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Study on the diseases of rose at Bangladesh Agricultural University campus

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ABSTRACT

Prevalence of diseases on rose was surveyed in five selected gardens location at the Bangladesh Agricultural University campus, Mymensingh. Altogether seven diseases were recorded during the survey. The diseases, in order of prevalence, were botrytis blight (*Botrytis cinera*), cercospora leaf spot (*Cercospora puderi*), rose mosaic (Rose Mosaic Virus), black spot (*Diplocarpon rosae*), die-back (*Botryodiplodia theobromae*), alternaria leaf spot (*Alternaria alternata*) and stem canker (*Crytosporella umbrina*). The incidence as well as the severity of the individual disease varied significantly of each other with respect to site of the flower garden and age of the plants. Of the seven diseases, except die-back cause by *B. theobromae*, six other diseases have been reported from different parts of the world. Thus, die-back of rose recorded in the present study appears to be a new world record of rose disease. Furthermore, among the seven diseases encountered in the present study, only black sport caused by *D. rosae* was reported earlier from Bangladesh. Thus, six diseases namely alternaria leaf spot, botrytis blight, cercospora leaf spot, die-back, rose mosaic and stem canker are being reported as new disease of rose in the country.

Introduction

Rose (*Rosa spp.*) is one of the nature's beautiful creations and is universally acclaimed as the Queen of flowers. No other flower is a better symbol of love, adoration, innocence, and other virtues than the rose and not in our time only but also it has been for thousands of years. The rose because of its utility occupies a prominent place amongst the flower crops and is one of the oldest of fragrant flowers to be cultivated by man. It is different types having beautiful flowers of exquisite shape, different sizes, bewitching colors and most delightful fragrance has made it an important flower for its varied uses. The interest in its cultivation, however, increased considerably mainly during the last three decades and at present it has become one of the most important commercial flowers. As a result of great demand for the flower, rose nurseries have been established in and around the big cities and the area under rose cultivation is increasing steadily. In fact, rose cultivation has great prospect for earning foreign exchange by exporting the commodity.

Among the various constraints which limit rose cultivation, various diseases play an important role. More than 40 different diseases are known to occur on roses in the world (USDA, 1960; Langhans, 1987; Cobb et al. 1978; Pal, 1972; Talukdar, 1974; Anonymous, 2001). United States Department of Agriculture listed 30 diseases on roses from United States of America (USDA, 1960). The important diseases listed in USDA compilation were hairy root (*Agrobactorium rhizogenes*), crown and stem gall (*Agrobactorium tumefaciens*), leaf spot (*Alternaria spp., Cercospora spp.*), root rot (*Armillaria mellea, Clitocybe tabescens*), canker and die-back (*Botryosphaeria ribis, Diplodia spp., Griphosphaeria corticola*), canker (*Cryptosporium minimum*), black spot (*Diplocarpon rosae*), blossom blight (*Dorhiorella spp.*), twig and cane blight (*Gloeosporium spp.*), downy mildew (*Peronospora sparsa*), rust (*Phragmidium spp.*), powdery mildew (*Phyllactinia guttata, Sphaerotheca spp.*), anthracnose (*Sphaceloma rosarum*), wilt (*Verticillium spp.*), mosaic (virus), streak (virsus), chlorosis (mineral deficiency) and crinkle (virus like organism).

Disease research on roses has been reviewed in "A manual For Greenhouse Rose Production" by Langhans (1987). It has also been critically reviewed on black spot (Baker & Dimock, 1987), mildew (Dimock et al., 1987), bacterial diseases and nematodes (Horst, 1987), root and stem diseases (Nelson & Nichols, 1987), foliar diseases (Nichols & Nelson, 1987), virus and virus like diseases (Romaine & Horst, 1987). In rose, research on disease and environmental interaction and control has been reported by Cobb et al. (1978), Marois et al. (1988, 1989) and Powell & De Long (1990). Important diseases of roses reported from India are die-back, powdery mildew, black spot, rust, stem blight and yellow mosaic virus (Pal, 1972).

Information on 14 diseases on rose has been obtained through Internet (Anonymous, 2001). The diseases are downy mildew, root rot, black spot, powdery mildew, rust, botrytis blight, cercospora spot of rose, rose brown canker and stem canker, verticillium wilt, crown gall, rose mosaic, alternaria leaf spot and spot anthracnose. Very little work has been done on diseases of rose in Bangladesh. Talukdar (1974) listed only three diseases namely black spot, leaf spot and powdery mildew on roses in his compilation 'Plant Disease in Bangladesh'. No other information is available about diseases of roses in the country. Therefore, a preliminary attempt has been made to survey the diseases occurring on roses in five

selected flower gardens location in the Bangladesh Agricultural University campus.

Materials and methods

Selection of flower gardens

Five flower gardens were selected for the survey of rose diseases around Bangladesh Agricultural University campus, Mymensingh, Bangladesh. These gardens were Horticultural farm flower garden, Bangladesh Institute of Nuclear Agriculture (BINA) campus flower garden, Liton nursery and agriculture centre (LNAC) flower garden, Jamal Hossain Hall (JHH) flower garden and Bangabondhu Sheikh Mujib Hall (BBSMH) flower garden. The age of the plants and total number of plants were recorded during the survey (**Table 1**).

Table 1. Age of the plants and total number of plants in selected five flower gardens.

Survey locations	Age of the plants (years)	Total number of plants
Horticultural farm flower garden	25	300
BINA campus flower garden	2.5	120
LNAC flower garden	1	40
JHH flower garden	8	60
BBSMH flower garden	1.5	50

Survey period

Survey was made during the period from June to September, 2005.

Method of survey

Each of the selected flower gardens was surveyed from time to time to find out the occurrences of each kind of disease. Foliar diseases of rose were surveyed from June to 15th August, stem disease of rose were surveyed from 16th August to 15th September, 2005. In each flower garden 10 infected plants were randomly selected for determining disease incidence and disease severity. For disease incidence of foliar diseases of rose, 10 infected plants were randomly selected. For one plant 30 compound leaves (from three branches) from the middle portion of the plant were included to record the disease incidence. Diseased leaves were counted from 30 compound leaves for disease incidence and finally it was expressed in percentage. The disease incidence of foliar diseases was determined by the following formula.

$$\text{Disease incidence (leaves)} = \frac{\text{No.of disease leaves}}{\text{No.of total leaves}} \times 100$$

In case of stem disease of rose, 10 infected plants were selected randomly. For one plant 8 stems were selected, from them diseased stems were selected and disease incidence was determined by the following formula.

$$\text{Disease incidence (stem)} = \frac{\text{No. of diseased stems}}{\text{No. of total stems}} \times 100$$

For flower disease of rose, 10 infected plants were randomly selected. From one plant 8 flowers were selected and from them diseased flowers were selected and disease incidence was determined by the following formula.

$$\text{Disease incidence (flower)} = \frac{\text{No. of diseased flowers}}{\text{No. of total flowers}} \times 100$$

In case of disease severity 10 infected plants were randomly selected from each flower garden for foliar, stem and flower disease of rose. For foliar, stem and flower diseases of rose, disease severity was determined by the following formula.

$$\text{Disease severity (leaves or stem or flowers)} = \frac{\text{Leaves or stem or flowers area diseased}}{\text{Total leaves or stems or flowers}} \times 100$$

Leaf area diseased, stem area diseased and flower area diseased were measured by eye estimation following disease rating scales and then summations of each area diseased, stem area diseased and flower area diseased in each plants were made. Total area of a compound leaf/stem/flower was considered as 100%.

Observation of the symptoms

A disease was recorded by observing the symptom(s). Symptoms of a disease were studied by visual observations. Sometimes 10x hand lens was used for critical observation of symptoms of the disease. A disease was identified based on matching the observed symptoms in the infected plants with the symptoms published in rResources.com Identification Guides (Anonymous, 2001). Identify of all the fungal diseases were finally confirmed by identification of the associated fungal organisms through isolation. Rose mosaic virus disease was identified based only on symptoms (as there were no facilities available for identified based on symptoms as the pathogen of the disease could not be isolated.

Isolation, purification and identification of the casual organisms

Isolation of casual organisms by moist blotter method
The pathogen associated with the diseased plant parts (leaf, stem and flower) were cut into several pieces by scissors and placed on the moist filter paper (Whatman No. 1). The filter papers were moistened by dipping in sterile water. The petri dishes with the plated inocula (diseased specimens) were incubated at 22± 2 ºC under 12/12 hour alternating cycles of NUV and darkness in the incubation room of the Seed pathology Center (SPC) for three to five days. After incubation, the plates were examined under stereomicroscope for primary identification of the fungal organisms. The fungi which did not sporulate on filter paper along with the sporulating ones were transferred to PDA plates for proper sporulation and purification.

Isolation of casual organisms by agar plate method
Inocula prepared from the diseasesed plant parts were surface sterilized by dipping them in 0.001% $HgCl_2$ solution or 2% NaOCl solution for 1.5 minutes. In case where surface sterilizatoin was performed with $HgCl_2$ solution, the inocula were washed three times with sterile water. Inocula, thust sterilize were placed on PDA (Potato = 17 g, Dextrose = 17 g, Agar = 17-20 g, water = 10000 ml) plates aseptically. The plates were incubated at 28 ±1 ºC for several days and examined daily for any fungal growth.

Purification of the isolated organism
The fungi which grew out of the innocula where transferred to PDA plates from where subcultures were

made by transferring single hyphal tip following the techniques use by Riker and Riker (1921). On PDA media *C. puderi* did not sporulate and for that matter it was not subcultured.

Identification of the pathogen
Slides were prepared directly from the diseased specimens and observed under compound microscope for identification of the associate organisms. Attempts were also made to identify the fungal organisms grown out of the inocula incubated in sterile wet filter paper by observing their growth characteristics under stereomicroscope (Mathur & Kongsdel, 2003). The fungal organisms cultured on PDA media were also identified under compound microscope following the keys of Govindu & Thirumalachar (1954), Barmett & Barry (1972), Ellis (1971) and Mathur & Kongsdel (2003).

Pathogenicity test

Pathogenicity test was conducted with the five fungi isolate from the leaves, stems, and flowers of rose. The five fungi used for inoculation were Alternaria alternata, Diplocarpon rosae, Cercospora puderi isolated from the leaves, Botrydiplodia theobrome islolated from the stem and Botrytis cinera isolated from the flowers. Inoculations of leaves with spores/ conidiophores/ micelial suspension were done using the following steps.

Preparation of spores/mycelial suspension
To prepared the inocula suspension of the two fungi *Alternaria alternata* and *Diplocarpon rosae*, spores of seven days old culture of their two fungi grown on PDA separately were harvested by rinsing with sterilized water. The fungal colonies were gently rubbed by a clean brush to float the conidia for a better harvest. The suspensions were sieved to removed micelial segmemnts and lumps of agar for each of these two fungi. Inocula suspension of *C. puderi* was prepared from the mycelial, conidiophores and conidial growth of the fungus grown out of the diseased specimens (inocula) placed on the wet filter paper in petridish for isolation. The fungal inocula suspension was used to inoculate the leaves without sieving. The concentrations of the suspension was prepared to ten conidia (along with mycelia and conidiophores) per 20× microscopic filed.

Inoculation of leaves
One month old leaves of rose (grown after pruning) were inoculated by spraying spore and/or mecelial and conidiophores suspension of the respective test fungi with a hand automizer. Thus, 50 leaves in 5 plants (five leaves per plant from two branch) raised in the flower garden were incolated with each of the three test fungi. After inoculation the plants were covered with polythene bags. Frequent watering of the plant was done to maintain 90-100% relative humidity. After 48 hrs, the polythene bags were removed. The inoculated plants were examined after ten days of inoculation for probable symptoms produced by the respective test fungus. Final records of lesion/spores produced were notated after 30 days of inoculation.

Preparation of mycelial block
Mycelial block of 1.5 mm diameter was cut with a sterilized cork borer from the edge of the 5 day old colony of the fungus, *B. theobromae* grown on PDA such block containing growing virulent hyphae of the test fungus were used for inoculation.

Inoculation of stems
One month old stems of rose plants (after pruning) were inoculated at the leaves axil bellow 5 cm from stem tip. The stem was first wounded by pricking with a sterile needle at the leaf axil. The 1.5 m diameter mycelia block was placed at the wounded stem. Thus, 20 stems in 5 plants (4 stems per plant) raised in the Horticulture Garden were inoculated with *B. theobromae*. After inoculation the plants were covered with polythene bags. Frequent watering of the plant was done to maintain 90-100% relative humidity. After 48 hrs, the polythene bags were removed. The inoculated plants were examined after 10 days of inoculation and continued for one month for development of probable symptoms by the test fungus. Lesions produced after one month of inoculation was measured in mm.

Preparation of spores and mycelia suspension
Spores and mycelia suspension of *B. cinera* was prepared from five days old culture of the fungus. The inoculums of the test fungus was prepared following the same techniques used for the three test fungi used for inoculation of leaves (described under previous section).

Inoculation of flowers
Ten buds and 10 flowers in five rose plants (2 buds and 2 flowers per plant) were inoculated by spraying spores suspension of the test fungus *B. cinera* with the help of an atomizer. After inoculation the plants were covered with polythene bags. Frequent watering of the plant was done to maintain 90-100% relative humidity. After 48 hrs, the polythene bags were removed. The inoculated buds and flowers were examined after 7 days of inoculation for development of probable symptoms if any by the test fungus and continued for two weeks.

Re-isolation of the test fungi from the inoculated plant parts

The five fungi used for inoculation were re-isolated from the symptoms developed on the inoculated parts (leaf, stem, and flower) of the rose plant in order to confirm that the specific symptom(s) produced on the inoculated part was caused by the respective test fungus.

Statistical analysis

The data were analyzed following the randomized complete block design. The mean difference for efficiency of the treatments was judged by least significant difference (LSD) test.

Results

Altogether seven diseases were recorded on rose plant in five flower gardens located at BAU campus. The recorded diseases were – alternaria leaf spot, black spot, botrytis blight, cercospora leaf spot, die-back, rose mosaic, and stem canker. Symptoms observed for each disease along with the respective identified pathogen (wherever possible) are given bellow:

Table 2. Incidence and severity of alternaria leaf spot of rose in five flower gardens at BAU campus.

Survey locations	Incidence (% leaf infection)	Severity (% leaf area diseased)
Horticultural farm flower garden	30.70 a	6.96 ab
BINA campus flower garden	31.23 b	6.17 b
LNAC flower garden	29.25 b	6.23 b
JHH flower garden	30.74 b	6.51 b
BBSMH flower garden	31.03 b	7.35 a
CV (%)	6.80	14.74

Table 3. Incidence and severity of black spot of rose in five flower gardens at BAU campus.

Survey locations	Incidence (% leaf infection)	Severity (% leaf area diseased)
Horticultural farm flower garden	51.10 a	18.42 a
BINA campus flower garden	48.54 b	16.90 b
LNAC flower garden	46.98 b	16.56 b
JHH flower garden	51.74 a	17.56 ab
BBSMH flower garden	48.30 b	17.14 b
CV (%)	64.29	7.40

Table 4. Incidence and severity of cercospora leaf spot of rose in five flower gardens at BAU campus.

Survey locations	Incidence (% leaf infection)	Severity (% leaf area diseased)
Horticultural farm flower garden	66.34 a	26.90 a
BINA campus flower garden	64.69 ab	20.80 b
LNAC flower garden	63.05 b	20.70 b
JHH flower garden	66.10 a	21.35 b
BBSMH flower garden	64.89 ab	22.70 b
CV (%)	3.49	9.53

Alternaria leaf spot (*Alternaria alternata*)

At first small dot like structures were found on the leaf surface and later the spots became larger and changed from yellow-brown to dark-brown. Spots enlarged to show concentric ring on the ridges (**Fig. 1A**).

The incidence of alternaria leaf spot varied significantly from 29.25-34.70% with respect to flower garden surveyed. The highest incidence (34.70%) was recorded at Horticulture farm, followed by BINA flower garden (31.23%); while the lowest incidence (29.25) was found at LNAC flower garden. The survey of alternaria leaf spot on rose varied significantly from 6.17-7.35 with respect to flower garden. The highest severity (7.35%) was recorded at BBSMH flower garden followed by Horticulture farm; while the lowest severity (6.17%) was found at BINA flower garden (**Table 2**).

The pathogen isolated and identified from the diseased leaves was identified as *Alternaria alternata* (**Fig. 1B**). On artificial inoculation, the fungus produced identical alternaria leaf spot symptoms on the inoculated leaves of the flower plants as observed in the leaves of the growing plants in the gardens surveyed. Such symptoms were produced on 20 leaves out of 50 inoculated leaves in 5 plants. One to two such spots were produced on each leaflet. The pathogen *Alternaria alternata* was reisolated from diseased symptoms produced in the inoculated leaves.

Black spot (*Diplocarpon rosae*)

Circular black spots with fringed margins were found on the upper surface on leaves. As the spots enlarge or increase in number, infected leaves turn yellow around the spot and leaves may drop (**Fig. 1C**).

The incidence of Black spot varied significantly from 46.98-51.74% with respect to flower gardens. The highest incidence (51.74%) was recorded at JHH flower garden followed by Horticulture farm (51.10%), BINA flower garden (48.54%), while the lowest (46.98%) incidence was found at LNAC flower garden. The severity of this disease recorded varied significantly from 16.56-18.42% with respect to flower garden. The highest severity (18.42%) was recorded at Horticulture farm followed by JHH flower garden; while the lowest (16.56%) severity was found at LNAC flower garden (**Table 3**).

The pathogen isolated and identified was *Diplocarpon rosae* (**Fig. 1D**). On artificial inoculation, the fungus produced identical Black spot symptoms on the inoculated leaves of the flower plants as observed in the leaves of the growing plants in gardens surveyed. Such symptoms were produced on 27 leaves out of 50 inoculated leaves in 5 plants. One to two such spots were produced each leaflet. The pathogen *D. rosae* was reisolated from diseased symptoms produced in the inoculated leaves.

Cercospora leaf spot (*Cercospora puderi*)

A few to several circular spots (1-4 mm in diameter) was found to appear on the upper surface of leaflets. The mature spots coalesced to form irregular larger spots. The color of the spots was usually purplish or reddish brown with pale brown tan, or gray centres (**Fig. 1E**).

The incidence of cercospora leaf spot varied significantly from 63.05-66.34% with respect to flower garden. The highest was recorded at Horticulture farm followed by JHH flower garden, while the lowest incidence was found at LNAC flower garden. The severity of this disease also varied significantly from 20.70-26.90% with respect to flower garden. The highest severity was recorded at Horticulture farm followed by BBSMH flower garden, while the lowest severity was found at LNAC flower garden (**Table 4**).

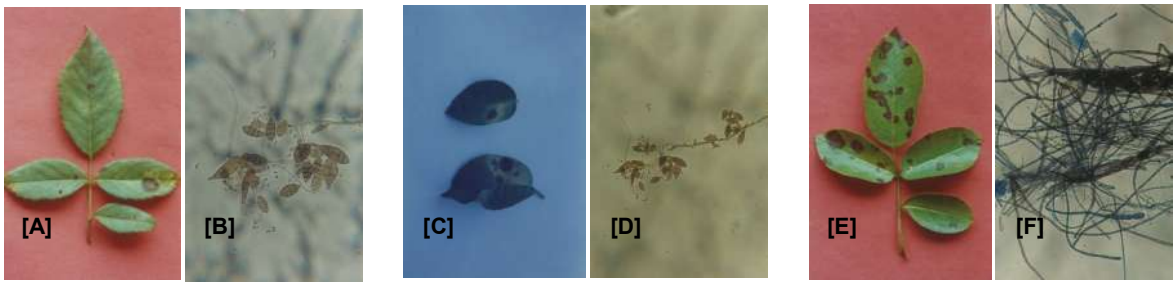

Fig. 1. Diseases of rose plant, [A]. Alternaria leaf spot, [B] Conidia of *Alternaria alternate* (× 400), [C] Black spot, [D] Hyphae with conidia of *Diplocarpon rosae* (× 200), [E] Cercospora leaf spot, [F] Conidia and conidiophores *Cercospora puderi* of (× 200).

The pathogen identified was *Cercospora puderi* (**Fig. 1F**). On artificial in, the fungus produced identical cercospora leaf spot symptoms on the inoculated leaves of the flower plants as observed in the leaves of the growing plants in the garden surveyed. Such symptoms were produced on 32 leaves out of 50 inoculated leaves in 5 plants. One to two such spots were produced on each leaflet. The pathogen *C. puderi* was reisolated from diseased symptoms produced in the inoculated leaves.

Botrytis blight (*Botrytis cinera*)

At first the margin of the petals were found infected then the whole plants were affected resulting blight symptoms. At the severe cases the flowers got rotted. Leaf brown blight symptoms were also observed on flower buds (**Fig. 2 A & B**). The incidence of Botrytis blight varied significantly from 76.12-83.90% with respect to flower garden. The highest incidence (83.90%) was recorded at Horticulture farm followed by BINA flower garden (78.26%), JHH flower garden (77.75%), while the lowest (76.12%) incidence was found at BBSMH flower garden. The severity of this disease varied significantly from 53.30-62.90% with respect to flower garden. The highest severity was recorded at Horticulture farm followed by BINA flower garden (55.00%), JHH flower garden (54.40%), while the lowest severity was found at LANC flower garden (**Table 5**).

The pathogen identified as *Botrytis cinera* (**Fig. 2C**). On pathogenicity test the fungus produced identical symptoms as observed on the flowers of the growing rose plants surveyed in the garden. In the pathogenicity test, 7 buds out of 10 and 8 flowers out of 10 were found infected. The fungus *B. cinera* was isolated from the inoculated flower parts confirming that the symptom was produced by the reisolated fungus from the Botrytis blight affected flowers and buds.

Die-back (*Botryodiplodia theobromae*)

Die-Back caused the death of branch or twig of the plant from top to downward. It starts as brown lesion from the pruned surface of the twig. The diseased twigs turned black. The leaves on the infected twig dropped. In the advanced stage of the disease, the symptoms spread from the branch twig to the main stem, killing the whole branch (**Fig. 2D**). The incidence of die-back varied significantly from 30.24-37.03% with respect to flower garden. The highest incidence was found at Horticulture farm followed by JHH flower garden (32.22%), while the lowest incidence was found at LNAC flower garden (30.24%). The severity of Die-back varied significantly from 7.00-9.10% with respect to flower garden. The highest leaf area diseased (9.10%) was recorded at JHH flower garden followed by LNAC flower garden (7.4%), while the lowest (7.0%) severity was found at Horticulture farm (**Table 6**).

The pathogen identified was *B. theobromae* (**Fig. 2E**). On the pathogenicity test, *B. theobromae* was reisolated from disease symptoms produced in the inoculated leaves. Such symptoms were produced on 9 stems out of 20 inoculated stems in 5 plants.

Table 5. Incidence and severity of botrytis blight of rose in five flower gardens at BAU campus.

Survey locations	Incidence (% leaf infection)	Severity (% leaf area diseased)
Horticultural farm flower garden	83.90 a	62.90 a
BINA campus flower garden	78.26 b	55.00 b
LNAC flower garden	76.44 c	53.30 b
JHH flower garden	77.75 b	54.40 b
BBSMH flower garden	76.12 b	53.95 b
CV (%)	5.67	4.96

Table 6. Incidence and severity of die-back of rose in five flower gardens at BAU campus.

Survey locations	Incidence (% leaf infection)	Severity (% leaf area diseased)
Horticultural farm flower garden	37.03 a	7.00 b
BINA campus flower garden	31.20 b	7.30 b
LNAC flower garden	30.24 b	7.40 b
JHH flower garden	32.22 b	9.10 a
BBSMH flower garden	31.33 b	7.40 b
CV (%)	8.02	14.84

Stem canker (*Crytosporella umbrina*?)

Symptoms started with small purplish spot on growing stems. The spots then turned into white nectrotic area with purplish margin. The necrotic lesions enlarged and such lesions were found to coalesce to form larger cankerous lesion. The color turned purplish brown with dark depressed centre (**Fig. 2F**). The incidence of Stem canker varied significantly from 24.65-34.55% with respect to flower garden. The highest incidence was found at Horticulture farm (34.55%) followed by JHH flower garden (25.05%), while the lowest incidence was found at BINA flower garden (24.65%). The severity of Stem canker varied significantly from 6.20-7.50% with respect to flower garden. The highest severity of stem canker (7.50%) was recorded at BBSMH flower garden followed by Horticulture farm flower garden (7.20%), while the lowest (6.20%) severity was found at BINA flower garden (**Table 7**).

The pathogen could not be isolated neither on PDA nor on wet filter paper in petri dish. A no fruiting body was formed on the cankerous lesion; the fungus could not be detected on the prepared slide out of the diseased stem tissue under the compound microscope.

Rose mosaic (Rose Mosaic Virus?)

Rose mosaic was characterized by yellow or whitish chlorotic lines, rings, mottles or netlike mosaic patterns on the foliage (**Fig. 2G**). The incidence of Rose mosaic varied significantly from 50.89-57.15% with respect to flower garden. The highest incidence was recorded at BBSMH flower garden followed by BINA flower garden (53.15%) and Horticulture farm flower garden (53.08%), while the lowest incidence was found at LNAC flower garden. The severity of Rose mosaic varied significantly from 17.60-25.40% with respect to flower garden. The highest severity was recorded at Horticulture farm flower garden followed by JHH flower garden (18.50%) and BBSMH flower garden (18.40%), while the lowest severity was found at BINA flower garden (**Table 8**).

As the rose mosaic is a viral disease, its pathogen could not be isolated and detected due to lack of proper facilities available in the Department of Plant Pathology, BAU.

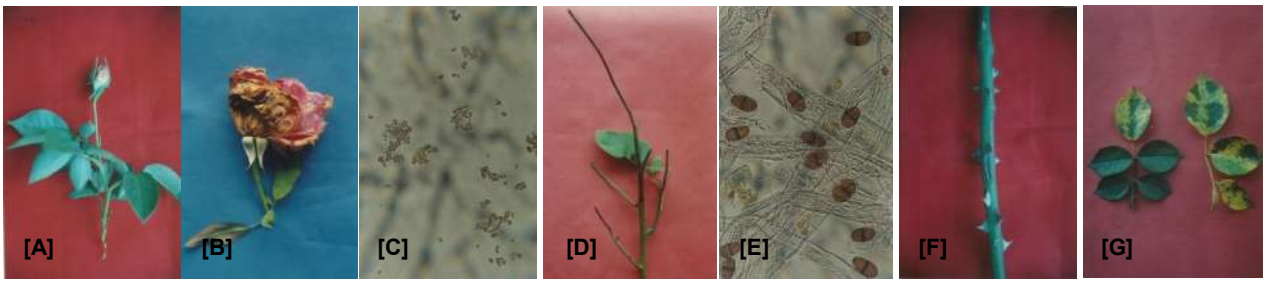

Fig. 2. Diseases of rose plant, [A]. Botrytis blight (bud), [B] Botrytis blight (flower), [C] Conidia of *Botrytis cinera* (× 400), [D] Die-back, [E] Conidia of *Botryodiplodia theobromae* (× 400), [F] Stem canker, [G] Rose mosaic.

Table 7. Incidence and severity of stem canker of rose in five flower gardens at BAU campus.

Survey locations	Incidence (% leaf infection)	Severity (% leaf area diseased)
Horticultural farm flower garden	34.55 a	7.20 ab
BINA campus flower garden	24.65 b	6.20 b
LNAC flower garden	24.90 b	6.20 b
JHH flower garden	25.05 b	6.20 b
BBSMH flower garden	25.10 b	7.50 a
CV (%)	5.75	16.39

Table 8. Incidence and severity of rose mosaic of rose in five flower gardens at BAU campus.

Survey locations	Incidence (% leaf infection)	Severity (% leaf area diseased)
Horticultural farm flower garden	53.08 b	25.40 a
BINA campus flower garden	53.15 b	17.60 b
LNAC flower garden	50.89 c	18.40 b
JHH flower garden	51.53 bc	18.50 b
BBSMH flower garden	57.15 a	18.40 b
CV (%)	4.16	9.55

Prevalence of diseases recorded in five flower gardens

Of the seven diseases recorded in the five selected flower gardens, the most predominant disease was botrytis blight followed by cercospora leaf spot, rose mosaic, black spot, die-back, alternaria leaf spot and stem canker (**Table 9**).

Table 9. Prevalence of seven different diseases recorded on rose in selected five flower gardens at BAU campus.

Rose diseases	[z]Average disease incidence (%)	[z]Average disease severity (%)
Altenaria leaf spot	31.39	6.64
Black spot	49.33	17.31
Botrytis blight	78.49	55.91
Cercospora leaf spot	65.01	22.49
Die-back	32.40	7.64
Rose mosaic	53.16	19.66
Stem canker	26.85	6.66

[z]Average was made based on the data recorded in five flower gardens.

Discussion

In the present survey seven diseases were recorded on rose in selected five flower gardens located in BAU campus, Mymensingh. The recorded diseases were alternaria leaf spot, botrytis blight, cercospora leaf spot, black spot, die-back, rose mosaic and stem canker. Five fungal pathogens viz., *Alternaria alternata, Diplocarpon rosae, Botrytis cinera, Cercospora puderi, and Botryodiplodia theobromae* were detected in as the causal organisms of alternaria leaf spot, black spot, botrytis blight, cercospora leaf spot and die-back, respectively. Of these five fungal diseases of rose, four except die-back caused by *B. theobromae* have been reported earlier from different countries by different researcher (USDA, 1960; Pal, 1972; Nicholas & Nelson, 1987; Marois et al., 1988; Anonymous, 2001).

No pathogen could be isolated from the infected tissues of the two diseases such as stem canker and rose mosaic. Literature shows that stem canker is a fungal disease caused by *Crytosporella umbrina*. The disease has been reported from different rose growing areas including USA and India (USDA, 1960; Pal, 1972; Anonymous, 2001). Though no pathogen could be isolated and identified from the stem canker disease, symptoms of the stem canker observed in the present study were identical to those published in the Rose Disease Identification Guides (Anonymous, 2001). Thus, it may be inferred that stem canker encountered in rose in the present study may be the same stem canker disease caused by the fungus *C. umbrina* reported elsewhere (Anonymous, 2001).

Rose mosaic caused by rose mosaic virus has been reported from different rose growing countries of the world (USDA, 1960; Romaine & Horst, 1987; Anonymous, 2001). Rose mosaic recorded in the present survey was identified symptomatologically through consultation of published literature (Bose & Yadav, 1998; Anonymous, 2001). Thus, there is a need for confirmation of the identity of this disease through critical virus identification techniques including electron microscopy.

Of the seven diseases recorded on rose in the present survey, all the diseases except die-back have been reported from different countries outside Bangladesh. Among the seven diseases, only black spot caused by *D. rosae* was reported earlier from Bangladesh by Talukdar (1974). He also reported a leaf spot caused by *Cercospora* sp. In the present survey cercospora leaf spot caused by *Cercospora puderi* has been observed. As Talukdar (1974) did not identify the *Cercospora* to species level, the cercospora leaf spot caused by *C. puderi* encountered in the present study could be considered as a different disease. Thus, the six diseases viz. alternaria leaf spot (*A. alternata*), botrytis blight (*B. cinera*), cercospora leaf spot (*C. puderi*), die-back (*B. theobromae*), rose mosaic (Virus?) and stem canker (*C. umbrina*) appears to be new records for rose diseases in Bangladesh.

The seven diseases recorded in the present study, in order of prevalence, were botrytis blight, cercospora leaf spot, rose mosaic, black spot, alternaria leaf spot, die-back and stem canker. So botrytis blight was the most predominant disease encountered on rose in the present study. On an average, the disease caused 78.49%, 55.91% plant infection and plant area diseased, respectively. Jorgensen (1992) reported botrytis blight as the major disease of rose in Denmark. Bar et al. (2001) also observed that cut rose flower at the post harvest stage was seriously affected by Botrytis blight.

The average disease incidence and disease severity of the seven recorded diseases in the selected five flower gardens varied from 26.85-78.49% and 6.64-55.91%, respectively depending on the individual disease, site of the flower garden and age of the rose plants. Such variation in the prevalence of diseases depending on the location or site and age almost a common phenomenon in outbreak of most plant disease in nature.

Among the five fungi, *A. alternata*, *D. rosae*, and *C. puderi* caused characteristics leaf spot symptoms on the leaves of rose. *B. cinera* caused characteristics blight symptom (0.8-1.2 cm long and 0.2-0.4 cm wide) on the bud and flower of rose. *B. theobromae* caused characteristics elongated black lesions (0.5-1.0 cm long and 1.0-2.0 cm wide) on the inoculated stem. Thus from the pathogenicity, it appears that all the five test fungi are pathogenic to rose.

World literature reveals that more than 40 different diseases occur on rose. The present limited study carried out in the selected five rose gardens of BAU campus showed that seven different diseases can outbreak on rose. But as the study was in a limited scale, this may not be the exact picture of the disease situation of the country. Therefore, further comprehensive study on the prevalence of disease on rose in a greater number of gardens in different parts of Bangladesh needs to be carried out.

Conclusion

Out of seven diseases encountered in the present survey, only black spot cause by *D. rosae* was reported earlier from Bangladesh. Thus six diseases, viz., alternaria leaf spot, black spot, botrytis blight, cercospora leaf spot, die-back, rose mosaic and stem canker are

being recorded as new diseases of rose in the country. These six diseases of rose also reported from different countries of the world. Therefore, die-back of rose caused by *B. theobromae* appears to be a new record for rose in the world.

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