Biological Forum – An International Journal **15(4): 181-190(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Seed-Borne Mycoflora of Chilli (*Capsicum annum* L.) and Tomato (*Solanum lycopersicum* L.)

Jingme A. Sangma and Hijam Meronbala Devi*

Department of Plant Pathology, School of Agricultural Sciences and Rural Development (SASRD), Nagaland University, Medziphema Campus (Nagaland), India.

(Corresponding author: Hijam Meronbala Devi)*
(Received: 08 February 2023; Revised: 04 March 2023; Accepted: 14 March 2023; Published: 20 April 2023)
(Published by Research Trend)

ABSTRACT: Seed is an important input for crop production. Seed carries various types of fungi which may be pathogenic and non-pathogenic known as seed mycoflora or seed-borne fungi. Seed-borne diseases had an adverse impact on the quality of chilli and tomato production. So to determine the presence and significance of fungi on seeds, the present investigation was carried out to identify the various mycoflora associated with chilli and tomato seeds and to determine the seed health by testing via blotter paper, PDA and water agar methods. Twelve number of seed mycoflora were isolated from chilli and tomato seeds collected from the West Garo Hills district of Meghalaya and the Dimapur district of Nagaland. The identified fungi were *Aspergillus niger, Aspergillus fumigatus, Aspergillus* sp.*1, Aspergillus* sp.*2, Aspergillus* sp.*3, Rhizopus* sp., *Penicillium* sp., *Alternaria solani, Fusarium* sp.*1, Fusarium* sp.*2, Fusarium* sp.*3* and *Unidentified* sp.*1*. Among these fungal species, *Fusarium* sp.*3* (63.55%) was the most predominant fungus followed by *Aspergillus niger* (49.17%) and *Aspergillus fumigatus* (41.88%). Among the different seed health testing methods, a similar number of fungal species were recorded in blotter paper and PDA methods and the least in the water agar method.

Keywords: Chilli and tomato seeds, seed borne mycoflora, seed health.

INTRODUCTION

Seed is a living tissue that is a primary unit in crop production technology. It is a propagating material used for growing new plants. However, scientifically, a seed can be defined as a fertilized mature ovule covered with seed coat or a propagating material. Most crops (about 90%) grown on this earth are propagated by seed (Maude, 1996). The foundation of agriculture starts with the seed. Therefore, the production of agronomic and horticultural crops mainly depends on the quality of the seeds. There are many factors that affect seed quality such as biotic and abiotic factors. Among various factors that affect seed health, the most important are the seed borne pathogens that not only lower seed germination, but also reduce seed vigor resulting in low yield of a certain crop type (Sultana *et al*., 2016). They are known to carry various pathogenic microorganisms which cause seed-borne diseases and result in considerable loss of yields (Ismail *et al*., 2012). Any pathogen present in the seed samples is called seed-borne pathogens, which are responsible for failure of seed germination or rotting of emerged seedlings or produces other disease symptoms on adult plants (Mekonnen Gebeyaw, 2020). They may be fungi, bacteria, viruses, nematodes or phanerogamic plant parasites. But among all the pathogenic microorganisms, fungi were found to be the largest group which may be pathogenic and non-pathogenic, known as seed mycoflora or seed borne fungi and affect the quality of seed and cause seed-borne diseases.

Spices like chilli (*Capsicum annum* L.) are important worldwide crop. It is one of the India's most essential and the largest produced spices. Chilli suffers heavy losses due to the attack of various pathogens such as fungi, bacteria, viruses and nematodes many of which are carried through seed. Primary seed-borne pathogens associated with chilli include *Colletotrichum capsici, Fusarium oxysporum, Aspergillus fumigatus, Alternaria alternata* and *Penicillium citrinum* (Pawar, 2018).

In the case of tomato (*Solanum lycopersicum* L.), which belongs to Solanaceae family, it is also the mainly grown and well-liked vegetable in India and the world. It has high nutritional value and is widespread in production. Therefore, it is also known as protective food. More than 200 diseases were known to cause disease on tomato crops in the world. Around 10 various mycoflora were found to cause seed-borne disease in tomato in various parts of the world (Ahmed *et al*., 1993). Some of the seed-borne fungi of tomato are *Alternaria solani, Aspergillus* spp., *Penicillium* spp., *Fusarium oxysporum. Phythopthora infestans* (Mont.) de Bary causes severe yield losses in tomatoes. Germination of seed, as well as crop yield, can be increased by 30% through the use of sound, clean and healthy sources (Hamin *et al*., 2014).

Although numerous workers have been reported isolation of various fungi from vegetable seeds (Al Kassim and Monawar 2000; Balogun *et al*., 2005; Makelo, 2010; Raju, 2018), there are no reports of the pathogenic seed borne fungi of pepper in Nagaland State.

In Northeast India, chilli and tomato crops are grown in the plains and hills of this region's states. Considering the economic importance of chilli and tomato crops in this region, studying the seed-borne mycoflora on chilli and tomato is essential. Considering all the views, the present research has been planned out with the following objectives: Isolation and identification of fungi from chilli and tomato seeds and the different seed health testing methods on the collected seeds of chilli and tomato.

MATERIALS AND METHODS

Source of seeds. The seed samples of chilli and tomato were collected from the Dimapur district of Nagaland State and the West Garo Hills district of Meghalaya state (Plates 1-4). The seeds were kept in sterilized polythene bags with proper labelling and brought to the Department of Plant Pathology laboratory, SASRD, Nagaland University, Medziphema.

Mycological evaluation. The type of fungi associated were determined according to their development on seeds, and mycoflora was isolated by three standard methods, *viz.* Moist blotter paper method, Agar-plate method (PDA method) and Water agar method (ISTA 1996).

Isolation and identification of fungi from chilli and tomato seeds. A total of 400 seeds each from all the seed samples was examined under a Stereo binocular microscope to determine the discolouration of the seeds and the presence of mycoflora. Fungi were isolated from the collected seeds of chilli and tomato by placing 10 seed samples per plate with four numbers of replications on moistened with sterilized distilled water on sterilized filter paper (Whatman No.1) in Petri dishes and incubated at room temperature (25±1°C). The fungal colonies thus observed on the seed surfaces were directly identified. Fungi that could not be identified directly were transferred and sub-cultured on PDA petriplates for further studies. The fungi were purified by single hyphal tip culture technique.

Culturing and sub-culturing of fungal colonies. The experiments were done in an aseptic environment inside the laminar air flow chamber. The number of fungal colonies per plate was counted according to the colour of the colony. With the help of a sterilized inoculating needle, the fungal colonies were then individually inoculated to the PDA slants and allowed to grow at room temperature of 25 ± 1°C for 3-5 days. After the individual fungal isolates gained sufficient growth, the slants were stored and kept in the refrigerator, which was sub-cultured periodically every 2 months.

Percent infection and percent occurrence of fungi were recorded on the basis of the following formula:

$$\text{Infection Percentage (\%)} = \frac{\text{No. of seeds infected with fungi}}{\text{Total no. of seeds}} \times 100$$

$$\text{Percentage occurrence of fungi (\%)} = \frac{\text{No.of times each fungi occurred}}{\text{Total no. of fungi per plate}} \times 100$$

Identification of the seed mycoflora. All identification was made based on morphological characteristics examined under compound microscope and photographic descriptions of fungi, by following the help of available relevant literatures (Booth, 1971; Ellis, 1976; Sutton, 1980; Arx, 1981; Nelson *et al*., 1983; Barnet and Hunter 1998; Nagamani *et al*., 2006).

Study of different seed health testing methods

Standard Blotter paper method. A total of 30 to 45 seeds from each seed sample were surface sterilized with 0.1% mercuric chloride ($HgCl_2$) for 2 minutes, followed by 3 washings with sterilized water. Surface sterilized seed were placed equidistantly on petri plates containing 3 layers sterilized filter paper (Whatman no.1) beds. Non-sterilized seeds were also maintained in the same way as control. Filter papers were kept moisten with sterilized distilled water. Seeds were incubated at 28±1°C for 12 hours of alternating cycles of day/night under fluorescent light (Annon. 1996). After 7 days the infection percentage of seed mycoflora was calculated, isolated and sub-cultured on PDA slants for further studies.

Agar plate method. A total of 30-45 seeds from each sample of chilli and tomato seeds were surface sterilized with 0.1% mercuric chloride ($HgCl_2$) for 2 minutes followed by 3 washings with sterilized distilled water. Surface sterilized seeds were placed equidistantly in circles in Petri plates (9cm diam.) containing PDA medium. Non-sterilized seeds were also maintained in the same way. Seeds were incubated at 28±1°C for 12 hours of alternating cycles of day or night under fluorescent light (Anonymous, 1996; Bhajbhuje, 2013). After 7 days, the seeds were examined under compound microscope and infection percentage (%) of seed mycoflora was calculated.

Water agar method. A total of 30-45 seeds from each sample of chilli and tomato were washedwith mercuric chloride 0.1% for 2 mins followed by 3 washings with sterilized distilled water. Surface sterilized seeds were placed equidistantly in circles in Petri plates (9cm diam.) containing water agar medium. Non-sterilized seeds were also maintained in the same way. Incubation conditions were the same as for the blotter paper method and agar plate methods. Data was collected on the incidence of seed mycoflora of chilli and tomato (ISTA, 1966).

RESULTS AND DISCUSSION

Assessment of fungal infection. The data in the Tables 1 & 2 represents the infection percentage of chilli (C1) and tomato (C2) cultivars of surface sterilized seeds and non-surface sterilized seeds, respectively collected from Meghalaya and Nagaland states. The seed health status was tested with blotter paper method (M_1), PDA method (M_2) and water agar method (M_3). It was observed that among the sterilized seeds of chilli and tomato, chilli cultivar (C1) from the West Garo Hills District, Meghalaya showed the highest infection (60.83%) followed by tomato cultivar (C2) from West Garo Hills District, Meghalaya (50.00%) and chilli cultivar (C1) from Dimapur, Nagaland (50.00%) whereas the least was found in tomato cultivar (C2) from Dimapur District, Nagaland (37.50%) shown in Table 1. The infection percentage of non-surface sterilized seeds of chilli (C1) and tomato (C2) were represented in Table 2. The results revealed that chilli cultivar (C1) from West Garo Hills District of Meghalaya recorded the highest infection (68.33%) followed by chilli cultivar (C1) from Dimapur District, Nagaland (59.17%), tomato cultivar (C2) from West Garo Hills District, Meghalaya (53.33%) and tomato cultivar (C2) from Dimapur District, Nagaland (50.42%). From the present investigation, it was observed that among the two cultivars, chilli (C1) seeds was more infected with mycoflora than tomato seeds (C_2) in both sterilized and non-sterilized seeds and PDA method showed the highest infection percentage than blotter paper method and water agar method and were found to be statistically significant. In Table 1 and Table 2 also indicated that the interaction between the cultivars and the methods and the data reveals that chilli cultivars (C1) showed the highest interaction on PDA (90.00% and 98.75%) than other methods in both surface sterilized and non-surface sterilized seeds which were found to be significant.

Das (2007) also reported a total of 20 and 13 fungal species from un- sterilized and surface sterilized seeds of chilli, respectively. Fuseini (2010) also determine the presence and significance of pathogenic fungi on tomato seeds and reported *Fusarium moniliforme* was found to be most prevalent seed-borne fungal species with a mean percentage incidence of 4.24%. Similarly Guldekar *et al*. (2017); Patekar *et al.* (2017) also reported association of seed borne mycoflora from chilli, tomato and vegetable seeds and their effect on germination of seeds.

Chauhan *et al*. (2018) also reported the occurrence of seed borne pathogens in chilli *in vitro* by using standard blotter method and PDA method.

Percent occurrence of fungal species on seeds of chilli (C1) **and tomato (C_2) cultivars.** A total of 12 fungal species have been isolated in the present investigation. The isolated fungi were *Aspergillus niger, A. fumigatus, Aspergillus sp.1, Aspergillus* sp.*2, Aspergillus* sp.*3, Rhizopus sp., Alternaria solani, Fusarium* sp.*1, Fusarium* sp.*2* and *Fusarium* sp.*3, Penicillium sp.* and *Unidentified* sp.

The table 3 reveals the seed mycoflora recorded from surface sterilized seeds of chilli (C1) and tomato (C2) cultivars collected from West Garo Hills Distric, Meghalaya. A total of five fungal species were recorded from the seeds of chilli (C1) cultivar. The recorded fungi were *Aspergillus niger* (17.78%), *A. fumigatus* (17.78%), *Rhizopus sp.* (0.83%), *Aspergillus* sp.*3* (14.44%) and *Fusarium sp.3* (32.50%). *Fusarium* sp.*3* (32.50%) was the dominant fungus in chilli followed by *Aspergillus niger* and *Aspergillus fumigatus* both showing (17.78%). A total of seven fungal species were recorded from surface sterilized seeds of tomato cultivar (C2). The isolated fungi were *Aspergillus niger* (43.80%), *Aspergillus fumigatus* (14.03%), *Alternaria solani* (1.67%), *Rhizopus sp.* (2.08%), *Aspergillus* sp.*1* (10.00%), *Fusarium sp.1* (7.92%) and *Unidentified sp.1* (3.84%). Among all the fungi, *Aspergillus niger* (43.80%) was the dominant fungus followed by *Aspergillus fumigatus* (14.03%) and *Aspergillus* sp.*1* (10.00%). The results in the table 4 reveals that a total of five species of fungus have been isolated from non-sterilized seeds of chilli cultivar (C1) of West Garo Hills, Meghalaya. The isolated fungal species were *Aspergillus niger* (42.95%), *A. fumigatus* (28.01%), *Penicillium* sp. (1.85%), *Aspergillus* sp.*3* (3.33%) and *Fusarium* sp.*3* (23.86%). In chilli, *Aspergillus niger* (42.95%) showed the highest percentage of occurrence followed by *Aspergillus fumigatus* (28.01%) and *Fusarium* sp.*3* (23.86%). A total of nine fungal species have been isolated from non-sterilized seeds of tomato cultivar (C2) of West Garo Hills, Meghalaya. The isolated fungal species were *Aspergillus niger* (35.97%), *A. fumigatus* (23.61%), *Alternaria solani* (3.33%), *Penicillium* sp. (3.75%), *Aspergillus* sp.*1* (1.67%), *Fusarium* sp.*1* (9.58%), *Fusarium* sp.*2* (2.08%), *Fusarium* sp.*3* (1.67%) and *Unidentified* sp.*1* (1.67%). In tomato, *Aspergillus niger* (35.97%) has the highest percentage of occurrence followed by *A. fumigatus* (23.61%) and *Fusarium* sp.*1* (9.58%).

The data of Table 5 represents the seed mycoflora isolated from surface sterilized seeds of chilli (C1) and tomato (C2) cultivars collected from Dimapur District, Nagaland. Five fungal species were isolated from chilli cultivar (C1) *viz*., *Aspergillus niger* (23.47%), *Aspergillus fumigatus* (37.78%), *Rhizopus* sp. (6.11%), *Aspergillus* sp.*2* (4.17%), *and Fusrarium sp.3* (20.14%). The fungus, *Aspergillus fumigatus* (37.78%) has recorded that the highest percentage of occurrence followed by *Aspergillus niger* (23.47%) and *Fusarium* sp.*3* (20.14%). A total of six fungal species were recorded from surface sterilized seeds of tomato cultivar (C2). The isolated fungal species were *Aspergillus niger* (27.20%), *A. fumigatus* (14.58%), *Penicillium* sp. (4.17%), *Rhizopus* sp. (1.67%), *Aspergillus* sp.*3* (5.16%) and *Fusarium* sp.*3* (22.23%). From the Table 5, we can also find out that *Aspergillus*

niger recorded the most dominant pathogen and highest percentage of occurrence in tune of 27.76%, followed by *Fusarium* sp.*3* (22.23%) and *Aspergillus fumigatus* (14.58%).

In the Table 6 represents the seed mycoflora associated with non-surface sterilized seeds of chilli (C1) and tomato (C2) cultivars collected from Dimapur District, of Nagaland state. A total of five fungal species *viz. Aspergillus niger* (21.81%), *Aspergillus fumigatus* (38.61%), *Penicillium* sp. (16.11%), *Rhizopus sp.* (7.94%) *and Unidentified* sp.*1* (6.95%) were isolated from chilli cultivar. *Aspergillus fumigatus* has the highest percentage of occurrence (38.61%), followed by *Aspergillus niger* (21.81%) and *Penicillium sp.* (16.11%). A total of five fungal species *viz. Aspergillus niger* (38.40%), *A. fumigatus* (13.75%), *Penicillium sp.* (9.79%), *Aspergillus* sp.*3* (3.33%) and *Fusarium* sp.3 (26.39%) were isolated from tomato cultivar. But in case of tomato cultivar, *Aspergillus niger* (38.40%) has the highest percentage of occurrence followed by *Fusarium* sp.3 (26.39) and *Aspergillus fumigatus* (13.75%). The above mentioned results were found to be statistically significant.

The present investigation observed that *Aspergillus sp.* and *Fusarium* sp. were the most frequently associated mycoflora in both the cultivars chilli (C1) and tomato (C2) collected from Meghalaya and Nagaland states. The fungus, *Aspergillus niger* was the most predominant fungus in both sterilized and non - sterilized seeds. Other dominant fungus were *Aspergillus fumigatus, Fusarium sp.3* and *Fusarium* sp.*1*. The fungus, *Aspergillus sp.2* (4.17%) isolated from chilli (C1) cultivar from Nagaland and *Fusarium* sp.*2* (2.08%) isolated from tomato (C2) cultivar from Meghalaya were the least occurred fungal species. In our findings, the most of the isolated fungi were belonged to the storage fungi which are responsible for reduction in the germination of seeds as well as vigour of the seedlings, ultimately causing great loss of yield.

Jogi (2007) also isolated the different seed mycoflora like *Alternaria alternata, Aspergillus flavus*, *A. fumigatus*, *A. niger*, *Bipolaris nodulosa*, *Colletotrichum capsici, Curvularia lunata, Fusarium oxysporum, F. roseum, Macrophomina phaseolina, Mycellasterilia sp., Penicillium citrinum, Rhizoctonia bataticola* and *Rhizopus nigricans* from chilli seeds by using blotter method. The prevalence of *Fusarium moniliforme* with a mean incidence of 4.24% and storage fungi *i.e. Aspergillus* spp. in tomato seeds was reported by Fuseini (2010).

Telang (2010) also conducted an experiment on chilli and tomato seeds and recorded that a total of 17 genera fungi associated with chilli and tomato seeds but the maximum seed mycoflora recorded in local tomato cultivar. *Aspergillus niger, A. flavus, Fusarium moniliforme, Rhizopus nigricans, Curvularia lunata* and *Alternaria alternata* were the most common and predominant fungi recorded in chilli and tomato seeds. They were also found responsible for inhibition and reduction of seed germination, poor seedling vigour and rotting of seed and seedling of tomato local cultivar.

Similarly a total of five fungi namely, *Aspergillus flavus*, *Aspergillus niger*, *Colletotrichum capsici*, *Pencillium* and *Fusarium anuum* seed born fungi were found associated with seed of chilli was reported by Pawar (2018).

Different seed health testing methods on infection and occurrence of seed-borne Mycoflora. Seed mycoflora of chilli and tomato cultivars of two different states of North eastern region were isolated by using three different seed health testing methods *viz.* blotter paper method, PDA method and water agar method. The data on Table 7 indicated that the interaction among different seed health testing methods on surface sterilized seeds of cultivars C1 and C2 collected from Meghalaya. The maximun occurrences of fungal species have been observed in case of C2M1. *viz. Aspergillus niger* (17.50%), *Alternaria solani* (5.00%), *Aspergillus sp.1* (22.50%), *Fusarium sp.1* (23.75%), and *Unidentified sp.1* (6.25%) followed by C1M2 that isolated four fungal species *viz. Aspergillus niger* (28.33%), *Aspergillus fumigatus* (25.83%), *Rhizopus sp*. (2.5%) and *Aspergillus sp.3* (43.33%).

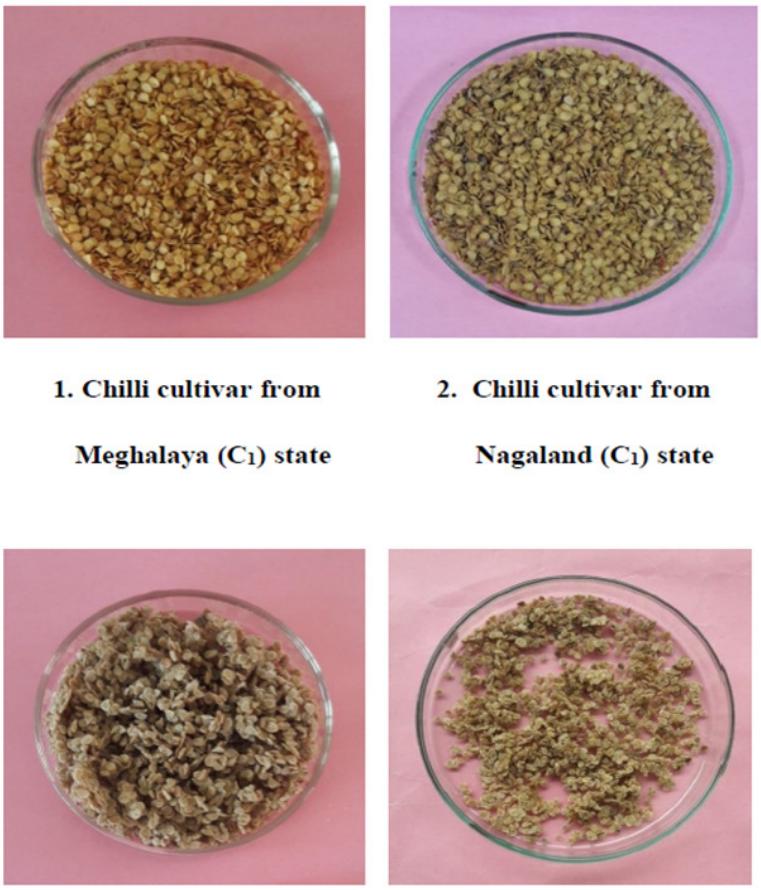
Similarly, in case of Table 8 indicated that the maximum occurrence of fungal species was observed in C1M1 *viz. Aspergillus niger, A. fumigatus, Aspergillus sp.2* and *Fusarium sp.3*. Same numbers of four fungal species were observed in C2M2 *viz. Aspergillus niger, Aspergillus fumigatus, Penicillium sp.* and *Aspergillus sp.3* from the surface sterilized seeds of chilli (C1) and tomato (C2) cultivars collected from Nagaland. In the Table 9 reveals that blotter paper method C2M1 yielded six fungal species *viz. Aspergillus niger* (18.75%), *Alternaria solani* (10.05%), *Penicillium sp.* (6.25%), *Fusarium sp.1* (28.75%), *Fusarium sp.2* (6.25%), *Fusarium sp.3* (5.00%), whereas the PDA method (C2M2) yielded five fungal species *viz. Aspergillus niger* (47.50%), *A.fumigatus* (37.50%), *Penicillium sp.* (5.00%), *Aspergillus sp.1* (5.00%), *Unidentified sp.1* (5.00%) on non-surface sterilized seeds of chilli and tomato cultivars from Meghalaya. The data on Table 10 indicated that chilli cultivar (C1) from Nagaland yielded five fungal species (*Aspergillus niger, Aspergillus fumigatus, Penicillium species, Rhizopus species* and *Unidentified sp.1)* on blotter paper method and in case of PDA method, four fungal species (*Aspergillus niger, Aspergillus fumigatus, Penicillium sp.* and *Rhizopus sp.)* from non-surface sterilize seeds of chilli and tomato cultivars from Nagaland. So, in our present investigation, greater and similar number of fungal species was recorded in both blotter and PDA methods and the lowest number of fungal species was recorded in water agar method. It may be due to the absence of nutrients in the medium which required for the growth and development of the fungus while the highest infection percentage was observed in PDA method followed by blotter paper

method and water agar method. In comparison amongst the different seed health testing methods, both PDA and standard blotter methods were found the best method than water agar method since the highest percentage of occurrence of fungal species and infection percentage was recorded. The suitability of PDA method for isolating fungal species may be due to the nutrients present in the medium which might have played a vital function in the initiation of growth and sporualtion of fungi (Shaker *et al.* 2010). Among all the fungal species, in both surface and non-surface sterilized seeds, *Fusarium sp.3, Aspergillus niger* and *Aspergillus fumigatus* were the most predominant fungal species.

Similar observations have also been reported by Sultana and co- workers during 2016 from five different varieties of tomato where *Fusarium oxysporum* was found to be the most dominant fungal species and other 3 fungal species belong to *Aspergillus sp.* of *Aspergillus flavus*, *Aspergillus niger* and *Cladosporium sp.* It was also evident that *Fusarium species like Fusarium sp.1, Fusarium sp.2,* and *Fusarium sp.3* were able to isolate only by the blotter paper method. The suitability of isolating *Fusarium* species by blotter method was also reported by Rajaput and Rao (2017). They reported that among the different seed health testing method, standard blotter method was the best method for the detection *of Fusarium sp., Alternaria solani* and *Alternaria alternata* whereas Perveen and Ghaffar (1995) reported that the greater numbers of fungal species were recorded by agar plate method and blotter method. Bhale *et al.* (2001) reported that standard blotter method to be better than agar plate method as 16 fungi were recorded in blotter method while only 8 fungi were recorded in PDA method.

Similar finding also reported by Chohan (2015) isolated 17 species of fungi by using blotter paper method and 13 species of fungi by agar plate method but two methods of isolation showed significant differences in the frequency and identification of fungi. *Fusarium solani* was recorded with the highest frequency of 15.0% in blotter test against 10.6% in the agar plate.

Five different types of seed borne fungi viz. Aspergillus, Fusarium, Alternaria, Curvularis and Colletotrichum were found associated with seeds of chilli following blotter paper method were detected (Guldekar *et al*., 2017).



Plates 1-4: Different chilli and tomato cultivars used in the experiment.

Table 1: Percent infection (%) of surface sterilized seeds of chilli (C_1) and tomato (C_2) in Blotter paper, PDA and Water agar method.

Treatments	Infection percentage (%)		
	Meghalaya	Nagaland	Mean
Crops			
Chilli: (C_1)	60.83 (54.99)	50.00 (45.49)	55.42
Tomato: (C_2)	50.00 (48.98)	37.50 (37.32)	43.75
SEm±	*1.58*	*0.66*	-
CD (P=0.05)	*4.71*	*1.95*	-
Methods			
Blotter paper method: (M_1)	48.75 (44.20)	30.00 (33.11)	39.38
PDA method: (M_2)	97.50 (85.39)	73.75 (59.60)	85.63
Water agar method: (M_3)	20.00 (26.37)	27.50 (31.51)	23.75
SEm±	*1.94*	*0.80*	-
CD (P=0.05)	*5.77*	*2.39*	-

Note: Data in the table are mean values and those in parenthesis arc sine transformed value

Table 2: Percent infection (%) of non-surface sterilized seeds of tomato and chilli in Blotter paper, PDA and Water agar method.

Treatments	Infection percentage (%)		
	Meghalaya	Nagaland	Mean
Crop			
Chilli: (C_1)	68.33 (60.00)	59.17 (55.64)	63.75
Tomato: (C_2)	53.33 (52.12)	50.42 (46.99)	51.88
SEm±	*1.45*	*0.78*	-
CD (P=0.05)	*4.30*	*2.31*	-
Method			
Blotter paper method: (M_1)	50.00 (45.09)	35.00 (36.19)	42.50
PDA method: (M_2)	98.75 (87.70)	97.50 (83.54)	98.13
Water agar method: (M_3)	33.75 (35.39)	31.88 (34.21)	32.81
SEm±	*1.77*	*0.95*	-
CD (P=0.05)	*5.27*	*2.82*	-

Note: Data in the table are mean values and those in parenthesis are arc sine transformed values.

Table 3: Percent occurrence (%) of different fungi in surface sterilized seeds of chilli and tomato collected from Meghalaya state in Blotter paper, PDA and Water agar method.

Treatments	Percent occurrence (%)								
	A. niger	***A. fumigatus***	***A. solani***	***Rhizopus sp.***	***A. sp.1***	***A. sp.3***	***F. sp.1***	***F. sp.3***	***Un. Sp.1***
Crop									
Chilli: (C_1)	17.78 (20.69)	17.78 (20.68)	0.00 (0.25)	0.83 (3.02)	0.00 (0.25)	14.44 (13.72)	0.00 (0.25)	32.50 (27.85)	0.00 (0.25)
Tomato: (C_2)	43.80 (40.85)	14.03 (18.15)	1.67 (4.30)	2.08 (4.82)	10.00 (14.72)	0.00 (0.25)	7.92 (9.71)	0.00 (0.25)	3.84 (9.24)
SEm±	*0.98*	*0.64*	*0.13*	*0.16*	*0.25*	*0.23*	*0.20*	*0.88*	*0.16*
CD (P=0.05)	*2.90*	*1.91*	*0.38*	*0.48*	*0.73*	*0.68*	*0.60*	*2.61*	*0.47*
Method									
Blotter paper method: (M_1)	8.75 (12.22)	0.00 (0.25)	2.50 (6.44)	0.00 (0.25)	11.25 (14.14)	0.00 (0.25)	11.88 (14.57)	48.75 (41.77)	3.13 (7.22)
PDA method: (M_2)	46.11 (42.61)	24.58 (29.65)	0.00 (0.25)	1.25 (4.54)	3.75 (7.94)	21.67 (20.58)	0.00 (0.25)	0.00 (0.25)	2.64 (6.63)
Water agar method: (M_3)	37.50 (37.47)	23.13 (28.60)	0.00 (0.25)	3.13 (7.22)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)
SEm±	*1.20*	*0.79*	*0.16*	*0.20*	*0.30*	*0.28*	*0.25*	*1.08*	*0.19*
CD (P=0.05)	*3.56*	*2.34*	*0.46*	*0.59*	*0.89*	*0.83*	*0.74*	*3.20*	*0.58*

Note: Data in the table are mean values and those in parenthesis arc sine transformed values.
A.niger = Aspergillus niger, A.fumigatus = Aspergillus fumigatus, A.solani = Alternaria solani, Rhizopus sp.= Rhizopus sp., A.sp.1 = Aspergillus sp.1, A.sp.3 = Aspergillus sp.3, F.sp.1 = Fusarium sp.1, F.sp.3 = Fusarium sp.3 and *Un.sp.1 = Unidentified sp.1.*

Table 4: Percent occurence (%) of different fungi of non-surface sterilized seeds of chilli and tomato collected from Meghalaya state in Blotter paper, PDA and Water agar method.

Treatments	Percent occurrence (%)									
	A. niger	*A. fumigatus*	*A. solani*	*Penicillium sp.*	*A. sp.1*	*A. sp.3*	*F. sp.1*	*F. sp.2*	*F. sp.3*	*Un. Sp.1*
Crop										
Chilli: (C_1)	42.95 (40.81)	28.01 (26.86)	0.00 (0.25)	1.85 (4.52)	0.00 (0.25)	3.33 (6.13)	0.00 (0.25)	0.00 (0.25)	23.86 (19.30)	0.00 (0.25)
Tomato: (C_2)	35.97 (36.47)	23.61 (24.34)	3.33 (6.13)	3.75 (9.11)	1.67 (4.30)	0.00 (0.25)	9.58 (10.80)	2.08 (4.82)	1.67 (4.31)	1.67 (4.30)
SEm±	*0.45*	*0.77*	*0.18*	*0.28*	*0.13*	*0.18*	*0.19*	*0.14*	*0.49*	*0.13*
CD (P=0.05)	*1.33*	*2.27*	*0.55*	*0.82*	*0.38*	*0.55*	*0.56*	*0.40*	*1.45*	*0.38*
Method										
Blotter paper method: (M_1)	23.59 (28.92)	0.00 (0.25)	5.00 (9.20)	3.13 (7.22)	0.00 (0.25)	0.00 (0.25)	14.38 (16.20)	3.13 (7.22)	38.29 (35.41)	0.00 (0.25)
PDA method: (M_2)	49.17 (44.52)	35.56 (36.56)	0.00 (0.25)	5.28 (13.22)	2.50 (6.44)	5.00 (9.20)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	2.50 (6.44)
Water agar method: (M_3)	45.63 (42.48)	41.88 (40.24)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)
SEm±	*0.55*	*0.94*	*0.23*	*0.34*	*0.16*	*0.23*	*0.23*	*0.17*	*0.60*	*0.16*
CD (P=0.05)	*1.63*	*2.78*	*0.67*	*1.01*	*0.46*	*0.67*	*0.69*	*0.50*	*1.77*	*0.46*

Note*:* Data in the table are mean values and those in parenthesis arc sine transformed values.
C_1 = Chilli, C_2 = Tomato, M_1 = Blotter method, M_2 = PDA method and M_3 = Water agar method. *A.niger = Aspergillus niger, A.fumigatus = Aspergillus fumigatus, A.solani = Alternaria solani, Penicillium sp = Penicillium sp., A.sp.1 = Aspergillus sp.1, A.sp.3 = Aspergillus sp.3, F.sp.1 = Fusarium sp.1, F.sp.2 = Fusariumsp.2, F.sp.3 = Fusarium sp.3 and Un.sp.1 = Unidentified sp.*

Table 5: Percent occurrence (%) of different fungi in surface sterilized seeds of chilli (C_1) and tomato (C_2) collected from Nagaland state in Blotter paper, PDA and Water agar method.

Treatments	Percent occurrence (%)						
	A. niger	*A. fumigatus*	*Penicillium* sp.	*Rhizopus* sp.	*A. sp.2*	*A. sp.3*	*F. sp.3*
Crop							
Chilli: (C_1)	23.47 (28.88)	37.78 (36.51)	0.00 (0.25)	6.11 (11.71)	4.17 (6.89)	0.00 (0.25)	20.14 (17.01)
Tomato: (C_2)	27.20 (30.19)	14.58 (18.52)	4.17 (6.89)	1.67 (4.30)	0.00 (0.25)	5.16 (7.71)	22.23 (18.25)
SEm±	*0.42*	*0.85*	*0.21*	*0.29*	*0.21*	*0.21*	*0.40*
CD (P=0.05)	*1.24*	*2.52*	*0.63*	*0.88*	*0.63*	*0.63*	*1.19*
Method							
Blotter paper method: (M_1)	13.54 (21.18)	4.17 (8.32)	0.00 (0.25)	0.00 (0.25)	6.25 (10.33)	0.00 (0.25)	63.55 (52.90)
PDA method: (M_2)	39.14 (38.57)	41.88 (39.90)	6.25 (10.33)	5.00 (9.20)	0.00 (0.25)	7.74 (11.56)	0.00 (0.25)
Water agar method: (M_3)	23.33 (28.86)	32.50 (34.33)	0.00 (0.25)	6.67 (14.81)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)
SEm±	*0.51*	*1.04*	*0.26*	*0.36*	*0.26*	*0.26*	*0.49*
CD (P=0.05)	*1.52*	*3.09*	*0.78*	*1.07*	*0.78*	*0.78*	*1.46*

Note: Data in the table are mean values and those in parenthesis arc sine transformed values.
C_1 = Chilli, C_2 = Tomato, M_1 = Blotter method, M_2 = PDA method and M_3 = Water agar method. *A.niger = Aspergillus niger, A.fumigatus = Aspergillus fumigatus, Rhizopus sp = Rhizopus sp., A.sp.2 = Aspergillus sp.2, A.sp.3 = Aspergillus sp.3, F.sp.3 = Fusarium sp.3*

Table 6 : Percent occurrence (%) of different fungi of non-surface sterilized seeds of chilli (C_1) and tomato (C_2) collected from Nagaland state in Blotter paper, PDA and Water agar method.

Treatments	Percent occurrence (%)						
	A. niger	*A. fumigatus*	*Penicillium* sp.	*Rhizopus* sp.	*A. sp.3*	*F. sp.3*	*Un.sp.1*
Crop							
Chilli: (C_1)	21.81 (27.54)	38.61 (38.12)	16.11 (19.29)	7.94 (16.21)	0.00 (0.25)	0.00 (0.25)	6.95 (9.04)
Tomato: (C_2)	38.40 (37.97)	13.75 (17.44)	9.79 (10.94)	0.00 (0.25)	3.33 (6.13)	26.39 (21.08)	0.00 (0.25)
SEm±	*0.96*	*0.97*	*0.52*	*0.41*	*0.18*	*0.73*	*0.28*
CD (P=0.05)	*2.84*	*2.88*	*1.56*	*1.22*	*0.55*	*2.17*	*0.83*
Method							
Blotter paper method: (M_1)	17.92 (24.82)	11.25 (14.11)	16.67 (17.61)	3.79 (7.88)	0.00 (0.25)	39.58 (31.61)	10.42 (13.55)
PDA method: (M_2)	39.06 (38.48)	28.75 (30.96)	22.19 (27.73)	5.00 (9.22)	5.00 (9.20)	0.00 (0.25)	0.00 (0.25)
Water agar method: (M_3)	33.33 (34.96)	38.54 (38.26)	0.00 (0.25)	3.13 (7.22)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)
SEm±	*1.17*	*1.19*	*0.64*	*0.50*	*0.23*	*0.90*	*0.34*
CD (P=0.05)	*3.48*	*3.52*	*1.90*	*1.49*	*0.67*	*2.66*	*1.01*

Note: Data in the table are mean values and those in parenthesis arc sine transformed values.
C_1 = Chilli, C_2 = Tomato, M_1 = Blotte rmethod, M_2 = PDA method and M_3 = Water agar method. *A.niger = Aspergillus niger, A.fumigatus = Aspergillus fumigatus, Penicillium sp = Penicillum sp., Rhizopus sp. = Rhizopus sp., A.sp.3 = Aspergillus sp.3, F.sp.3 = Fusarium sp.3 and Un.sp.1 = Unidentified sp.1.*

Table 7: Interaction effect between the surface sterilized seeds of chilli (C_1) and tomato (C_2) from Meghalaya and the methods on percent occurrence (%) of different fungi.

Treatments (C x M Interaction)	Percent occurrence (%)								
	A. niger	*A. fumigatus*	*A. solani*	*Rhizopus* sp.	*A. sp.1*	*A. sp.3*	*F. sp.1*	*F. sp.3*	*Un. sp.1*
C_1M_1	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	97.50 (83.54)	0.00 (0.25)
C_1M_2	28.33 (32.12)	25.83 (30.50)	0.00 (0.25)	2.50 (9.07)	0.00 (0.25)	43.33 (41.16)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)
C_1M_3	25.00 (29.94)	27.50 (31.55)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)
C_2M_1	17.50 (24.45)	0.00 (0.25)	5.00 (12.89)	0.00 (0.25)	22.50 (28.28)	0.00 (0.25)	23.75 (29.14)	0.00 (0.25)	6.25 (14.45)
C_2M_2	63.89 (53.09)	23.33 (28.80)	0.00 (0.25)	0.00 (0.25)	7.50 (15.89)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	5.28 (13.27)
C_2M_3	50.00 (45.00)	18.75 (25.65)	0.00 (0.25)	6.25 (14.45)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)
SEm±	*1.69*	*1.12*	*0.22*	*0.28*	*0.42*	*0.40*	*0.35*	*1.52*	*0.28*
CD (P=0.05)	*5.03*	*3.32*	*0.65*	*0.84*	*1.26*	*1.18*	*1.04*	*4.52*	*0.82*

Note: Data in the table are mean values and those in parenthesis arc sine transformed values.
C_1 = Chilli, C_2 = Tomato, M_1 = Blotter method, M_2 = PDA method and M_3 = Water agar method. *A.niger = Aspergillus niger, A.fumigatus = Aspergillus fumigatus, A.solani = Alternaria solani, Rhizopus sp = Rhizopus sp., A.sp.1 = Aspergillus sp.1, A.sp.3 = Aspergillus sp.3, F.sp.1 = Fusariumsp.1, F.sp.3 = Fusarium sp.3* and *Un.sp.1 = Unidentified sp.1*

Table 8 : Interaction between the surface sterilized seeds of chilli (C_1) and tomato (C_2) from Nagaland state and the methods on percent occurrence (%) of different fungi.

Treatments (C x M Interaction)	Percent occurrence (%)						
	A. niger	*A. fumigatus*	*Penicillium* sp.	*Rhizopus* sp.	*A. sp.2*	*A. sp.3*	*F. sp.3*
C_1M_1	18.75 (25.65)	8.33 (16.63)	0.00 (0.25)	0.00 (0.25)	12.50 (20.66)	0.00 (0.25)	60.42 (51.04)
C_1M_2	28.75 (32.42)	61.25 (51.52)	0.00 (0.25)	10.00 (18.39)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)
C_1M_3	22.92 (28.58)	43.75 (41.38)	0.00 (0.25)	8.33 (16.73)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)
C_2M_1	8.33 (16.71)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	66.68 (54.76)
C_2M_2	49.53 (44.73)	22.50 (28.28)	12.50 (20.66)	0.00 (0.25)	0.00 (0.25)	15.48 (23.12)	0.00 (0.25)
C_2M_3	23.75 (29.14)	21.25 (27.28)	0.00 (0.25)	5.00 (12.89)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)
SEm±	*0.73*	*1.47*	*0.37*	*0.51*	*0.37*	*0.37*	*0.69*
CD (P=0.05)	*2.16*	*4.37*	*1.10*	*1.52*	*1.10*	*1.10*	*2.06*

Note: Data in the table are mean values and those in parenthesis arc sine transformed values.
C_1 = Chilli, C_2 = Tomato, M_1 = Blotter method, M_2 = PDA method and M_3 = Water agar method. *Aspergillus niger, A. fumigatus = Aspergillus fumigatus, A.sp.2 = Aspergillus sp.2, Penicillium sp = Penicillium sp., Rhizopus sp = Rhizopus sp., A.sp.3 = Aspergillus sp.3, F.sp.3 = Fusarium sp.*

Table 9: Interaction between the non-surface sterilized seeds of chilli (C_1) and tomato (C_2) cultivars from Meghalaya state and the methods on percent occurrence (%) of different fungi.

Treatments (C × M Interaction)	Percent occurrence (%)									
	A. niger	*A. fumigatus*	*A. solani*	*Penicillium* sp.	*A. sp.1*	*A. sp.3*	*F. sp.1*	*F. sp.2*	*F. sp.3*	*Un. sp.1*
C_1M_1	28.42 (32.19)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	71.58 (57.90)	0.00 (0.25)
C_1M_2	50.83 (45.48)	33.61 (35.36)	0.00 (0.25)	5.56 (13.56)	0.00 (0.25)	10.00 (18.39)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)
C_1M_3	49.58 (44.76)	50.42 (45.23)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)
C_2M_1	18.75 (25.65)	0.00 (0.25)	10.00 (18.39)	6.25 (14.45)	0.00 (0.25)	0.00 (0.25)	28.75 (32.41)	6.25 (14.45)	5.00 (12.92)	0.00 (0.25)
C_2M_2	47.50 (43.57)	37.50 (37.75)	0.00 (0.25)	5.00 (12.89)	5.00 (12.89)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	5.00 (12.89)
C_2M_3	41.67 (40.20)	33.33 (35.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)
SEm±	*0.78*	*1.33*	*0.32*	*0.48*	*0.22*	*0.32*	*0.33*	*0.24*	*0.84*	*0.22*
CD (P=0.05)	*2.31*	*3.94*	*0.95*	*1.42*	*0.65*	*0.95*	*0.97*	*0.70*	*2.51*	*0.65*

Note: Data in the table are mean values and those in parenthesis arc sine transformed values .
C_1 = Chilli, C_2 = Tomato, M_1 = Blotter paper method, M_2 = PDA method and M_3 = Water agar method. *A.niger = Aspergillus niger, A.fumigatus = Aspergillus fumigatus, A.solani = Alternaria solani, Penicillium sp = Penicillium sp., A.sp.1 = Aspergillus sp.1, A.sp.3 = Aspergillus sp.3, F.sp.1 = Fusarium sp.1, F.sp.2 = Fusarium sp.2, F.sp.3 = Fusarium sp.3 and Un.sp.1 = Unidentified sp.1*

Table 10: Interaction between the non-surface sterilized seeds of chilli (C_1) and tomato (C_2) cultivars from Nagaland state and the methods on percent occurrence (%) of different fungi.

Treatments (C x M Interaction)	Percent occurrence (%)						
	A. niger	*A. fumigatus*	*Penicillium* sp.	*Rhizopus* sp.	*A. sp.3*	*F. sp.3*	*Un.sp.1*
C_1M_1	15.00 (22.50)	22.50 (28.23)	33.33 (35.23)	7.58 (15.76)	0.00 (0.25)	0.00 (0.25)	20.84 (27.11)
C_1M_2	27.50 (31.61)	47.50 (43.54)	15.00 (22.64)	10.00 (18.43)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)
C_1M_3	22.92 (28.52)	45.83 (42.60)	0.00 (0.25)	6.25 (14.45)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)
C_2M_1	20.83 (27.14)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	79.17 (63.23)	0.00 (0.25)
C_2M_2	50.63 (45.36)	10.00 (18.39)	29.38 (32.82)	0.00 (0.25)	10.00 (18.39)	0.00 (0.25)	0.00 (0.25)
C_2M_3	43.75 (41.40)	31.25 (33.91)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)	0.00 (0.25)
SEm±	*1.66*	*1.68*	*0.91*	*0.71*	*0.32*	*1.27*	*0.48*
CD (P=0.05)	*4.92*	*4.98*	*2.69*	*2.11*	*0.95*	*3.76*	*1.43*

Note: Data in the table are mean values and those in parenthesis arc sine transformed values. C_1 = Chilli, C_2 = Tomato, M_1= Blotter Method, M_2 = PDA method and M_3 = Water agar method. *A. niger = Aspergillus niger, A. fumigatus = Aspergillus fumigatus, Penicillium* sp = *Penicillium* sp., *Rhizopus* sp. = *Rhizopus* sp., *A.sp.3 = Aspergillus sp.3, F.sp.3 = Fusarium sp.3 and Un.sp.1 = Unidentified* sp.

CONCLUSIONS

The results from the present studies, we concluded that the chilli and tomato cultivars collected from West Garo Hills of Meghalaya and Dimapur districts of Nagaland states of India respectively had wide diverse seed borne mycoflora which may be either pathogenic or non-pathogenic in nature. Since tomato and chilli are the very important vegetables crops in the North Eastern regions as well as in the country as a whole, it may be inferred from the present investigations that adoption of better seed health testing is very important steps for successful cultivation of chilli and tomato.

FUTURE SCOPE

The infected and contaminated seeds might act as pathogen or inoculum transmission agent for many important diseases of chilli and tomato plants. Since chilli and tomato are the very important vegetables crops in our regions as well as in the country as a whole, so adoption of better seed health testing and devising management strategies, including seed treatment with the best fungicides in a combination of biofungcides will be considered significant steps for the successful cultivation of chilli and tomato.

Acknowledgement. The authors would like to thank the Department of Plant Pathology, SASRD, Nagaland University, for allowing them to carry out the research work.
Conflict of Interest. None.

REFERENCES

Ahmed, I., Iftikhar, S. and Bhutta, A. R. (1993). Seed-borne microorganisms in Pakistan. Pakistan Agricultural Research Council, PO Box 1031, Islamabad, pp 32.

Al Kassim, M. Y. and Monawar, M. N. (2000). Seed-borne Fungi of Some Vegetable Seeds in Gazan Province and Their Chemical Control. *Saudi J. of Biol. Sci., 7*(2), 179-185.

Anonymous (1996). International rules for seed testing. *Seed Science and Technology*, *21*, 12-59.

Arx, J. A. V. (1981). The genera of funi sporulation in pure culture. 2nd Edition Leher. *Journal of Carmer Germany*.

Balogun, O. S., Odeyemi, G. A. and Fawole, O. B. (2005). Evaluation of the pathogenic effect of some fungal isolates on fruits and seedlings of pepper (Capsicum spp). *J. Agric. Res. & Dev*., *4* (2), 159-169.

Barnet, H. L. and Hunter, B. B. (1998). Illustrated genera of imperfect fungi. 4th Edition. St, Paul, MN, APS press. pp 218.

Bhajbhuje, M. N. (2013). Biodiversity of mycoflora in storage of *Solanum melongena* L. seeds. *International Journal of Life Sciences*, *1*(3), 165-181.

Bhale, M. S., Khare, D., Rawat, N. D. and Singh D. (2001). Seed borne diseases objectionable in seed production and their management. *Scientific Publishers, Jodhpur (India).* pp 10-16.

Booth, C. (1971). The genus Fusarium. *Common Wealth Mycological Institute Kew Survey England,* pp: 237.

Chauhan, R. T., Patel, P. R. and Thumar, V. M. (2018). Occurrence of seed borne pathogens in chilli (*Capsicum frutescence* L.) cv. GVC 111 *in vitro*. *International Journal of Chemical Studies*, *6*(2), 1374-1376.

Chohan, S. (2015). Antifungal activity and phytochemical analysis of various medicinal plants against pathogenic fungi of tomato (*Lycopersicon esculentum* L.). M.Sc. (Hons) Agri. Thesis. Department of Plant Pathology, Bahauddin Zakariya University, Multan. pp 71.

Das, R. (2007). Analysis of seed mycoflora of chilli during storage period. *Journal of Plant Disease Sciences*, *2*(2), 179-181.

Ellis, M. B. (1976). More dematiaceoushyphomycetes. Common Wealth Mycological Institute Kew Survey England . pp 505.

Fuseini, Z. (2010). Occurrence and control of seedborne pathogenic fungi of tomato (*Lycopersicon esculentum* Mill.) seeds from five agro-ecological zones of Ghana using plant extracts. M.Sc. (Ag.) Thesis, Kwame Nkrumah University of Science and Technology, College of Agriculture and Natural Resources, Ghana.

Guldekar, D. D., Potdukhe, S., Kakde, A. P., Thakre, K. T. and Raut, M. (2017). Association on seed-borne fungi on chilli seeds. *International Journal of Researches in Biosciences, Agriculture and Technology*, *5*(2), 2347-517.

Hamin, I., Mohanto, D. C., Sarkar, M. A. and Ali, M. A. (2014). Effect of seed borne pathogens on germination of some vegetable seeds. *Journal of Phytopathology and Pest Management*, *1*(1), 34-51.

Ismail, M., Anwar, S. A., Haque, M. I., Iqbal, A., Ahmad, N. and Arain, M. A. (2012). Seed-borne fungi associated with cauliflower seeds and their role in seed germination. *Pakistan Journal of Phytopathology*, *24*(1), 26-31.

ISTA (1996). International Rules for Seed Testing. *Seed Science and Technology, 24*, 1-335

Jogi, M. G. (2007). Studies on seed borne pathogens of chilli (*Capsicum annum* L.) http://krishikosh.egranth.ac.in/handle/1/5810006089. Accessed on 18 November 2020.

Makelo, M. N. (2010). Assessment of seed borne pathogens for some important crops in Western Kenya, Machakos Kenya, PP1-7.

Maude, R. B. (1996). Seed borne diseases and their Control. CAB Inter. Cambridge Pp.280.

Mekonnen Gebeyaw (2020). Review on: Impact of Seed-Borne Pathogens on Seed Quality. *American Journal of Plant Biology*, *5*(4), 77-81.

Nagamani, A., Kunwar, I. K. and Manoharachary, C. (2006). Handbook of soil fungi. *I.K.* International Private Limited.

Nelson, P. E., Toussoum, T. A. and Marasas, W. F. (1983). Fusarium species- An illustrated manual for identification. The State University Press, Penn. USA. pp 203.

Pawar, S. M. (2018). Studies on seed borne fungi infecting to Capsicum (Chilli) cultivated in Kannad Region of Aurangabad District. *International Journal of Science and Research, 8*(8), 1265-1267.

Perveen, S. and Ghaffar, A. (1995). Seed-borne mycoflora of tomato. *Pakistan Journal of Botany, 27*(1), 201-208.

Patekar, M. A., R. M Kadam, R. M. and Biradar, R. P. (2017). Assessment of seed- borne fungi of tomato and brinjal seeds. *Trends in Biotechnology Research*, *6* (1), 106-110.

Rajaput, J. and Rao, M. S. L. (2017). Status of seed-borne fungal diseases of tomato in Northern Karnataka and evaluation of seed health testing methods. *Journal of Farm Science*, *30*(2), 212-215.

Raju, R. I. (2018). Evaluation of seed-borne fungi associated with tomato and their control measures. *Jahangirnagar University Journal of Biological Sciences*, *6*(2), 59–66.

Shaker, M, Momin, R. K. and Hashmi, S. (2010). Isolation and identification of some pulses mycoflora. *Bionano Frontier, 3*(2), 321-324.

Sultana, A., Mehedi, I. and Raju, A. U. M. (2016). Control of seed borne fungi on tomato seeds and their management by botanical extracts. *Research in Agriculture, Livestock and Fisheries*, *3*(3), 403-410.

Sultana, N., Ali, Y., Jahan, S. and Yasmin, S. (2016). Effect of Storage Duration and Storage Devices on Seed Quality of Boro Rice Variety BRR Idhan 47. *J Plant Pathology and Microbiol.*, *8*, 392.

Sutton, B. C. (1980). The coelomycetes. Common Wealth Mycological Institute Kew Survey England. pp 696.

Telang, S. M. (2010). Effect of different storage periods on seed mycoflora, seed germination and seedling emergence of chilli variety local seeds treated with leaf powder of *Azadirachta indica*. *Asian Science, 5*(1), 42-45.

How to cite this article: Jingme A. Sangma and Hijam Meronbala Devi (2023). Seed-Borne Mycoflora of Chilli (*Capsicum annum* L.) and Tomato (*Solanum lycopersicum* L.). *Biological Forum – An International Journal, 15*(4): 181-190.