J. Farm Sci., 30(2): (212-215) 2017

Status of seed-borne fungal diseases of tomato in Northern Karnataka and evaluation of seed health testing methods

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(Received: December, 2016 ; Accepted: June, 2017)

Abstract: Many of the seed-borne fungal infections in tomato like *Alternaria solani, A. alternata, Fusarium solani, Septoria, Phoma, Pythium* and *Phytophthora* were known to cause economically important diseases like early blight, *Fusarium* wilt, Septoria leaf spot, damping off, Phoma rot affecting both quality and quantity of the seeds. Hence, an investigation was carried out at department of plant pathology UAS Dharwad to know the seed health status of tomato seed samples obtaine1d from different tomato growing areas of northern Karnataka. The results of this seed health testing of 30 seed samples of tomato by Standard blotter method revealed the dominance of *Alternaria solani, A. alternata* and *Fusarium* sp. Among the different seed samples tested, PKM-1 obtained from Haveri area exhibited maximum seed borne infections compared to other. Among the five different seed health testing methods tested, standard blotter method was found superior for the detection of *Alternaria solani, A. alternata* and *Fusarium* sp.

Key words: Cultivars, Seed borne fungi, Tomato

Introduction

Tomato (*Solanum lycopersicum* Mill.) is the most popular vegetable crop grown in the world, next to potato. It is used as a fresh vegetable as well as processed and canned, paste, juice, sauce, powder or as a whole. The ripe fruits are good source of vitamin A, B and C which add wide varieties of colour and flavour to the food. Recently, it started gaining more medicinal value because of the antioxidant property (Anon., 2000). Several human studies indicated a relationship between a high intake of tomato products and a decreased risk of several types of cancer, atherosclerosis and cardiovascular diseases (Cecilia *et al.,* 2010). Recently, this crop is recognized as a model for plant-pathogen interactions (Arie *et al.,* 2007). Hence, tomatoes are called as poor man's apple.

Several diseases affecting tomato are caused by fungi, bacteria, viruses and nematodes and many of them are seed-borne in nature. These seed-borne pathogens are known to cause economically important diseases like early blight, late blight, Fusarium wilt, Septoria leaf spot, damping off and fruit rot. Seed-borne fungi are of considerable importance due to their in?uence on the overall health, germination and ?nal crop stand in the field. The infected seeds may fail to germinate, or transmit disease from seed to seedling and or from seedling to growing plant (Islam and Borthakur, 2012). Fungal pathogens may be externally or internally seed-borne, extra- or intra-embryal, or associated with the seeds as contaminants (Singh and Mathur, 2004). Other fungi, including saprophytes and very weak pathogens, may lower seed quality causing discoloration, which reduces the commercial value of the seeds (Al-Askar *et al.,* 2012). Seed-borne infections or infected seed is very important discouraging factor, which posses a serious problem in seed certification. Although infected seeds which may otherwise be viable with prescribed germinability as per certification standards, may not be acceptable as seed because of poor physical appearance, high incidence of seed-borne fungi and mycotoxin such as aflatoxin. Good seed is a basic input in agricultural production. Successful agriculture depends on quality of seed used for sowing. Thus the seed producer holds a greater responsibility in producing genetically pure but viable seed, besides preserving its quality from harvest to next one or two planting seasons. Hence, the present investigation was carried out to know the status of seed-borne fungal diseases of tomato in northern Karnataka and to standardize the suitable seed health testing methods for the detection of seed-borne fungal infections of tomato.

Material and methods

The present investigation was carried out during the year 2015-16. Tomato seed samples were collected from different tomato growing districts of northern Karnataka *viz.,* Belagavi, Dharwad and Haveri. Following are the details of the seed samples collected:

District	Taluk	Cultivars
Belagavi	Belagavi	Navodaya, PKM-1, Megha
	Bailhongal	Abhinav, Local, Chenya
	Gokak	S-22, Pusa ruby
Dharwad	Dharwad	Pusa ruby, DMT- 1, DMT- 2,
	Hubblli	Local, PKM-1 Megha, S-85
	Kundagol	Punjab chhahura, H-24
	Kalaghatagi	Laxmi, Soubhagya
Haveri	Haveri	Ramya, Rakshita, PKM-1,
	Byadgi	Nutan Laxmi, Shivam,
	Ranebennur	Soubhagya Abhinav, Abhishek, Laxmi, Shivam

Treated and untreated seed samples were collected and stored at room temperature (25±2°C) and further they were subjected to initial seed health testing by Standard Blotter Method (Anon., 1996). Seeds of each variety obtained from different locations were tested by employing standard blotter method with three replications. Three pieces of blotting paper

of 90 mm size were moistened with distilled water and placed in 90 mm sterilized petriplates after draining exess water. Seeds were placed at the rate of 25 seeds per petriplate at equal distance in each petriplate. The plates were incubated at room temperature (25±2°C) under alternate cycles of 12 hours NUV light and darkness. After 8 days of incubation, the seeds were examined under stereoscopic binocular microscope for the associated fungi.

Different seed health testing methods *viz.,* standard blotter method, deep freezing blotter method, 2, 4-D blotter method, water agar method and potato dextrose agar method were evaluated for the detection of seed borne fungal infections in tomato. Deep freezing blotter method is similar to standard blotter method but the petriplates were incubated at 25±2°C for first 24 hrs under alternate cycles of 12 h NUV light and darkness, for next 24 hrs the plates were incubated at -20°C and then kept back under original conditions for next 6 days. In 2,4-D blotter method, 25 seeds per petriplate were placed on moistened blotter dipped in 0.2 per cent solution of sodium salt of 2,4-dichlorophenoxy acetic acid and petriplates were incubated in the same way as described under standard blotter method. In water agar method 25 seeds were placed per petriplate containing 20 ml of 2 per cent water agar. The petriplates were incubated for 7 days as described under standard blotter method. In potato dextrose agar method 25 surface sterilized seeds were placed in the petriplate containing 20 ml of PDA and petriplates were incubated for 7 days as described under standard blotter method.

Results and discussion

The seed samples of tomato collected from different parts of northern Karnataka were tested initially by employing standard blotter method and the results are presented in Table 1. The results of this study indicated the dominance of *Fusarium* sp. (34.87%), *Alternaria solani* (30.73%), *Alternaria alternata* (26.77%), *Phoma* sp. (2.02%) and *Curvularia* sp. (2.29%). Other saprophytic fungi included species of *Aspergillus* (3.49%). Of the 30 tomato seed samples tested, PKM-1 from Haveri area showed maximum seed borne infection (93.2%) followed by Soubhagya (83.8%) from Kalaghatagi and Laxmi (75.8%) from Ranebennur. Similar trend was noticed by Thippeswamy *et al.* (2011) who observed the dominance of *Alternaria solani* (12.0%), *Alternaria alternata* (3.0%) and

Table 1. Seed health testing of different tomato cultivars collected from different parts of Northern Karnataka by standard blotter method during *Kharif* 2015

District	Taluk	Cultivar	Per cent seed infection of the pathogen						Total
			Alternaria solani	*A. alternata*	*Fusarium* spp.	*Phoma* spp.	*Curvularia* spp.	*Aspergllus* spp.	
Belagavi	Belagavi	Megha	18.6	13.3	26.6	0	0	1.3	59.8
		PKM-1	22.6	21.3	29.3	1.3	0	0	74.5
		Navodaya*	5.3	10.6	10.6	1.3	1.3	5.3	34.4
	Bailhongal	Chenya*	10.6	10.6	12	0	2.6	2.6	38.4
		Local	26.6	20	22.6	1.3	1.3	2.6	74.4
		Abhinav	12.0	30.6	13.3	1.3	4.0	5.3	66.5
	Gokak	S-22	8.0	9.3	8	0	1.3	0	26.6
		Pusa ruby	18.6	28.0	14.6	2.6	1.3	2.6	67.7
Dharwad	Dharwad	DMT-1	26.6	12.0	21.3	0	2.6	0	62.5
		DMT-2	4.0	4.0	12	0	0	1.3	21.3
		PKM-1	22.6	12	21.3	1.3	1.3	2.6	61.1
		Pusa ruby	29.3	9.3	12	1.3	2.6	4	58.5
		Local	16.0	13.0	22.3	2.6	0	0	54.4
	Hubblli	Megha	14.6	12.0	22.3	1.3	0	0	50.5
		S-85*	12.0	5.3	10.3	1.3	0	1.3	30.5
	Kundgol	Punjab chhahura	30.6	9.3	12.0	1.3	1.3	2.6	54.5
		H-24	6.6	9.3	16.0	0	1.3	0	33.2
	Kalaghatagi	Laxmi	12.0	13.3	18.6	2.6	0	2.6	49.1
		Soubhagya	22.6	21.3	37.3	1.3	1.3	0	83.8
Haveri	Haveri	Ramya*	4.0	9.0	10.6	0	0	1.3	25.2
		Rakshita*	4.0	5.0	9.3	0	0	1.3	19.9
		Nutan*	3.0	12	12	0	0	0	28
		PKM-1	40	21.3	26.6	1.3	0	4	93.2
	Byadgi	Laxmi	16	18.6	24	2.6	1.3	0	66.5
		Shivam	18.6	13	30.6	0	0	1.3	63.8
		Soubhagya	22.6	14.6	22	1.3	0	2.6	63.7
	Ranebennur	Abhinav	13.6	9	14.6	2.6	2.6	0	45.1
		Abhishek	4	5.3	5.3	0	0	2.6	17.2
		Laxmi	14.6	28	22	1.3	1.3	4	75.8
		Shivam	13	6.6	16	1.3	0	2.6	33.1
		Total	473.5	412.4	537.2	31.2	35.4	53.8	1540.5
			30.73%	26.77%	34.87%	2.02%	2.29%	3.49%	

*Seed samples pre-treated with Captan

Fusarium oxysporum (18.0%) on tomato seeds in Karnataka. Sultana (2009) found eight fungi *viz. Aspergillus* sp., *Fusarium* sp., *Botrytis* sp., *Curvularia* sp., *Colletotrichum* sp., *Rhizopus* sp., and *Phomopsis* sp. on tomato seeds. Among these pathogens *Fusarium* sp. was highly prevalent in all the crop seeds ranging from 1.60 to 30%.

In the present investigation, among the seed samples of different cultivars tested from different places, PKM-1 cultivar from Haveri area showed maximum infection of *A. solani* (40%), Soubhagya from Kalaghatagi area showed maximum infection of Fusarium sp. (37.3%), Abhinav from Bailhongal area showed maximum infection of *A. alternata* (30.6%). In general seed samples from Dharwad and Haveri districts exhibited maximum infection of *Fusarium* sp. and *A. solani* and the infection of *A. alternata* was maximum at Belagavi and Haveri seed samples. This might be because of provenance effect and microclimatic conditions existing in these areas for which the seeds were exposed during and after harvest. Even the pre treated seeds like Navodaya, Chenya, Ramya etc., exhibited seed-borne infections. This might be due to improper seed treatment or the chemical treated may not be having broad spectrum activity.

Among the 30 seed samples tested, per cent infection of *Fusarium* sp. varied from 8 to 37.3 per cent, *A. solani* varied from 4 to 40 per cent and *A. alternata* varied from 4 to 30.6 per cent. Similar results were obtained by Meraj and Nandkar (2015) who observed 29 fungi associated with tomato seed samples collected from different localities of Vidarbha region. Fungi like *Alternaria solani, Aspergillus flavus, A. niger, Botrytis cinera, Cladosporium fulvum, Colletotrichum capsici, Curvularia lunata, Fusarium solani, F. lycopersici, Penicillium* sp. were found to be most dominant fungi on tomato seeds.

Dabbas *et al.* (2008) observed association of *Alternaria solani, A. tenuis, A. alternata, Fusarium oxysporum, Rhizopus infestans, Aspergillus niger, Sclerotinia sclertivorum, Rhizopus spp. Mucar and Botrytis* spp. with tomato seeds by standard blotter method. Abdulaziz *et al.* (2014) reported that among the one hundred samples of tomato seeds were collected from tomato-cultivated felds in Saudi Arabia and screened for their seed-borne mycoflora, a total of 30 genera and 57 species of fungi were recovered from the collected seed samples using agar plate and deep-freezing blotter methods. Among the different seed-borne fungi observed in the current investigations, fungi like *Fusarium* sp. *Alternaria solani* and *A. alternata* were found to be dominant. From the seed health point of view, these fungi are known to cause economically important diseases like wilt, early blight and leaf spot respectively. These seed-borne diseases are known to affect overall yield and seed quality parameters like per cent germination and vigour index. Hence, further studies were carried out like evaluation of seed heath testing methods.

Seed samples of tomato variety PKM-1 was used for the evaluation of seed health testing methods. The results of the experiment are presented in Table 2. Among the five different methods employed for the detection of seed-borne fungal pathogen of tomato, standard blotter method was found to be good for the detection of *A. solani, A. alternata* and *Fusarium* sp. Significantly, higher counts of *Fusarium* sp. were recorded in standard blotter method (36.00%) followed by 2, 4-D blotter method (33.33%). For *A. solani,* standard blotter method (34.67%) followed by water agar method (24.33%) and for *A. alternata,* standard blotter method (31.33%) followed by water agar method (26.00 %) were found to be suitable. Deep freezing blotter method was found to be ineffective for the detection of seed-borne fungi in tomato as it recorded least seed infection. Sowley and Kodua (2012) reported the efficacy of standard blotter method for the detection of seed-borne fungal infections in tomato over agar plate method. Hence, it can be concluded from the present study that Standard blotter method can be recommended for routine seed health diagnosis of seed-borne fungal infection in tomato as the method is simple, sensitive and reliable. Kumara *et al.* (2012) reported that standard blotter method to be superior over agar plate method for detection of seed borne fungi of chilli.

Table 2. Evaluation of seed health testing methods in detecting the seed-borne fungal infections in tomato

Treatment	Per cent seed infection by		
	Alternaria solani	*Alternaria alternata*	*Fusarium* sp.
Standard blotter method	34.67 (36.06)*	31.33 (34.04)	36.00 (36.87)
Deep freezing blotter method	12.00 (20.27)	8.67 (17.10)	8.00 (16.43)
2,4-D blotter method	16.00 (23.58)	14.00 (21.97)	33.33 (35.26)
Water agar method	24.33 (29.56)	26.00 (30.66)	11.33 (19.66)
Potato dextrose agar method	20.00 (26.57)	21.33 (27.50)	17.33 (24.60)
S.Em±	0.37	0.41	0.40
C.D. at 1%	1.68	1.83	1.79

*Figures in parentheses indicates arcsine transformed value

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