable crops grown in India and Tamil Nadu. Tomato productivity and quality is affected by several pests and diseases and over 200 diseases reported in tomato. Early blight is the most important disease of tomato caused by *Alternaria solani* (Ellis & Martin) Sorauer which is seed borne in nature can reduce the seed germination and yield up to 70%. Seed is being exchanged worldwide. A healthy seed contributes a lot to agriculture on the other hand it can also act as an effective mode of transmission of plant pathogens over long distances if infected. Seed borne pathogens have significant influence on seed production and food industry because they can affect germination, growth and crop productivity, cause seed and seedling diseases resulting in the development of systemic or local infections, cause biochemical changes and cause contamination of grains with mycotoxins which is of great health risk to humans and animals. Seeds may be infected internally resulting in destruction of embryo and endosperm or simply contaminated where pathogen is associated with the seed coat. The quarantine for seed requires biological and ecological information about seed borne pathogens, methods to detect seed borne pathogens, knowledge about the inoculum type, location in seed, mechanism of infection and its transmission is very essential for its effective control. Present study in tomato was designed to study *Alternaria solani* occurrence, location, seed to seed transmission.

Methodology
Seed samples Collection
A total of 100 tomato seed samples were collected from seed producers and farmers across different agro climatic regions of Tamilnadu. Seeds were extracted from mature fruits and brought down to the safe moisture content and were subjected to various experiments.

Detection of seed borne *Alternaria solani* by various Seed health testing methods
Standard Blotter Method
Detection of seed borne fungi in seed samples was done by following ISTA procedures. In this method, three layers of blotter paper was soaked in sterilized water and placed in the petri plates. 100 seeds were sterilized in 0.2% Sodium hypochlorite solution for 2 to 3 minutes and seeds taken randomly from each sample and were placed in petri plates and incubated for seven days in the laboratory under alternating cycles of 12 hrs light and 12 hrs darkness.

The incubated seeds were examined under stereo binocular microscope to ascertain the presence of fungi. (ISTA, 1993) [9]

Potato Dextrose Agar Method
In this method 100 seeds were sterilized with 0.2% Sodium hypochlorite solution for 2 to 3 minutes. Then, the seeds were placed on sterile glass petri plates containing PDA medium and incubated at 40 ºC with alternating cycles of 12 hrs light and 12 hrs darkness for seven days and examined under stereo binocular microscope. (ISTA, 1993) [9]

Water Agar Method
In this method 100 seeds were sterilized with 0.2% Sodium hypochlorite solution for 2 to 3 minutes. Seeds were placed on sterile glass petri plates containing 2.5% water agar medium and incubated at 25±2ºC for seven days then examined under stereo binocular microscope (Neergaard, 1977) [16].

2, 4-D Method
In this method, 100 seeds were sterilized with 0.2% Sodium hypochlorite solution for 2 to 3 minutes. The three layers of blotter paper discs were dipped in 0.2% of 2, 4-Dichloro phenoxy acetic acid solution. Seeds were placed equidistantly on moist blotter discs using sterilized forceps under aseptic conditions in laminar air flow chamber and the plates were incubated at room temperature for seven days. Seeds were examined under stereo binocular microscope on the seventh day (Limonaard, 1968) [13].

Deep Freezing Blotter Method
In this method, three layers of blotter paper were soaked in sterilized water and placed in the petri plates. 100 seeds were sterilized in 0.2% Sodium hypochlorite solution for 2 to 3 minutes and seeds taken randomly from each sample and were placed in petri plates and incubated at 25±2ºC for first 24 hrs under alternate cycles of 12 h NUV light and darkness, for next 24 hrs the plates were incubated at -20ºC and then kept back under original conditions for next six days and examined under stereo binocular microscope to ascertain the presence of fungi. (ISTA, 1993) [9]

Location of the pathogen by Component Plating Method
Location of the pathogen in different seed components would be known by this method. 200 seeds from each sample were selected and washed 4 - 5 times with distilled water and soaked separately in sterile distilled water for 24 hours. The seeds were dissected into different components as seed coat, cotyledons and embryo using sterilized scissors and forceps under aseptic condition in laminar air flow chamber. Each part was surface sterilized by 1% Mercuric chloride solution and washed with sterile water and placed directly on moist blotters. All the components were plated individually and incubated as in described in SBM method. (Basak, 1998).

Screening of *Alternaria solani*
The incubated seeds were screened on eighth day using stereo binocular and compound microscope. The germination, associated fungi were recorded and identified with the help of standard guides and manuals. Barnett (1960) [4], Booth (1977) Sigourd and Funder (1961) [23] Subramanian (1983) [24], Van Arx (1981) [26].

Disease transmission
Among the seed samples, five samples which shown higher incidence of *Alternaria solani* were selected for disease transmission studies in the experimental plot. The seed samples were sterilized by 2% Sodium hypochlorite solution for 2-3 minutes and washed in the distilled water before sowing. Sterilized seeds were sown in the fields and the proper agronomical practices were followed for raising the plants. Severity of the disease was assessed by using 0-9 scale in the randomly selected plants and percentage of diseases index was calculated by using the formula (Mayee and Datar, 1986) [14]. Seed to seed transmission of *Alternaria solani* was also studied.

$$\text{Per cent disease index (PDI)} = \frac{\text{Sum of individual ratings}}{\text{No. of leaves examined} \times \text{Maximum disease grade (9)}} \times 100$$

Recovery of pathogens from diseased plants
Seeds were collected from experimental plots and subjected to various seed health testing methods. Again the seeds were sown in experimental plots for estimating the recovery of pathogens in resultant F1 generation. (Thippeswami *et al*, 2006) [25].

Results and Discussion
Seed health testing
Results of various seed health testing methods were shown in (Table 1). The standard blotter method was more sensitive in detection of *Alternaria solani* than the PDA, Water agar, deep freeze blotter and 2, 4 – D methods . Significant differences in occurrence of seed borne pathogen was observed. The present study revealed that occurrence of seed borne *Alternaria solani* varied depending up on the location and sources of collection from different farmers and fields. The present findings are in conformity with earlier reports of (Sharma, 1982), Rangeshwaran and Prasad (2000) [17], Rao Raghavendra and Pavgi (1975), Kulkarni and Oblisami (1973) [12], Kolte (1985) [11], Caromona, *et al* (2006) [5]. Choudary and Puttoo (1991), Cook (1955), Bradley and Del Rio (2002), Basuchaudary and Putto (1997) Hans Kendal (2002) [8]. Standard blotter method was the most effective method and revealed the higher incidence of seed infection than the other methods.

Table 1: Percent infection of tomato seeds by *Alternaria solani* under different seed health testing methods

Place of collection	Seed health testing methods (% infection)				
	SBM	PDA	Water agar	2,4-D	Deep freezing blotter
Coimbatore	14	12	11	9	5
Dharmapuri	23	21	19	16	15
Krishnagiri	28	25	24	21	19
Salem	10	9	8	6	4
Dindugal	19	15	12	9	9
Mean	18.80	16.40	14.80	12.20	10.40
SEd	0.39	0.37	0.20	0.17	0.19
C D at 5%	0.86	0.82	0.44	0.37	0.43

*Data based on 100 seeds for each sample with ten replications.

Table 2: Location of *Alternaria solani* in tomato seeds by Component Plating Method

Place of collection	Seed components (% infection)		
	Seed coat	Cotyledons	Embryonic Axis
Coimbatore	37	45	18
Dharmapuri	31	53	16
Krishnagiri	34	49	17
Salem	33	52	15
Dindugal	39	40	21
Mean	34.80	47.80	17.40
SEd	0.56	1.20	0.46
C D at 5%	1.24	2.66	1.03

*Data based on 100 seeds for each sample with ten replications.

Table 3: Seed transmission of *Alternaria solani* in experimental plots

Place of collection	Parent seed (SBM% infection)	Germination (%)	Pre-emergence mortality (%)	Post-emergence mortality (%)	Diseased plants (%)	Healthy plants (%)	Resultant F1 seed Pathogen recovery (%)
Coimbatore	14	79	21	7	36	57	39
Dharmapuri	23	75	25	10	41	49	46
Krishnagiri	28	72	28	12	43	45	49
Salem	10	82	18	4	34	62	35
Dindugal	19	76	24	6	39	55	41
Mean	18.80	76.80	23.20	7.80	38.60	53.60	42.00
SEd	0.29	2.45	0.59	0.19	0.76	0.97	0.95
C D at 5%	0.65	5.47	1.31	0.43	1.70	2.15	2.12

*Data based on 100 seeds for each sample with ten replications.

Location of pathogen in different seed components

To control seed borne pathogens it is essential to know the location of pathogen in the seed. Based on the location of the pathogen in the seeds, the chemicals are selected to prevent the seed borne inoculation of the pathogens. Many researchers have reported that majority of the seed borne pathogens are lodged on the seed coat, some pathogens are present in the cotyledons and some are in embryonic axis (plumule and radicle) of various crops. (Thippeswamy *et al* (2006) [25]; Agarwal and Singh, 2000; Shrestha *et al*., 2000; Basak, 1998 and Vishunavat and Sanjay Kumar, 1994). *Alternaria solani* recorded 35 percent in seed coat, 48 percent in cotyledons and 17 percent in embryonic axis (plumule and radicle). (Table 2).

Transmission studies

The first symptoms of early blight are small, dark, necrotic lesions that usually appear on the older leaves and spread upward as the plants become older. As lesions enlarge, they commonly have concentric rings with a target like appearance, and they are often surrounded by a yellowing zone. In severe cases premature defoliation occurs, which weakens the plants and exposes the fruit to injury from sunscald. Large, dark and sunken lesions may appear on the stem of seedlings at the ground line, causing partial girdling known as collar rot. Seedlings are weakened and can die when the stem is completely girdled by the lesion. On the main stem and side branches of adult plants, the fungus causes small, dark, slightly sunken areas that enlarge to form dark brown, elongated spots, which occasionally have concentric rings like those on the leaves. These spots are scattered along the stem and branches. On green or ripe fruits, dark, velvety, sunken spots may occur at the stem end. These spots occasionally develop from mycelia extending from stem lesions and can reach a considerable size and also develop distinct concentric markings. Semi ripe fruits are more susceptible than matured fruits. Heavily infected fruits frequently drop before they mature. The present study results revealed that the seeds having 19% infection of *Alternaria solani* showed 42% transmission. (Table 3)

Recovery of the pathogen from seeds

Seed samples were collected from the experimental plot were subjected for various seed health testing methods for the recovery of pathogens. The seeds collected from disease transmitted plants, sown again the seeds having 19% infection of *Alternaria solani* showed 42% transmission. (Table 3) Seed yield reduction is based on the environmental conditions and the disease severity. The mode of seed to seed transmission of the pathogen depends on the aggressiveness of the pathogen and the environmental conditions it also depends on specific growth stages of the crop. Many researchers (Arya *et al.,* 2004) [1] Ashish Kumar Dubey and Tribhuvan Singh (2005) [2], Ashishkumar Dubey and Tribhuvan Singh (2006) [3], Basak (1998), Ghasolia and Jain (2004), Rout (1985) [19], Thippeswamy *et al* (2006) [25] have recorded the transmission of disease on different crops.

Conclusion

Present investigation indicated that there was variation in *Alternaria solani* from one locality to another across Tamilnadu due to varied agro climatic conditions prevailing during seed development, harvesting and storage. Detection of seed borne *Alternaria solani* plays an important role in determining the quality and longevity of seeds. Microbial invasion can cause loss of seed vigour, viability, germination and productivity. It suggests that seeds are major agents of fungal transmission. Presowing seed treatment with suitable chemical or any other bio agents is essential to reduce the fungal infection for a successful crop production.

References

1. Arya VK, Vishunavat K, Himanshu Negi. Detection, Location and transmission of seed-borne inoculum of *Macrophomina phaseolina* in charcoal rot in soybean. J Mycol. Plant Pathol 2004;34(2):233-236.
2. Ashish Kumar Dubey, Tribhuvan Singh. Location and transmission of seed-borne inoculum of *Fusarium moniliforme* in sesame seed. J Mycol Plant Pathol 2005;35:12-15.

3. Ashish Kumar Dubey, Tribhuvan Singh. Seed-borne infection of *Alternaria alternata* and its role in development in sesame. J Mycol Plant Pathol 2006;34(2):169-172.
4. Barnett HL. Illustrated genera of imperfect fungi. Burgees publishing company II[nd] edition, West Virginia. 1960, 1-225.
5. Caromona MA, Ferrazini M, Barreto DE. Tan Spot of wheat caused by *Dreschlera tritici-repentis*. Detection, Transmission and control in wheat seed. Cereal Res 2006;34(3):1043-1049.
6. Chandra S, Narang M, Srivastava RK. Studies on mycoflora of oil seeds in India: Mycoflora in relation to pre and post emergence mortality. Seed Sci. Technol 1985;13:537-541.
7. Chhata LK. Evaluation of fungicides for the control of Alternaria blight of Castor. J Mycol Plant Pathol 2005;35(1):88.
8. Hans Kendal. Niger (*Guizotia abyssinica* (L. f).Cass) Production in Northwest Minnesota, Extention Service Minnesota 2002, 218-253.
9. ISTA. International Seed Testing Association. The germination test. International rules for seed testing. Seed Sci. Technol 1993;21:152.
10. Kabeere F, Hampton JG, Hill MJ. Transmission of *Fusarium graminearum* (Schwabe) from Maize seeds to seedlings. Seed Sci Technol 1997;25:245-252.
11. Kolte SJ. Diseases of Annual Edible Oilseed Crops. sunflower, safflower and niger seed Diseases. CRC Press Inc., Florida, USA 1985;III:135.
12. Kulkarni JH, Oblisami GH. The mycoflora of stored Niger seeds. Madras Agri. J. 1973;60:1879-1881.
13. Limonard J. Ecological aspects of seed health testing. International Proceedings of Seed Testing Association, 1968;33:1-8.
14. Maye CD, Datar VV. Technical bulletin-1. Marathwad Agricultural University, Parbhani. Phytopathometry 1986, 46.
15. Mukerwar PM. Seed transmission of *Alternaria macrospora* in *Gossypium arboreum*. Seed Res 1992;20(2):166-167.
16. Neergaard P. Seed pathology, Mac Millan, London 1977; I(II):850, 250.
17. Prasad NVK. Studies on the Alternaria leaf blight of safflower (*Carthamus tinctorius* L.). Ph.D. Thesis, Banaras Hindu University, Varanasi India 1988.
18. Rangaswamy G, Mahadevan. Diseases of crop plants in India. 4th ed., Prentice Hall of India Pvt. Ltd., New Delhi-110001, 2005.
19. Rout JG. Location of *Alternaria helianthi* in sunflower seed and transmission from to seed to plant. Phytopathol. Notes 1985;38:522.
20. Saharan GS, Naresh Mehta, Sangavan MS. Diseases of Niger diseases, of oil seed crops, Indus. Publishing Company, Fs-5, Tagore Garden, New Delhi-110027 2005, 475-479.
21. Shekarappa G, Patil PV. Chemical control of leaf blight of sesame caused by *Alternaria sesame*. Karnataka J Agri. Sci 2001;14(4):1100-1102.
22. Shukla BN, Singh BP. Effect of fungicides on seed-borne pathogens of Niger (*Guizotia abyssinica* (L.f).Cass), Phytopathol. Notes 1972;3:231-232.
23. Sigourd, Funder. Practical mycology, manual for identification of fungi. A.W. Broggers, Bltrykkeri, AISOSIO-Norway 1961, 1-145.
24. Subramanian CV. Hypomycetes Taxonomy and Biology. Academic Press, London 1983;I(II):1-930.
25. Thippeswamy B, Krishnappa M, Chakravarthy CN. Location and transmission of *Alternaria solani* and *Fusarium oxysporum* in tomato. Asian J Microbiol. Biotechnol. Enviviron. Sci 2006;8(1):45-48.
26. Van Arx JA. The genera of fungi sporulating in pure culture. J Cramer Inder. A.R. Ganter Verlag, Kommanditgesellsehaff. F.L-9490. VADUZ 1981.