



International Journal of Current Research and Academic Review

ISSN: 2347-3215 Volume 4 Number 11 (November-2016) pp 135-141

Journal home page: <http://www.ijcrar.com>

doi: <http://dx.doi.org/10.20546/ijcrar.2016.411.018>



Fungal Infection in Some Infected Solanaceous Vegetable Fruit at Jabalpur during Storage in Different Seasons

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KEYWORDS

Mycoflora,
*Lycopersicon
esculentum*,
Solanum tuberosum,
Solanum melongena
and *Capsicum annum*.

A B S T R A C T

Tomato (*Lycopersicon esculentum*), Potato (*Solanum tuberosum*), Brinjal (*Solanum melongena*) and Chilli (*Capsicum annum*) are important and valuable food commodities. During storage the food commodities are spoiled by both biotic and abiotic agents amongst whom fungi play important role. In the present study mycoflora of *Lycopersicon esculentum*, *Solanum tuberosum*, *Solanum melongena* and *Capsicum annum* were studied using blotter method, dilution method, Agar plate method, and direct slide method during different seasons such as rainy, winter and summer. Altogether nineteen fungal species were isolated from *Lycopersicon esculentum*, Twelve from *Solanum tuberosum*, sixteen from *Solanum melongena* and thirteen from *Capsicum annum* during all the three seasons.

Introduction

Tomato (*Lycopersicon esculentum*) Potato (*Solanum tuberosum*), Brinjal (*Solanum melongena*) and Chilli (*Capsicum annum*) are important and valuable food commodities. During storage the food commodities are infected by both biotic and abiotic agents. Amongst microorganisms Fungi play important role in deteriorating the aesthetic and nutritive value of stored food commodity (Christensen and Kaufman, 1965 Neergard, 1977). Under storage conditions they were susceptible to attack by different species of fungi because they have

a rich source of nutrients conducive for the growth of numerous fungi such as *Aspergillus flavus*, *Aspergillus niger*, *Rhizopus sp.*, *Penicillium sp.*, etc.

A significant variation in pattern of mycoflora incidence was observed in terms of source and season. Fungal infection was highest during rainy season. Many species of fungi cause many types of diseases, species of genus *Alternaria* causes diseases in tomato, Potato and eggplant in all contents of the world (Proyor *et al.*, 2000).

Colletotrichum sp., is one of the most common and unusual pathogen causes anthracnose of wide range of hosts worldwide (Sutton., 1992, Hyde *et al.*, 2009). *Rhizoctina solani* has been identified as an important pathogen of potatoes. Brinjal on the other hand is attacked by numerous mycoflora and causes significant losses by reducing yield and marketable value of crop. *Alternaria* and *Cercospora* causes huge losses to brinjal. *Cercospora melongena* are characterised by chlorotic lesions, angular to irregular in shape, Later turns greyish brown. Major fungal diseases affecting capsicum are damping off (*Pythium* and *Phytophthora*) Anthracnose and ripe rot (*Colletotrichum capsici*), wilt (*Fusarium oxysporum*), Dry rot (*Sclerotium rolfsii*). Post harvest rots are caused by *Aspergillus niger*, *Aspergillus flavus*, *Fusarium moniliforme* and *penicillium* etc. (Bose *et al.*, 2002, Gupta and Paul 2002, Gupta and Hind 2006). Tomato on the other hand have serious challenges to their existence these include climatic conditions, pests, bacteria and fungal attack. It is estimated that about 20-25% of the harvested fruits are decayed by pathogens during post-harvest handling and even in developing countries (Drobby, 2006., Zhu 2006). Fungi produce abundance of extracellular pectinase and hemicellulases that are important factor for fungal spoilage. Mycological investigations on spoilage of these solanaceous vegetable fruit that are most dominant are *Aspergillus niger*, *Aspergillus flavus*, *Rhizopus*, *Mucor*, *Penicillium*, and *Alternaria sp.*, *Aspergillus* species appeared to be most toxigenic fungi recoverd from infected solanaceous

vegetables. *Aspergillus niger* had the highest percentage of occurrence, followed by *Aspergillus flavus* while *mucor* species had the least percentage of occurrences.

Sevral environmental factors like humidity and temperature during storage influences the infection of fungi and aflotoxin production. It is generally assumed that *Aspergillus* species are commonly associated with commodities in warmer and tropical climates (Pitt and Hocking 2009).

Materials and Methods

Samples of infected Tomato, Potato, Brinjal and Chilli fruit were procured from different markets of Jabalpur in sterilized glass containers during rainy (July-Oct.) winter (Nov-Feb.) Summer (March-June) seasons. After each collection they were studied for their associated mycoflora by using blotter method, dilution method, Agar plate method and direct slide method (Annon, 1996). For isolation of fungi PDA medium were used adding tetracycline in order to inhibit the growth of bacteria. Fungi were identified on their morphological and reproductive conidial structures under digital microscope. Reproductive conidia or spore were measured in dimensions through micrometry. They were identified with the help of available literature (K.H.Domsch and W.Gans, M.B.Ellis, Gillman 1967, Rapper and Fennel 1965).

For calculating the % of occurrences following formula were used:

$$\% \text{ of occurrences} = \frac{\text{No. of colonies of a particular fungal species in all plate}}{\text{Total No. of colonies of all the fungi in all the plates on a commodity}}$$

Results and Discussion

Table first revealed that nineteen species were isolated from infected.

Lycopersicon esculentum of solanaceous vegetables during all the three seasons. Twelve species were isolated from rainy

season, eleven from winter and eleven from summer season respectively. *Aspergillus niger*, *Aspergillus flavus* and *Geotrichum candidum* were found in all the three seasons. *Mucor sp.*, *Penicillium digitatum* and *Rhizopus stolonifer* were found in both winter and summer season.

Table.1

| Fungi isolated | Rainy | | | | Winter | | | | Summer | | | |
|---------------------------------|-------|-----|------|-----|--------|-----|-----|-----|--------|-----|-----|------|
| | July | Aug | Sept | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | June |
| <i>Geotrichum candidum</i> | + | + | + | + | - | + | + | + | - | + | + | + |
| <i>Aspergillus flavus</i> | - | + | + | + | + | + | + | + | + | + | + | - |
| <i>Mucor sp.</i> | - | - | - | - | - | + | - | - | - | + | + | - |
| <i>Penicillium digitatum</i> | - | - | - | - | - | - | - | + | + | + | + | - |
| <i>Alternaria solani</i> | + | + | + | + | - | - | - | - | - | + | + | - |
| <i>Rhizopus nigricans</i> | - | + | + | - | - | - | + | + | - | - | - | - |
| <i>Fusarium solani</i> | - | + | + | - | - | - | - | - | + | + | + | - |
| <i>Rhizopus stolonifer</i> | - | - | - | - | + | - | + | + | + | - | + | - |
| <i>Curvularia lunata</i> | - | - | - | - | - | + | - | - | - | - | - | - |
| <i>Cladosporium herbarum</i> | - | - | - | - | + | - | + | + | - | - | - | - |
| <i>Mucor racemosus</i> | - | - | - | - | - | - | - | - | + | - | + | + |
| <i>Phytophthora infestans</i> | - | + | + | + | - | - | - | - | - | - | - | - |
| <i>Alternaria alternata</i> | - | + | + | - | - | - | - | - | + | + | + | - |
| <i>Fusarium moniliforme</i> | + | + | + | - | - | - | - | - | - | - | + | - |
| <i>Penicillium notatum</i> | - | - | - | - | + | + | + | - | - | - | - | - |
| <i>Curvularia lunata</i> | - | - | - | + | + | + | - | - | - | - | - | - |
| <i>Sclerotium rolfsii</i> | - | + | + | + | - | - | - | - | - | - | - | - |
| <i>Colletotrichum acervulus</i> | - | + | + | + | - | - | - | - | - | - | - | - |
| <i>Aspergillus niger</i> | + | + | + | + | + | - | + | + | + | - | + | + |

Table.2

| Fungi isolated | Rainy | | | | Winter | | | | Summer | | | |
|------------------------------|-------|-----|------|-----|--------|-----|-----|-----|--------|-----|-----|------|
| | July | Aug | Sept | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | June |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| <i>Aspergillus niger</i> | - | + | + | + | - | + | + | + | - | + | + | + |
| <i>Aspergillus flavus</i> | + | + | + | + | + | + | + | + | + | + | + | + |
| <i>Fusarium oxysporum</i> | - | - | + | + | - | - | - | + | + | + | + | - |
| <i>Fusarium moniliforme</i> | - | - | + | + | - | - | - | - | + | - | - | - |
| <i>Rhizopus stolonifer</i> | - | - | + | + | - | - | - | - | + | + | - | + |
| <i>Mucor piriformis</i> | - | - | - | - | - | - | - | + | - | + | - | - |
| <i>Alternaria solani</i> | - | + | + | - | + | - | + | + | - | - | - | - |
| <i>Alternaria alternata</i> | - | - | - | - | + | - | - | + | + | - | + | + |
| <i>Fusarium solani</i> | - | - | - | + | + | + | + | + | - | - | - | - |
| <i>Rhizopus oryzae</i> | - | + | - | + | + | - | - | - | - | - | - | - |
| <i>Aspergillus fumigatus</i> | - | + | + | + | + | - | - | - | - | - | - | - |
| <i>Rhizopus nigricans</i> | - | - | - | - | + | - | + | + | - | + | + | - |

Table.3

| Fungi isolated | Rainy | | | | Winter | | | | Summer | | | |
|---------------------------------------|--------------------------|-----|------|-----|--------|-----|-----|-----|--------|-----|-----|------|
| | July | Aug | Sept | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | June |
| | <i>Aspergillus niger</i> | - | + | + | - | - | - | - | - | + | - | + |
| <i>Aspergillus flavus</i> | + | + | + | + | + | + | + | + | + | + | + | + |
| <i>Rhizopus nigricans</i> | - | - | - | - | + | - | + | - | - | - | - | - |
| <i>Fusarium solani</i> | - | - | + | + | + | + | - | - | - | - | - | - |
| <i>Tricothecium roseum</i> | - | + | + | + | - | - | - | - | - | - | - | - |
| <i>Colletotrichum gloeosporioides</i> | + | + | + | - | + | - | - | - | - | - | - | - |
| <i>Curvularia lunata</i> | - | - | - | + | - | + | + | - | - | - | - | - |
| <i>Alternaria solani</i> | + | + | + | - | - | - | - | - | - | + | + | - |
| <i>Fusarium oxysporum</i> | - | - | + | + | - | - | + | - | + | + | - | - |
| <i>Trichoderma viridae</i> | + | + | - | + | - | - | - | - | - | - | - | - |
| <i>Alternaria alternata</i> | - | - | + | + | - | - | - | + | + | - | + | + |
| <i>Aspergillus fumigatus</i> | - | + | + | - | - | - | - | - | - | - | - | + |
| <i>Cladosporium cladosporioides</i> | - | - | - | - | + | + | - | - | - | + | + | + |
| <i>Penicillium funiculosum</i> | - | + | - | - | - | - | - | - | - | - | - | - |
| <i>Aspergillus nidulans</i> | + | + | + | + | - | + | - | - | - | - | - | - |
| <i>Curvularia calvata</i> | - | - | - | - | - | + | - | - | - | - | - | - |

Table.4

| Fungi isolated | Rainy | | | | Winter | | | | Summer | | | |
|--------------------------------|-------|-----|------|-----|--------|-----|-----|-----|--------|-----|-----|------|
| | July | Aug | Sept | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | June |
| <i>Colletotrichum capsici</i> | - | + | + | + | - | - | - | + | + | - | - | - |
| <i>Alternaria alternata</i> | - | + | + | - | - | - | + | + | + | - | - | - |
| <i>Aspergillus niger</i> | - | + | + | + | + | + | + | + | + | + | + | + |
| <i>Aspergillus flavus</i> | + | + | + | + | + | + | + | + | + | + | - | + |
| <i>Colletotrichum dematium</i> | - | - | + | + | + | - | - | - | + | - | - | - |
| <i>Aspergillus fumigatus</i> | - | + | - | - | - | - | - | - | - | + | - | - |
| <i>Fusarium solani</i> | - | - | - | + | + | + | - | - | - | - | - | - |
| <i>Fusarium oxysporum</i> | - | - | + | + | - | - | - | + | + | + | + | - |
| <i>Mucor racemosus</i> | - | - | - | - | + | + | - | - | - | - | - | - |
| <i>Alternaria solani</i> | + | + | - | + | + | - | - | - | - | - | - | - |
| <i>Penicillium notatum</i> | - | - | - | + | + | + | - | - | - | - | - | - |
| <i>Cercospora capsici</i> | - | - | + | + | - | - | - | - | + | - | - | - |
| <i>Colletotrichum acutatum</i> | - | - | + | + | - | - | - | - | - | - | - | - |

Phytophthora infestans, *Sclerotium rolfsii* and *Colletotrichum acervulus* were found only in rainy season. *Curvularia lunata* were found only in winter season. *Alternaria solani* and *Alternaria alternata* showed equal frequencies. Least frequently occurred was *mucor racemosus*.

Table 2nd reveals a total of twelve species encountered on infected on *solanum tuberosum*. *Aspergillus niger*, *Aspergillus flavus* were frequently occurred in all the three seasons followed by *Fusarium* species. Total no. of species recorded in rainy season

was nine species, ten in winter season and eight species were recorded in summer season. *Mucor piriformis*, *Alternaria alter*, *Rhizopus nigricans* were not found in rainy season. *Rhizopus stolonifer* showed highest dominance in summer season. *Fusarium solani* frequently occurred in winter season.

Table 3rd exhibits a total of sixteen species infecting the *solanum melongena* during all the three seasons, but the number of species varied with the season. Thirteen species were found in rainy season, ten species were reported in winter season and seven species

were found in summer season respectively. *Aspergillus niger*, *Aspergillus flavus* were frequently reported in all the three seasons, followed by *alternaria alternate*. *Tricothecium roseum* and *Trichoderma viridae* were found only in rainy season. *Curvularia calvata* and *Rhizopus nigricans* were found only in winter season.

Table 4th exhibits a total of thirteen species from infected *Capsicum annum* during all the three seasons. *Alternaria alternate*, *Aspergillus niger*, *Aspergillus flavus*, *Fusarium oxysporum* were found in all the three seasons. *Colletotrichum acutatum* were found only in rainy season. *Aspergillus fumigatus*, *Cercospora capsici*, and *Colletotrichum acutatum* were not found in winter season.

Conclusion

Present study on infected solanaceous vegetables in different seasons of Jabalpur revealed that *Aspergillus flavus*, *Aspergillus niger*, *Fusarium oxysporum* were found throughout the year. Some fungi were more dominant in rainy season, some in winter and some in summer season. Rich diversity of fungi was observed in rainy season due to high moisture and humidity. The marketers and consumers take necessary precaution in preventing contamination and eating of contaminated vegetables. This will however, enhance reduction the risk of aflatoxin and other mycotoxins that are deleterious to human health which are produced by these fungi that have been isolated in this study.

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How to cite this article:

Sajad, A.M., Jamaluddin, Bhoopendra Kumar Ahirwar and Jitendra, N. 2016. Fungal Infection in Some Infected Solanaceous Vegetable Fruit at Jabalpur during Storage in Different Seasons. *Int.J.Curr.Res.Aca.Rev.4(11): 135-141*.
doi: <http://dx.doi.org/10.20546/ijcrar.2016.411.018>