



# Fundamental and Applied Agriculture

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## Plant Pathology

### ORIGINAL ARTICLE

## Occurrence of fungal pathogens on improved jujube in Bangladesh

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#### ARTICLE INFO

##### Article history:

Received: 30 June 2016

Received in revised form: 17 August 2016

Accepted: 05 September 2016

Available online: 15 October 2016

Academic Editor: Ahmed Khairul Hasan

##### Keywords:

Occurrence

Fungal pathogens

Jujube

#### ABSTRACT

Disease causes tremendous yield loss and deteriorates fruit quality in terms of nutrition and also reduces the market value if not managed properly. Occurrence and proper identification of diseases are utmost important for developing an effective management approach. An investigation was conducted during 2007-08, 2008-09 and 2009-10 in five major Jujube growing districts of Bangladesh. A total of 405 diseased samples namely leaf, stem, fruit and inflorescence were collected from Gazipur, Mymensingh, Pabna, Rajshahi and Rangpur. Altogether 1851 fungal infections were recorded of Jujube and average number of fungal infections per sample was 4.57. The diseases as well as the fungi associated with them were identified. Altogether 16 fungal pathogens were isolated from different plant parts of Jujube which were, *Alternaria alternata*, *Aspergillus* spp., *Capnodium* sp., *Cercospora ziziphi*, *Colletotrichum gloeosporioides*, *Curvularia lunata*, *Fusarium semitectum*, *Isaiopsis indica* var. *ziziphi*, *Lasiodiplodia theobromae*, *Mitrella ziziphi*, *Nigrospora* sp., *Oidium erysiphoides* f. sp. *ziziphi*, *Penicillium* sp., *Pestalotiopsis palmarum*, *Phomopsis* sp. and *Rhizopus* sp. Among the isolated fungal pathogens, *C. lunata* was the most predominant followed by *Fusarium semitectum*, *A. alternata*, *C. gloeosporioides*, *O. erysiphoides* f. sp. *ziziphi*, *Pestalotiopsis palmarum*, *Aspergillus* spp., *Rhizopus* sp. and *Penicillium* sp. Their prevalence was 11.29, 11.08, 9.99, 9.62, 9.35, 8.75, 6.70, 6.32 and 5.35%, respectively. Prevalence of other fungi ranged 1.89-4.54%. Among three varieties, BAU Kul was found as the most disease vulnerable variety followed by Apple Kul, whereas, BARI Kul-1 showed second highest infection in terms of fruit infection.

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#### INTRODUCTION

Jujube (*Ziziphus mauritiana* Lam.), locally called Ber or Kul is nutritious and rich in vitamins (Kuliev and Guseinova 1974; Great Vista Chemicals 2004), is a popular indigenous fruit of Bangladesh. It is mostly cultivated in homestead since time immemorial. Recently, it is widely cultivated in commercial orchards as a high value cash crop and subjected to attack by various diseases, causing tremendous yield loss. Reports from different countries reveal that various fungal pathogens attack Jujube plants causing different diseases. In India and China, several research works have been done on different aspects of Jujube diseases (Singh and Singh 1979; Rai et al. 1982; Sharma et al. 1993; Nallathambi et al. 1999; Quin and Tian 2004). In India, Jujube plants are attacked by different diseases such as

powdery mildew (*Oidium erysiphoides* var. *ziziphi*), sooty mold (*Isariopsis indica* var. *ziziphi*), leaf spots (*Alternaria*, *Cercospora*, *Septoria*, *Cladosporium*, *Pestalotiopsis*, etc.) rust (*Phakopsora ziziphi-vulgaris*.) and witches broom (by MLOs) (Jamadar et al. 2009). *Pestalotiopsis palmarum* is an important fungal pathogen of Jujube (Madan and Gupta 1976; Rai et al. 1982) caused leaf spot and fruit rot diseases. Yuan et al. (2009) reported seven Jujube diseases, which are powdery mildew (*Oidium erysiphoides* f. sp. *ziziphi*), anthracnose (*Colletotrichum gloeosporioides*) grey mold (*Botrytis cinerea*), black spot (*Alternaria alternate*), blight (*Phytophthora* sp.), brown spot (*Phomopsis mauritiana*) and brown rot (*Streptobotrys streptothrix*) in China.

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Jujube fruits on the tree are attacked by *Alternaria chartarum*, *Aspergillus nanus*, *A. parasiticus*, *Helminthosporium atroolivaceum*, *Phoma hessarensis*, and *Stemphylium valparadisicum*. Fruit rots are caused by *Fusarium* spp., *Nigrospora oryzae*, *Epicoccum nigrum*, and *Glomerella cingulata*. The fruits may be spotted by the fungi, *Alternaria brassicicola*, *Phoma* spp., *Curvularia lunata*, *Cladosporium herbarum* in storage (Morton 1987).

In Bangladesh, continuous cultivation of high yielding varieties of Jujube like BAU Kul, Apple Kul and BARI Kul-1 in large scale and due to their intensive cultivation, these varieties are suffering from different fungal diseases in the growing area. Farmers are applying different control measures without knowing their effectiveness. Literatures on the identification of disease problems of Jujube and their management are very limited in our country. But for the safety of newly developed commercial Jujube orchard, identification of disease related problems and development of effective control measures against them are essential. By considering the above points, the present investigation was undertaken to determine the occurrence of fungal pathogens associated with diseased plant parts of Jujube grown in commercial orchards of Bangladesh.

## METHODOLOGY

### Collection and Preservation of Diseased Samples

Commercial Jujube orchards were selected in five prominent Jujube growing areas of Bangladesh. These are Gazipur, Pabna, Rajshahi, Rangpur and Mymensingh. A total of 405 Jujube samples representing 150 fruits, 135 leaves, 30 trunks and 90 inflorescences were collected from the selected orchards. The samples were collected during August-April in three consecutive years of 2007-08, 2008-09 and 2009-10. Fruits samples were collected from orchards and markets of selected areas in equal proportion i.e. 50% from orchard and 50% from market. After collection, samples of infected plant parts were checked carefully and disease symptoms were recorded and photographs were taken. Collected samples were stored in polyethylene bags and preserved in a refrigerator at 4°C for isolation and identification of associated fungal pathogens.

### Isolation of Fungal Pathogen

Fungal pathogens were isolated from infected leaves, fruits and other aerial plant parts of Jujube following tissue planting methods according to Aneja (2003). For isolation of associated fungi, diseased leaf samples were surface sterilized with 70% ethanol and then washed with sterile water for three times and air dried within laminar flow cabinet. The samples were cut into small pieces (5 mm) with a sharp sterilized blade at the junction of healthy and diseased area. The cut pieces were again surface-sterilized with 70% ethanol for 30 seconds and rinsed with distilled water for three times. The surface sterilized specimens were blotted with dry, clean and sterile paper towels to remove excess water. The sterilized pieces of leaf samples were placed on PDA plates aseptically and incubated in inverted position at room temperature (25±2°C). In some cases, the infected leaves or portion of leaves were taken in moist chambers and incubated at room (25±2°C) temperature for two days to trigger the fungal growth on the specimen and then the fungal mycelia grew on the leaf samples were transferred directly to PDA plates. In addition, the fruiting bodies like acervuli and pycnidia developed on incubated leaf samples were picked up and placed on fresh PDA medium after dipping in a surface sterilant for few seconds.

Fungal pathogens associated with samples of stem, fruit and other aerial plants parts were also isolated following the same procedures as described before. Deep seated pathogens were isolated by culturing pieces of internal tissues. The diseased fruit

(or woody tissue) was wiped with cotton swab dipped in 70% ethanol followed by lightly flaming the tissue. Then peel back outside layer by a flamed scalpel exposing tissues not previously exposed to contaminants. A small piece of tissue (1/8 to 1/2" sizes) was isolated with flamed scalpel or forceps from freshly exposed area of the advancing margin of infection and plated in each Potato Dextrose Agar Plate (PDA supplemented with streptomycin sulphate). The plates were incubated at 25 ±2°C in an inverted position for 5-7 days.

The respective plates were monitored starting from the second day of incubation up to 1-2 weeks to observe fungal growth and sporulation. A very small amount of PDA containing mycelium from the edges of the developing colonies was transferred to slant or nutrient media plates for identification and future use. The nature of growth of the pathogen on PDA plate indicated the responsible causal organisms as fungal pathogen.

### Purification and Pathogenicity Test of Isolated Fungi

Purification of fungi was done by single spore culture and/or hyphal tip culture method according to Aneja (2003). Pathogenicity of different fungal isolates from diseased samples of Jujube was done following detached leaf and detached fruit inoculation method previously described by Omar and Wahid (2001). The purified fungal isolates were examined and their morphological characteristics were recorded. Then the isolates were identified through observation of symptoms on plant parts, growth characters of fungal isolates on PDA plates, pathogenic structures under microscope and comparing them with the available standard literatures and keys (Barnett and Hunter 1972; Sutton 1980).

## RESULTS AND DISCUSSION

### Identification of Fungal Pathogens Associated with Diseased Jujube Plant Parts

Altogether 1851 fungal infections were recorded from 405 diseased samples of Jujube. Of them, the plant pathogenic fungi were *Alternaria alternata*, *Aspergillus* spp., *Capnodium* sp., *Cercospora ziziphi*, *Colletotrichum gloeosporioides*, *Curvularia lunata*, *Fusarium semitectum*, *Isaiopsis indica* var. *ziziphi*, *Lasiodiplodia theobromae*, *Mitrella ziziphi*, *Nigrospora* sp., *Oidium erysiphoides* f. sp. *ziziphi*, *Penicillium* sp., *Pestalotiopsis palmarum*, *Phomopsis* sp. and *Rhizophus* sp. Predominant fungal pathogen was *C. lunata* followed by *Fusarium semitectum*, *A. alternata*, *C. gloeosporioides*, *O. erysiphoides* f. sp. *ziziphi* and *Pestalotiopsis palmarum*, *Aspergillus* spp., *Rhizophus* sp. and *Penicillium* sp. Their prevalence was 11.29, 11.08, 9.99, 9.62, 9.35, 8.75, 6.70, 6.32 and 5.35%, respectively. Prevalence of other fungi ranged 1.89-4.54% (Table 1).

### Prevalence of Fungi on Different Plant Parts

Fourteen (14) fungal pathogens were isolated from diseased samples of fruits except *C. ziziphi* and *I. indica* f. sp. *ziziphi*, (these two fungi were isolated only in leaf samples). Among the pathogens, *C. gloeosporioides*, *F. semitectum*, *A. alternata*, *P. palmarum*, *C. lunata* and *L. theobromae* were noted as the most prevalent pathogens and their prevalence were 76.67, 71.33, 64.00, 53.33, 52.00 and 44.00%, respectively (Table 1).

Twelve fungi were isolated from leaf samples and among them 10 were plant pathogenic. Among the leaf samples tested, 48.15, 46.67, 45.93, 44.44 and 43.70% produced by *P. palmarum*, *C. gloeosporioides*, *O. erysiphoides* f. sp. *ziziphi*, *Capnodium* sp., *A. alternata* and *C. lunata*, respectively (Table 2).

Only three pathogenic fungi namely *P. palmarum*, *C. lunata* and *F. semitectum* were isolated from stem samples. Their prevalence were 56.67, 36.67 and 32.22%, respectively. Four

**Table 1.** Prevalence of different plant pathogenic fungi associated with fruit, leaf, stem and inflorescence of Jujube

| Name of fungi                                    | % Prevalence |       |       |         | % Prevalence |
|--|--------------|-------|-------|---------|--------------|
|  | Fruit        | Leaf  | Stem  | Inflor. |              |
| <i>Alternaria alternata</i>                      | 64.00        | 44.44 | 0.00  | 32.22   | 9.99         |
| <i>Aspergillus</i> spp.                          | 82.67        | 0.00  | 0.00  | 0.00    | 6.70         |
| <i>Capnodium</i> sp.                             | 14.67        | 45.93 | 0.00  | 0.00    | 4.54         |
| <i>Cercospora ziziphi</i>                        | 0.00         | 38.52 | 0.00  | 0.00    | 2.81         |
| <i>Colletotrichum gloeosporioides</i>            | 76.67        | 46.67 | 0.00  | 0.00    | 9.62         |
| <i>Curvularia lunata</i>                         | 52.00        | 43.70 | 36.67 | 67.78   | 11.29        |
| <i>Fusarium semitectum</i>                       | 71.33        | 28.15 | 40.00 | 53.33   | 11.08        |
| <i>Isaiopsis indica</i> var. <i>ziziphi</i>      | 0.00         | 35.56 | 0.00  | 0.00    | 2.59         |
| <i>Lasiodiplodia theobromae</i>                  | 44.00        | 19.26 | 0.00  | 0.00    | 4.97         |
| <i>Mitriella ziziphi</i>                         | 18.67        | 11.11 | 0.00  | 0.00    | 2.32         |
| <i>Nigrospora</i> sp.                            | 30.00        | 0.00  | 0.00  | 0.00    | 2.43         |
| <i>Oidium erysiphoides</i> f. sp. <i>ziziphi</i> | 18.67        | 45.93 | 0.00  | 92.22   | 9.35         |
| <i>Penicillium</i> sp.                           | 66.00        | 0.00  | 0.00  | 0.00    | 5.35         |
| <i>Pestalotiopsis palmarum</i>                   | 53.33        | 48.15 | 56.67 | 0.00    | 8.75         |
| <i>Phomopsis</i> sp.                             | 23.33        | 0.00  | 0.00  | 0.00    | 1.89         |
| <i>Rhizophus</i> sp.                             | 78.00        | 0.00  | 0.00  | 0.00    | 6.32         |
| % Prevalence                                     | 46.86        | 27.52 | 8.99  | 16.63   | -            |
| Number of fungal infections per sample           | 6.93         | 4.07  | 1.33  | 2.46    | 4.57 (Mean)  |

**Table 2.** Prevalence of different fungi on diseased samples of fruit, leaf stem and inflorescence of three Jujube varieties commercially grown in Bangladesh

| Name of isolated fungi                           | % Prevalence of different fungi on three jujube varieties |           |            |       |
|--|---|-----------|------------|-------|
|  | BAU Kul   | Apple Kul | BARI Kul-1 | Mean  |
| Leaf samples <sup>A</sup>                        |   |           |            |       |
| <i>Alternaria alternata</i>                      | 11.26   | 10.99     | 10.22      | 10.82 |
| <i>Capnodium</i> sp.                             | 10.81   | 11.52     | 11.68      | 11.34 |
| <i>Cercospora ziziphi</i>                        | 9.46  | 8.90      | 10.22      | 9.53  |
| <i>Colletotrichum gloeosporioides</i>            | 10.36   | 13.09     | 10.95      | 11.47 |
| <i>Curvularia lunata</i>                         | 11.26   | 9.95      | 10.95      | 10.72 |
| <i>Fusarium semitectum</i>                       | 7.66  | 7.33      | 5.11       | 6.70  |
| <i>Isaiopsis indica</i> var. <i>ziziphi</i>      | 6.76  | 9.95      | 10.22      | 8.98  |
| <i>Lasiodiplodia theobromae</i>                  | 5.41  | 4.71      | 3.65       | 4.59  |
| <i>Mitriella ziziphi</i>                         | 2.70  | 2.09      | 3.65       | 2.81  |
| <i>Oidium erysiphoides</i> f. sp. <i>ziziphi</i> | 11.26   | 10.99     | 11.68      | 11.31 |
| <i>Pestalotiopsis palmarum</i>                   | 13.06   | 10.47     | 11.68      | 11.74 |
| Inflorescence samples <sup>B</sup>               |   |           |            |       |
| <i>Alternaria alternata</i>                      | 15.00   | 11.69     | 12.50      | 13.06 |
| <i>Curvularia lunata</i>                         | 30.00   | 25.97     | 26.56      | 27.51 |
| <i>Fusarium semitectum</i>                       | 20.00   | 23.38     | 21.88      | 21.75 |
| <i>Oidium erysiphoides</i> f. sp. <i>Ziziphi</i> | 35.00   | 38.96     | 39.06      | 37.67 |
| Fruit samples <sup>C</sup>                       |   |           |            |       |
| <i>Alternaria alternata</i>                      | 8.78  | 9.60      | 9.60       | 9.33  |
| <i>Aspergillus</i> sp.                           | 11.13   | 12.80     | 12.12      | 12.02 |
| <i>Capnodium</i> sp.                             | 1.71  | 1.60      | 4.04       | 2.45  |
| <i>Colletotrichum gloeosporioides</i>            | 9.85  | 10.93     | 14.14      | 11.64 |
| <i>Curvularia lunata</i>                         | 7.71  | 7.47      | 7.07       | 7.42  |
| <i>Fusarium semitectum</i>                       | 10.06   | 10.93     | 9.60       | 10.20 |
| <i>Lasiodiplodia theobromae</i>                  | 6.42  | 6.13      | 6.57       | 6.37  |
| <i>Mitriella ziziphi</i>                         | 3.64  | 2.13      | 1.52       | 2.43  |
| <i>Nigrospora</i> sp.                            | 3.64  | 4.00      | 6.57       | 4.74  |
| <i>Oidium erysiphoides</i> f. sp. <i>ziziphi</i> | 2.57  | 2.93      | 2.53       | 2.68  |
| <i>Penicillium</i> sp.                           | 8.57  | 9.87      | 11.11      | 9.85  |
| <i>Pestalotiopsis palmarum</i>                   | 11.35   | 5.33      | 3.54       | 6.74  |
| <i>Phomopsis</i> sp.                             | 3.21  | 3.20      | 4.04       | 3.48  |
| <i>Rhizophus</i> sp.                             | 11.35   | 13.07     | 7.58       | 10.67 |

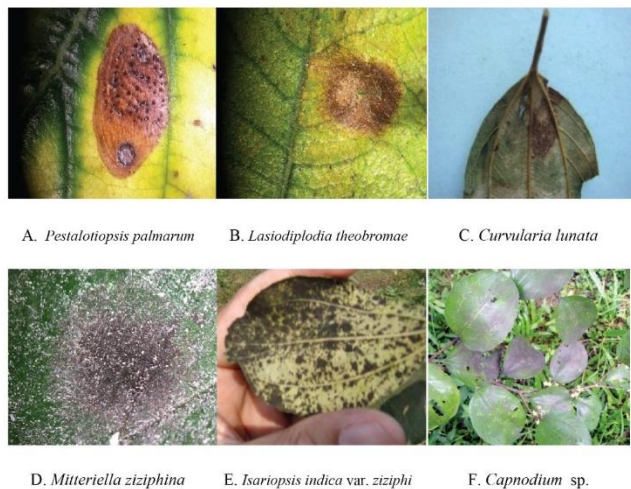
<sup>A</sup>45 leaf samples of variety, <sup>B</sup>10 inflorescence samples and <sup>C</sup>60 BAU Kul, 60 Apple Kul and 30 BARI Kul-1 fruit samples

pathogenic fungi namely *A. alternata*, *C. lunata*, *F. semitectum* and *O. erysiphoides* f. sp. *ziziphi* were associated with diseased samples of inflorescence and their prevalence were 32.22, 67.78, 53.33 and 92.22%, respectively (Table 1).

Prevalence of various fungi on fruits, leaves, inflorescences and stems were 46.86, 27.52, 8.99 and 16.67%, respectively. Average number of fungal infections per sample was 4.57. But the highest number of fungal infections was found on fruit samples followed by leaf, inflorescence and stem samples which were 6.93, 4.07, 2.46 and 1.33, respectively. Among 16 fungi identified, *C. lunata* and *F. semitectum* were associated with all types of plant parts of Jujube (Table 1).

**Effect of Jujube Varieties on the Prevalence of Fungi**

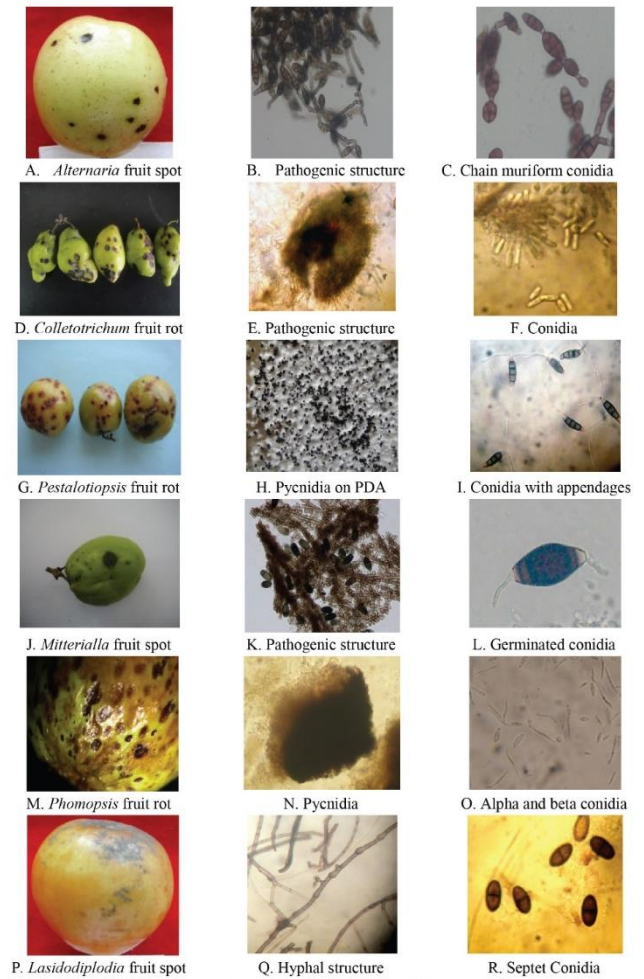
Influence of Jujube varieties on infection of leaves varied to some extent but the variation was not significant in most pathogens. Prevalence of each of the important pathogens namely *A. alternata*, *C. ziziphi*, *C. lunata*, *L. theobromae* and *O. erysiphoides* f. sp. *ziziphi* on leaves of BAU Kul, Apple Kul and BARI Kul-1 was statistically similar. Prevalence *C. gloeosporioides* on leaf samples of BAU Kul and BARI Kul-1 was statistically similar and significantly lower compared to the variety Apple Kul. Statistically similar but prevalence of *F. semitectum* was recorded from the leaf samples of two Jujube varieties, BAU Kul and Apple Kul, which significantly higher compared to BARI Kul-1. Among three Jujube varieties, occurrence of *P. palmarum* on Apple Kul was comparatively low but the difference was significant compared to only BAU Kul (Table 2; Figure 4). Different symptoms caused by various fungal pathogens are presented in Figure 1-3.



**Figure 1.** Leaf symptoms caused by different fungi

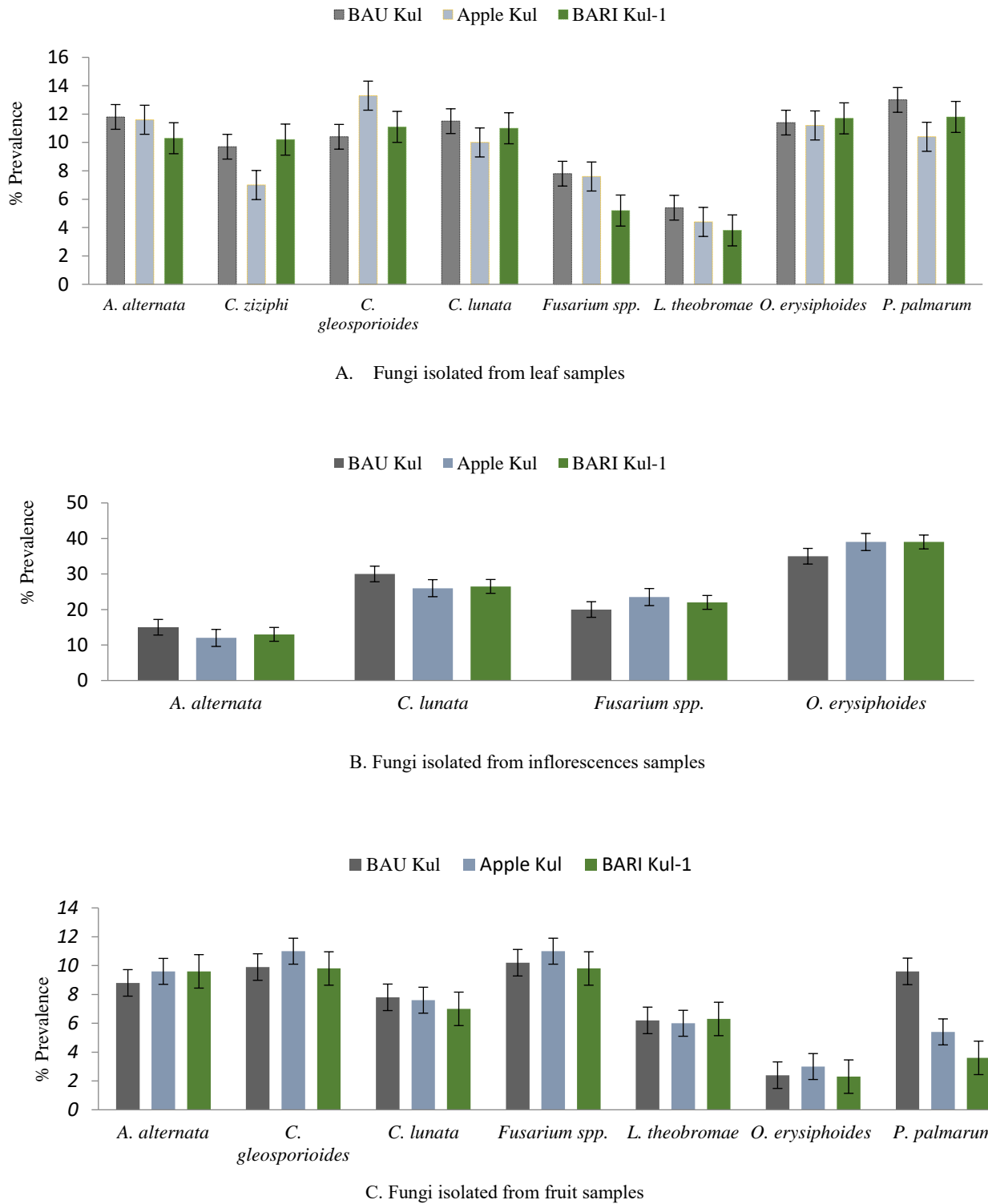


**Figure 2.** Symptom caused by gummosis/stem bleeding disease



**Figure 3.** Fruit symptoms caused by different fungi

Based on findings, it may be concluded that 16 fungal plant pathogens are associated with diseases of Jujube varieties in Bangladesh. Of them, *C. lunata*, *Fusarium semitectum*, *A. alternata*, *C. gloeosporioides*, *O. erysiphoides* f. sp. *ziziphi*, *Pestalotiopsis palmarum*, were the most predominant fungi. These findings are in accordance with the findings of other researchers (Madan and Gupta, 1976; Rai et al. 1982; Morton, 1987; Jamadar et al. 2009; Yuan et al. 2009). Among three varieties, BAU Kul was found as the most disease vulnerable variety followed by Apple Kul. In terms of fruit infection, BARI Kul-1 showed the second highest infection. Fungal pathogens associated with diseases of improved Jujube in Bangladesh were, leaf spots (*A. alternata*, *C. ziziphi*, *C. lunata*, *L. theobromae*, *M. ziziphina* and *Pestalotiopsis palmarum*), rust (*Phakopsora zizyphae-vulgaris*) fruit spot and fruit rot (*A. alternata*, *C. gloeosporioides*, *C. lunata*, *F. semitectum*, *L. theobromae*, *M. ziziphina*, *Nigrospora* sp., *P. palmarum*, *Phomopsis* sp.), powdery mildew (*Oidium erysiphoides* f. sp. *ziziphi*), sooty mould (*Capnodium* sp.), black mould or Isariopsis mould (*I. indica* var. *ziziphi*), and stem bleeding or gummosis (*P. palmarum*, *F. semitectum*, *C. lunata*) and fruit spot and rot disease (*A. alternata*, *Aspergillus* spp., *C. gloeosporioides*, *C. lunata*, *F. semitectum*, *L. theobromae*, *F. semitectum*, *Nigrospora* spp., *Penicillium* spp., *Phomopsis* spp., *P. palmarum*, *Rhizopus* spp.).



**Figure 4.** Prevalence of fungi isolated from diseased samples of leaf (A) inflorescence (B) and fruit (C) of three Jujube varieties

**CONCLUSION**

It may be concluded that 16 fungal pathogens were associated with diseases of improved varieties of Jujube in Bangladesh and identified diseases were leaf spots, leaf rust, fruit spot and fruit rot, powdery mildew, sooty mould, black mould or *Isariopsis* mould and stem bleeding or gummosis. Of the identified fungi, *C. lunata*, *Fusarium semitectum*, *A. alternata*, *C. gleosporioides*, *O. erysiphoides* f. sp. *ziziphi*, and *Pestalotiopsis palmarum* were the most predominant fungi. On the other hand, BAU Kul was found as the most disease

susceptible variety than Apple Kul but in terms of fruit infection, BARI Kul-1 showed the second highest infection.

**CONFLICT OF INTEREST**

The authors declare that there is no conflict of interests regarding the publication of this paper.

**REFERENCES**

Aneja KR. 2003. Experiments in Microbiology Plant Pathology and Biotechnology. Fourth Edition. New Age International

- Publishers. Ansari Road, Daryaganj, New Delhi-110002.607 pp.
- Barnett HL, Hunter BB. 1972. Illustrated Genera of Imperfect Fungi. Burgess publishing Company, Third edition. 237 pp
- Great Vista Chemicals 2004. Bioflavonoids (Vitamin P). In, Grewal, SS, Singh, G and Dhillon, WS. 1993. Effect of growth regulators on fruit drop and quality of fruit in ber (*Ziziphus mauritiana* Lamk). Punjab Horticultural Journal, 33(1/4): 76-83.
- Jamadar MM, Balikai RA, Sataraddi AR. 2009. Status of diseases on ber (*Ziziphus mauritiana* Lamarck) in India and their management options. Acta Horticulturae. (840): 383-390 (<http://www.actahort.org/books/840/84053.htm>).
- Kuliev AA, Guseinova NK. 1974. The content of vitamin C, B1, B2 and E in some fruits. Referativnyi Zhurnal, 2: 69-73.
- Madan RL, Gupta PC. 1976. Diseases of fruits from Haryana. II. Two new leaf spot disease of *Ziziphus mauritiana*. Indian Phytopathol. 29:328
- Morton J. 1987. Indian Jujube. In: Fruits of warm climates. 272–275p.[http://www.hort.purdue.edu/newcrop/morton/indian\\_jujube.html](http://www.hort.purdue.edu/newcrop/morton/indian_jujube.html)
- Nallathambi P, Umamaheswari C, Nath V, Pareek OP. 1999. Fungal colonization in processed fruits of ber. In: Proceedings of Fourth Agricultural Science Congress, Jaipur, 212 pp.
- Omar A, Abdul Wahid. 2001. Occurrence of *Colletotrichum anthracnose* disease of guava fruit in Egypt. International J. Pest Mgt. 47 (2):147-152.
- Quin GZ, Tian SP. 2004. Biocontrol of postharvest diseases of Jujube fruit by *Cryptococcus laurentii* combined with a low dosage of fungicides under different storage conditions. Plant Disease. 88(5): 497-501
- Rai RN, Arya, A, Lal, B. 1982. Pestalotiopsis rot of ber (*Ziziphus mauritiana*). Indian Phytopathol. 35: 709-710.
- Sharma MV, Majumder I, Sharma M. 1993. Some new postharvest diseases of ber fruits in India. Indian Phytopathol. 46:415
- Singh UP, Singh HS. 1979. Occurrence of *Fusarium decemcellulare* on living galls of *Ziziphus mauritiana* in India. Mycologia 70: 1126-1129
- Sutton BC. 1980. The Coelomycetes. Fungi Imperfecti with Pycnidia, Acervuli and Stromata. Commonwealth Mycological Institute. Kew, Surrey, England. 696 pp.
- Yuan GQ, Li QQ, Wei JG, Lai CY. 2009. Identification of the pathogens of different diseases of Yunnan Jujube *Zizyphus mauritiana*. South China Fruits (3): 57-59