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SEVERITY AND INTENSITY OF FUNGAL DISEASES OF CUCURBIT CROPS OF HAMIRPUR REGION, HP, INDIA

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ABSTRACT

Cucurbitaceae is the vegetable family enriched with numerous vitamins and minerals. In early rainy season cucurbits are the host of different fungal pathogens. In present study, four fungal diseases dominant on three members of cucurbitaceae family are observed in Bhoranj block of District Hamirpur, lie in lower foot hills of Himachal Pradesh. Four fungal diseases along with host plants are leaf spot of *Lagenaria siceraria,* downy mildews of *Cucumis sativus,* powdery mildews of *Coccinia grandis* and powdery mildews of *Cucumis sativus.* Among all these diseases, Disease Incidence and Disease Severity of Powdery mildews of *Coccinia grandis* are most dominant i.e. 40.3±1 and 51.2±1 respectively. Disease Incidence and Disease Severity of Leaf spot of *Lagenaria siceraria* is least i.e. 12.5±1 and 1.1±1, respectively.

***Keywords*:** Disease Incidence; Disease Severity; Fungal Pathogens; Lower Foot Hills.

INTRODUCTION

Plants are the real wealth of living beings. Survival and existence of living beings is completely dependent on plants. Cereal crops, vegetable crops, fruit crops and fodder crops etc are the known cash crops of the villagers, as these plants are the valuable source of villager's income. In these, the vegetables are one of the common crops. Further, cucurbitaceae family plays an important role and account 5.6% of total vegetable production in India (Meena *et al*., 2019). This includes more than 118 genera with 825 species (Lebeda *et al*., 2007). Different vegetable crops like *Cucumis* sp., *Cucurbita* sp., *Luffa* sp., *Lagenaria* sp. are quite efficient in nutritional value as well as income point of view. Cucurbit plants contain vitamins, minerals and these are good source of various macromolecules (Watt & Merrill, 1963). Further the production of squashes, pumpkins and guards was 55.7 million tons, cucumber and gherkins was 19.6 million tons in 2018 (Food and Agricultural Organization, 2019). Various environmental conditions, living factors, improper cultivation and inappropriate control strategies are responsible for low crop yield. Among all these drastic factors, living factors like insects, weed plants, bacteria, fungi and viruses also play an important role in crop yield. Diseases are the major factor associated with economic loss of crop and leads to food insecurity. Nearly 20-40% of crop yield losses are caused by the biotic factors at global level and fungal pathogens are responsible for 30% of crop diseases (Anderson *et al*., 2004; Oerke *et al*., 1994; Oerke, 2006). Assessment of plant diseases include the amount of disease present in particular field, up to how much extent it can spread and leads to damage of crops. Crop diseases assessment leads to the measure of diseases at pre harvesting time, which further leads to assessment of crop loss during post harvesting time (Savary *et al*., 2012). Crop loss assessment is an effective strategy for delivery of management to benefit the masses like farmers, society and consumers. In 20th century, the agricultural researches are focused on increasing crop productivity to meet the future food need for rapidly increasing population (Nellemann *et al*., 2009). Keeping this in view the present study aims at (1) To survey and collect the diseased samples of cucurbitaceae (2) To measure the disease incidence and severity of members of family cucurbitaceae. (3) To isolate and identify the plant pathogen.

MATERIALS AND METHODS

Study Area:

Himachal Pradesh is one of the major fruit and vegetable growing region of India in Asia. Bhoranj Block of District Hamirpur (Himachal Pradesh, India) was selected as study area for present research, which includes Amroh, Badehar, Dhirad, Garsahar, Paplah, Hanoh, Kakkar, Bhoranj, Dhamrol, Manvain and Jahu panchayats (Fig. 1) Study area lies at 738 m and average temperature ranges from 6ºC to 39ºC (Chander *et al*., 2017).

Survey and Sampling : Survey was conducted at different fields in the early rainy season during year 2019-2020. Survey was conducted by questioner method as well as by direct interviews of villagers. Some of the questions of questioner include about:

(i) Name to host plant (ii) Type of host plant on the basis of origin, Life span (iii) Habit of plant (iv) Condition of host plant during survey (v) Plant part infected (vi) Symptoms of infection of plant on the basis of morphology and development of plant part (vii) Color and special features in infected plant part.

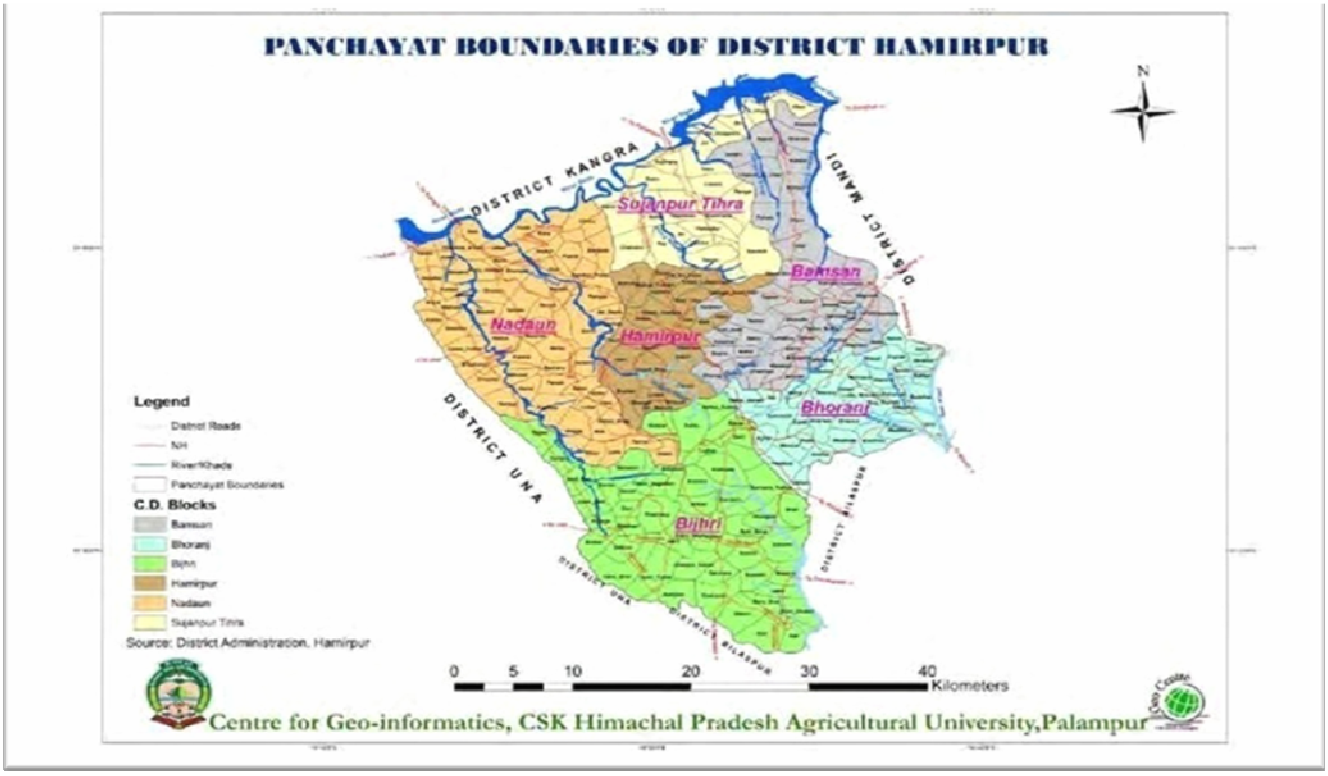

Fig. 1: Study area

Mostly aged people and professional farmers were asked during the interview. For selecting these categories of informants a preliminary survey was carried out before final survey. Final informants were selected on the basis of pilot survey. Diseased Plant parts were collected randomly by moving diagonally as well as by moving W shaped pattern in fields. Standard quadrates were placed in the field and each quadrate was assessed. Main purpose of survey was to know about the geographical distribution of fungal pathogens of cucurbits, to assess the rate of spread of pathogen and presence of other hosts of pathogens.

Assessment of Disease incidence and Severity : For the assessment of disease incidence quadrates of equal size were placed in the field. Number of affected plants, number of unaffected plants and total number of plants in each quadrate was calculated. Further disease incidence was calculated by the method of James (1974). Disease assessment keys were followed for calculating disease severity. Disease keys were also produced for each crop by the supervision of whole disease cycle of the crop plants (Gollifer & Brown, 1974; Carnegie *et al*., 1994). Affected leaves were matched with Key and grades were provided (British Mycological Society, 1948). Further severity was calculated the methods of James (1971) and Neufeld *et al.* (2013). Whole sampling regarding disease incidence and disease severity was performed in triplet form. Mean average of three values was considered for final reading of assessment of disease incidence as well as for disease severity.

Isolation and Identification of Pathogen : Free hand sections of infected leaves were cut, stained with Lectophenol and observed under light microscope by adhesive tape method (Correll *et al*., 1987). Before isolation of fungi, affected sample portion was dipped in to 0.1% solution of mercuric chloride for three to five minutes for removing extra impurities and for surface sterilization (Mekonnen *et al.*, 2013). Further culturing was carried out on Potato Dextrose Agar medium (Tsao and Guy, 1977; Torres-Andrade *et al*., 2019). Petriplates were incubated in dark at 27ºC (Reddy *et al*. 2014). Color, growth and growth pattern of fungal culture were observed and matched with the earlier published literature (Alsohaili & Bani-Hasan 2018). Isolated fungi was further stained with cotton blue and different morphological features like spores, conidia, hyphae and conidiophores were observed at 100X and matched with authentic literature, with the characters earlier published in research papers for final identification (Swada, 1931; Runge & Thines, 2009; Gaddeyya *et al*., 2012; Alsohaili & Bani-Hasan, 2018).

RESULTS

Total four diseases were identified in the family cucurbitaceae in early rainy season. Diseases were observed on foliar part of plants and cause of all the foliar diseases was the fungus of different types. Total three host plants were surveyed and observed i.e. *Lagenaria siceraria, Cucumis sativus*, *Coccinia grandis* from different panchayats of Bhoranj block. Leaf spot of *Lagenaria siceraria*, Downy mildews of *Cucumis sativus*, Powdery mildews of *Coccinia grandis* and Powdery mildews of *Cucumis sativus* were observed for assessment. Fungal Pathogens responsible for Leaf spot of *Lagenaria siceraria* was *Alternaria alternata (*Pleosporaceae), Downy mildews of *Cucumis sativus* was caused by *Pseudoperonospora cubensis* (Peronosporaceae), Powdery mildews of *Coccinia grandis and Cucumis sativus* was caused by *Golovinomyces orontii and Podosphaera xanthii* (Erysiphaceae) respectively.

In this Disease incidence and disease severity was measured for each disease. It was found to be 12.5, 26.8, 40.3

and 14.3 respectively in *L. siceraria* (Leaf spot), *C. sativus* (Downy mildew), *C. grandis* (Powdery mildew) and *C. sativus* (Powdery mildew). The results have been represented in Fig. 2.

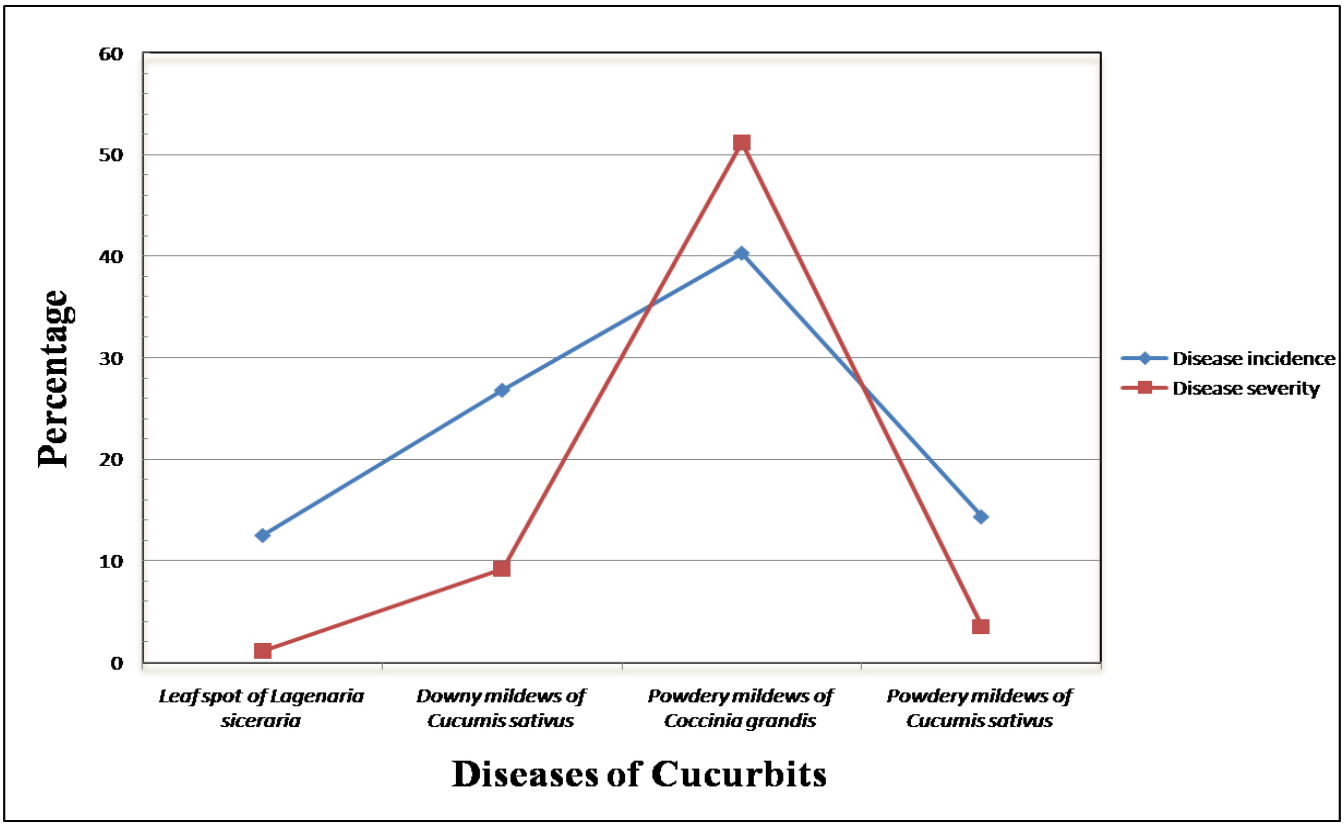

Fig. 2: Disease severity and Disease incidence

Description of Diseases:

Leaf Spot of *Lagenaria siceraria* (Molina) Standl.

Symptoms: In early stage of disease development small yellow colored spots appear on upper surface of leaf which later on turned in to brown spots to form necrotic area. Irregular brown spots are also surrounded by pale colored crown like structures. Later on stages brown spots having concentric rings of variable shapes spread on most of the area of leaf. Finally drying of leaf occurs.

Fungal growth characteristics: Leaf blight disease of bottle guard is caused by *Alternaria alternata*. Fungus was dark grayish brown in color with some but light colored center with almost rounded margin when grown on PDA. Conidiophores are grown singly as well as in clusters having length of 30.10 to 110µm and width of 3.70 to 8.10µm. 03 to 15 conidia are born in chains on conidiophores. Conidia are olive to brownish in color and variable in shape like muriform, obclavate and ellipsoidal. Conidia tapers at one end having longitudinal and transverse septa. Characters of fungus were matched with the research papers of Lagopodi & Thanassoulopoulos (1995), Nagrale *et al.* (2013) and Maheshwari *et al.* (2017).

Management: Disease resistant varieties should be grown in sufficient sunlight, fungicides are applied.

Downy Mildews of *Cucumis sativus* (L.)

Symptoms: Downy mildew is very fast moving fungal disease. Fungi is very aggressive, once it got spread it is difficult to control the disease. Pale yellow colored, crown like patches appear of upper surface of leaf. Sometime patches provide irregular blocky appearance. On entire green leaf yellow patches appear. As the lesions increases, leaf becomes necrotic. Underside of leaf area, lesions become sunken and water soaked.

Fungal growth characteristics: Downy mildew of cucurbits is caused by fungal pathogen. *Pseudoperonospora cubensis* is the casual organism. Sporangiophores of fungi were 18—270 µmx4.5 – 7.4 µm. Sporangiophores show monopodial branching having branchlets (Lebeda, 1992). Elliptical to ovoidal shaped spores having narrow towards the apical and distal end emerge from branchlets. Sporangia were brownish in color having hyaline papilla at tip, characters matched with Lebeda (1999) and Runge *et al.* (2012). Disease spread from one plant to other and from one plant part to other by spreading of spores through air.

Management: Cultivate resistant verities of cucurbits, avoid over watering. Plant should be grown in sunny area, spread of fungicide.

Powdery Mildews of *Coccinia grandis* (L.) Voigt

Symptoms: Talc like appearance on upper surface of leaf. It is light grayish in color. In early conditions fungi is restricted to smaller area but later on it spread on entire surface of leaf and provide dusty appearance. Spread of fungi to greater extant leads to defoliation. Powdery mildew is mostly observed in shady area of plant. Fungi can also infect the stem and fruit part of host plant.

Fungal growth characteristics: Powdery mildew is a fungal disease which is caused by *Golovinomyces orontii*. Fungal hyphae are long, straight, hyaline having aspersoria which appear as bud like structure. Conidia of fungus appear on upper surface of leaf in the form of powder. Ascospores are

also produced in cleistothecia on leaf surface. Air current is responsible for spread of disease from one area to other. Fungus show long conidiophores of 80-115 µm in length and 6-12µm in width. Conidiophores were long, unbranched and straight. Foot cell of conidiophores was cylindrical and 30-40µmX6-8 µm in size (Meeboon *et al.,* 2018). Elliptical, cylindrical and doliform shaped conidia having length of 20µm-42µm and width of 13 µm-20µm formed singly on the apex of conidiophores (Braun *et al.,* 2019)

***Management*:** Spread of fungicides, Cultivate disease resistant verities. Grow plants in sunny area.

Powdery Mildews of Cucumis sativus (L.)

Symptoms: White colored powdery, oval to circular patches appear on leaf surface. Later on conditions small patches overlap and entire surface of leaf becomes powdery white.

Fungal growth characteristics: Powdery mildew of bottle guard is also caused by *Podosphaera xanthii.* White powder on leaf surface includes fungal conidia. Conidia spread from one place to other by air currents and responsible for spread of disease. Hyphae are smooth, septate occasionally branched, shows nipple like appresoria and near to it germinating conidia with tubes are also present. Brown colored, rounded chasmothecia with appendages are present. Diameter of chasmothecium varies from 25µm to 100 µm. Ascospores are also present having subglobose to ovoid in shape. Size varies from 40-90 µm x 38-80 µm. Characters were matched with Meeboon & Takamatsu (2015) and Thite *et al*. (2018).

Management: Cultivate disease resistant varieties. Detach the affected leaf from plant in early diseased conditions. Plant should be grown in sunny areas. Spray of fungicides.

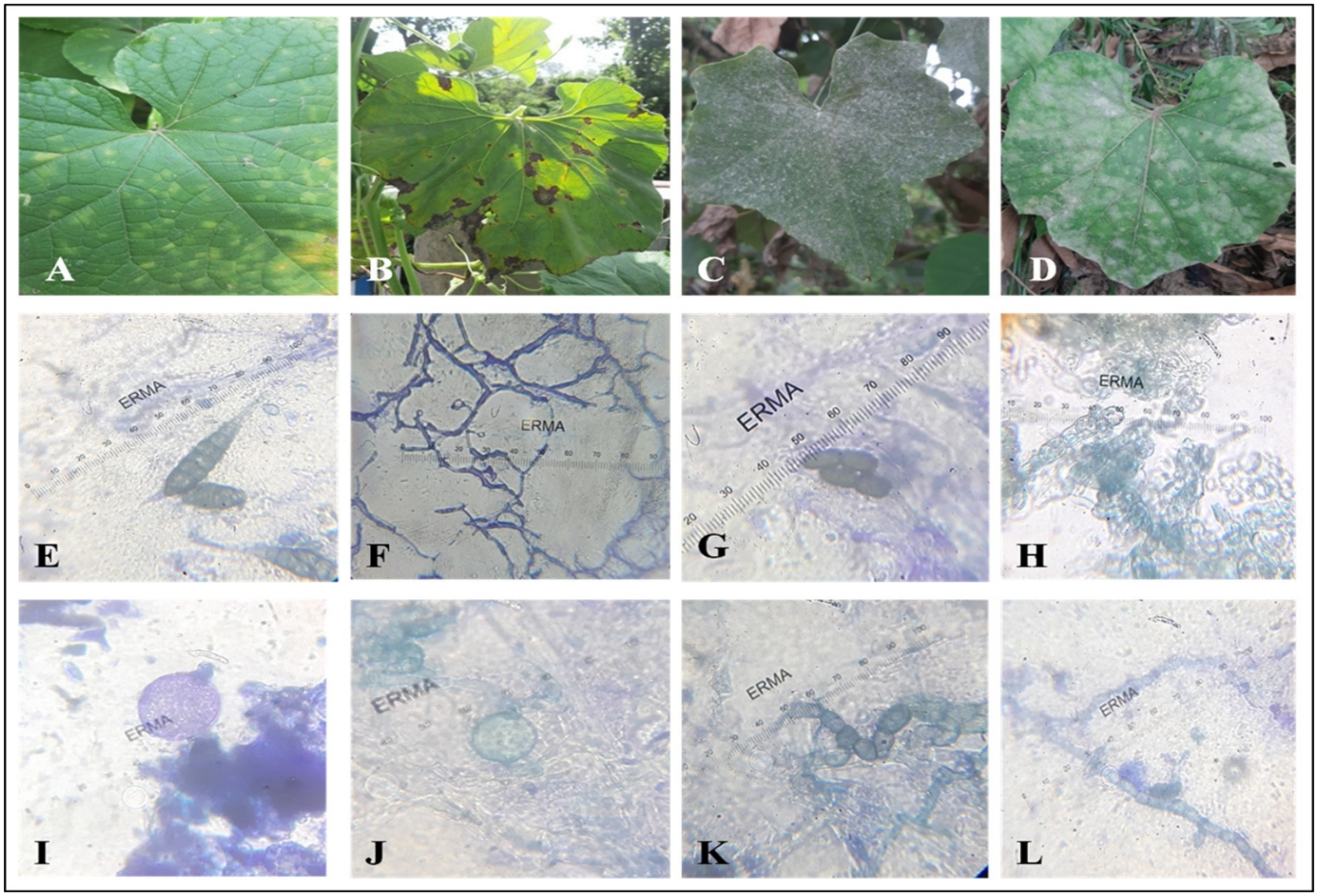

Fig. 3 : Different Diseases on Foliar part of Cucurbits. **A.** Downy mildew of *Cucumis sativus* **B.** Leaf spot of *Lagenaria siceraria* **C.** Powdery mildews of *Coccinia grandis* **D.** Powdery mildews of *Cucumis sativus* **E.** Conidia of *Alternaria alternata* **F.** *Hyphae and conidia of Pseudoperonospora cubensis* **G.** Conidia of *Golovinomyces orontii* **H.** Conidiophores of *Golovinomyces orontii* **I.** Ascus of *Golovinomyces orontii* **J.** Ascus of *Podosphaera xanthii* **K.** Conidiophores of *Podosphaera xanthii* **L.** Germinating conidia and nipple like appresorium of *Podosphaera xanthii*.

DISCUSSION

Agriculture is the major occupation of lower foot hills of Himachal Pradesh. Various crops like cereal crops, vegetable crops, fruit crops, fodder crops etc. are grown by the rural villagers for survival and cash income. In every season villagers cultivate the fields and adopt crop rotation method. Tomato, Potato, Pea, Beans, Onion, Garlic, Brinjal, Lady Finger, Luffa, Pumpkin, Cucumber and Bitter guard are the major vegetable crops of lower foot hills of Himachal Pradesh (Department of Agriculture, H.P., 2009). Healthy crops leads to good yield and is the priority of farmers for crops. There are numerous factors responsible for devastate of health of plants. These factors are biotic as well as abiotic. Biotic factors include various pests, pathogens which could be weed plants, insects, viruses, bacteria and fungi etc (Dhaliwal *et al.,* 2007). Present study is focused on fungal diseases of cucurbits. Cucurbitaceae is the major family of vegetable crops which include Pumpkin, Luffa, Cucumber, sponge guard etc (Rahman, 2013). In this study disease incidence, disease severity and pathogen responsible for diseases of *Lagenaria siceraria, Cucumis sativus* and

Coccinia grandis are studied. Total 4 diseases on 3 host crops have been observed. Diseases observed are Leaf spot of *Lagenaria siceraria,* Downy mildews of *Cucumis sativus,* Powdery mildews of *Coccinia grandis* and Powdery mildews of *Cucumis sativus.* Fungal pathogens are the cause of all these diseases. Out of four fungal pathogens 2 belongs to family Erysiphaceae i.e. *Golovinomyces orontii* and *Podosphaera xanthii.* Rest two pathogens belong to Pleosporaceae and Peronosporaceae families i.e. *Alternaria alternata* and *Pseudoperonospora cubensis* respectively. Among all these diseases, disease incidence and disease severity of Powdery mildews of *Coccinia grandis* are most dominant i.e. 40.3±1 and 51.2±1 respectively. Disease incidence and disease severity of Leaf spot of *Lagenaria siceraria* is least i.e. 12.5±1 and 1.1±1 respectively. Assessment of diseases leads to the assessment of crop losses. This is further an effective tool for calculating economic advantage and control strategies of crop plants. Further there are a lot of scopes in quantification, discovery of new pathogens to researchers, farmers, educationalist and society.

Disclosure Statement:

No potential conflict of interest was reported by author(s).

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