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RESEARCH ARTICLE

SURVEY OF DISEASE INCIDENCE AND SEVERITY OF POWDERY MILDEWS ON ROSES (*ROSA SINENSIS* L.) IN GREENHOUSES IN MAISIRWA, ERITREA

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ABSTRACT

Powdery mildews are the main causes of plant deterioration and reduction in quality of rose flowers. Two surveys were carried out on disease incidence, severity in different cultivars of rose and its existing management practices during autumn season and winter season on rose flowers in the two different greenhouses at MaiSirwa. Disease assessment was made by randomized block design. Result of the surveys clearly indicated that rose flower at all stages of growth was susceptible to powdery mildew infection. Disease incidence and severity was higher during the autumn season in the both greenhouses than winter season. Disease incidence and severity rate among the cultivars in each greenhouse was found different in both of the periods. Disease incidence and severity in the autumn season was 81.94 to 100% and 25.83to 86.81% in greenhouse-I respectively, while, in greenhouse-II it was 23.33 to 78.70% and 25.11to 4.66% recorded respectively. During winter season disease incidence was between 29.44 to7.77 % and severity was 5.88 to 1.55 % in greenhouse-I, in green house-II it was observed that 34.72 to 10 % and 8.11 to 2% respectively. Though some available fungicides were used for the controlling of powdery mildews, which were more effective during the winter season but not in the autumn period in both the greenhouses.

INTRODUCTION

Rose (*Rosa sinensis* L.) cut flowers constitute 45% share of the total world trade in floriculture production. The use of cut flowers in home decoration has become an integral part of living in human society, particularly in affluent countries (Nelson, 1998). In Africa especially the East Africa is favorable for an extension of cut flowers; the climate is suitable for all year round. The largest European importer of cut flowers from Africa is Germany, followed by Belgium, Luxembourg and France. Many other African countries in both East and West Africa has the potential to achieve significant level of horticultural export, due to their favorable climate conditions and their relative proximity to European market, compared with that of producers in Asia and South America (Kroll, 1995). The Eritrean farmers however started to grow cut flowers 40-45 years ago. Even the limited information available points out that, Eritrea has great opportunity of producing cut flowers in a large scale, which looks not only for the local market but for international market too (Fitwi, *et al.,* 2003). The plants are harvested at flowering stage, 70% of the harvested flowers were distributed for local consumption to Asmara flower shop and 30% is sent for export to Saudi Arabia. These harvested flowers are packed in standard flower boxes and pallets, and then exporting is done by Air transport. The flowers are cultivated all year round. Plants are cultivated at a spacing of 30cm between rows and 20cm between individual crops. Fertigation application is used to apply the organic and inorganic fertilizers to improve soil fertility. Some of the inorganic (soluble fertilizers) are like $CaNO_3$, KNO_3, NKP, Mg, P, $MgSO_4$, $MgNO_3$, Iron, Micro-elements+Acids (HNO_3, H_2SO_4, H_3PO_4) which are used for maintaining the pH level of the soil. The plants are watered by means of drip irrigation (Personal communication, 2015). Powdery mildew is one of the most important diseases of roses, both in the garden and in the greenhouse. The disease appears on roses year after year and causes reduced flower production and weakening of the plants by attacking their buds, young leaves, and growing tips. The crop get diseased by wind transportation at all stages of the crop and affects effectively. The powdery mildew is economically important disease because it reduces the aesthetic value, reduce yield and also reduces the quality of the flowers. Development of powdery mildew is highly influenced by weather factors, mainly temperature and high relative humidity long duration. Sequential occurrence of favorable temperature and high relative humidity above a threshold limit (mostly >80%) at a particular growth stage of plant are known to be conducive for growth and development

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of the pathogen as mildew is limited to those areas where environment is simultaneously favorable for a sufficient time period for pathogen and host (Jeger, 1984).

***Symptoms*:** On young leaves the disease appears at first as slightly raised blister-like areas that soon become covered with a grayish white, powdery fungus growth. As the leaves expand, they become curled and distorted. On older leaves, large white patches of fungus growth appear that cause little distortion but may eventually become necrotic. White patches of fungus growth also appear on young, green shoots, and they may coalesce and cover the entire terminal portions of the growing shoots. Infected shoots may become arched or curved at their tip (Agrios, 2005). The figure 1 shows the infection may also spread to the flower parts, which become discolored, dwarfed, and eventually die.

Powdery mildew on roses is caused by a special form of *Sphaerotheca pannosa* (Wallr.) de Bary f. sp. *rosae*. It belongs to family Erysiphaceae of Phylum Ascomycota. The fungus produces white mycelium that grows on the surface of the plant tissues, sending glubose haustoria into the epidermal cell. The mycelium forms a weft of hyphae on the surface, some of which develop into short, erect, conidiophores. At the tip of each Conidiophore, 5 to 10 egg-shaped conidia are produced that cling together in chains (Agrios; 2005). With the coming of cool weather late in the season, the production of conidia ceases and cleistothecia may be formed, mainly on canes. The ascospores continue to develop during the fall, and in the spring they are mature and ready for dissemination. In the spring the cleistothecia absorb water and crack open. The tip of the single ascus in each cleistothecium then protrudes, bursts open, and discharges eight mature ascospores (Fig. 2).

Fig. 1. Powdery mildew symptoms caused by *Sphaerotheca pannosa* as on the Rose twig, bud and on the leaves, in greenhouses, Maisirwa

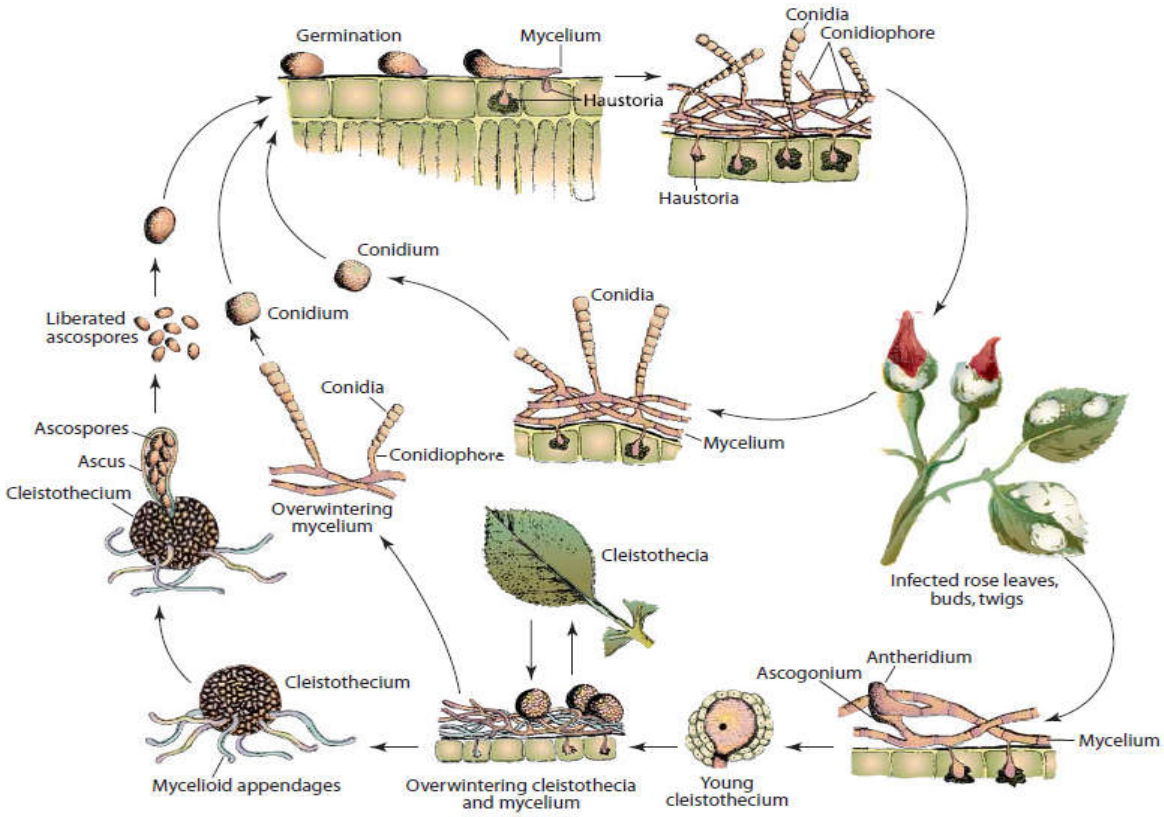


Fig. 2. Life cycle of *Sphaerotheca pannosa* causing powdery mildews on roses (Agrios, 2005)

There is little information on diseases and the infection of powdery mildews on roses and on the exact cause of deterioration of plants and quality of flowers in the zone. It is therefore, essential to study the status of mildews on roses at greenhouse level, disease incidence, severity of powdery mildew in different cultivars of rose and its existing management practices.

MATERIALS AND METHODS

Site description

The survey has been done at Asmara flowers Company which is located in MaiSirwa that is 13 km North West from Asmara, at 15° 23'north latitude and 38^0 54' east longitudes and an elevation of 2300 meter above sea level. The annual rainfall of the area ranges from 4000mm to 600mm and annual mean of maximum and minimum temperature are 4.3 to 25.5°C (Ministry of Agriculture, 2015).

Fig. 3. Green house view from outside (A) and inside (B)

Green house is to protect the crop with materials to shield against damaging factors other than climate, such as birds and insects. (Biniam Mesfn, 2010). The government of Eritrea established a green house in MaiSirwa in 2009, at an area of 8.2ha with the main objective of planting this crop is for decoration, sale and export. In MaiSirwa there are two types of greenhouses (Fig.3) i.e., greenhouse-1 which includes eight cultivars (High and Magic, Marie Claure, Tropical Amazone, Aqua, Bordeaux, Upper Class, Avalanche, Poisson) of three years and eight months old and greenhouse-2 that includes seven cultivars (namely: Avalanche, Gold strike, Contrast, Wham, Top Secret, Upper Class, Poisson) of ten months old, which were introduced from India (Fig.4) (Zoba Maekel Admin., 2014).

Fig. 4. Cultivars Aqua (A); Avalanche (B); Bordeaux (C); High And Magic (D); Marie Claure (E); Poisson (F); Upper Class (G) and Gold Strike (H) are cultivating in MaiSirwa.

Experimental design

Survey was conducted in different rose plantations at MaiSirwa. Infected rose leaves collected from the gardens of cultivating areas. Leaves were considered as a sampling unit.

Field Survey and Sampling

The first survey was executed during autumn season *(qewi)* and the second survey was carried out during winter season *(hagay)* in both the greenhouses I and II, MaiSirwa. In greenhouse 1 the total area, 4.2 hectare was divided into 4 sectors of equal area for growing the cultivars and the remaining 0.2ha for postharvest management. In Greenhouse-II the total area, 4ha was also divided in to 2 sectors of equal areas. Disease severity was estimated as a percentage of total leaf area of a single plant which was covered with powdery symptoms by giving maximum rating 1-5 scale.

Percentage of Disease	Rating Scale
0-10%	1
11-25%	2
26-50%	3
51-75%	4
>75%	5

The formulae in calculating the disease incidence and severity are:

$$\text{Plant disease incidence (PDI)} = \frac{\text{Total Number of Infected Plants}}{\text{Total Number of Plants Assessed}} \times 100$$

$$\text{Plant disease severity (PDS)} = \frac{\text{Number of Individual Raitngs}}{\text{Number of Plants Assessed}} \times \frac{100}{\text{Maximum Scale}}$$

Isolation and identification of the pathogen

Isolation of the fungus from the infected plant parts or leaf has been done by taking some samples of the fungus symptoms randomly from each selected plots and bought to the laboratory in brown-paper covers. Slides were prepared by scratching powdery symptoms from the leaves then stained by lacto phenol cotton blue (Fig. 5). The suspected pathogen *Sphaerotheca pannosa* was observed from infected parts of various cultivars and the pathogen identification was carried out by binocular compound microscope examination based on the characteristics of the fungus by using standard identification keys (Aneja, 2004).

Data Analysis

The data was analyzed by GENSTAT 10.3 (2011) software ANOVA at 5% level of significance.

RESULTS AND DISCUSSION

Though different type of disease signs were seen in all cultivars of rose, but the powdery mildews was found to be the major disease in both greenhouses of MaiSirwa. During the autumn season, the incidence was found with no significant difference among the cultivars. Aqua cultivar was found with highest disease incidence of 100% and avalanche cultivar was found with least disease incidence of 81.94%. Similarly, the winter season also has shown, with no significant difference among the cultivars in disease incidence. Aqua and Marie Claire cultivars recorded with the highest 29.44% and lowest 7.77% disease incidence respectively (Table 1). During the autumn and winter periods there was no significant difference among the cultivars in disease severity. In the first sample

Aqua was with high disease severity of 86.81% and Avalanche with least disease severity of 25.83%. Aqua with high disease severity of 5.88% and Marie Claire with least disease severity of 1.55% was showed during winter season (Table 2). Disease incidence was not significantly different among the cultivars, during the autumn and winter sample assessment period. In the sample collected autumn period, Gold strike and Avalanche were found with most and least disease incidence of 78.15% and 23.33% respectively. In the samples collected during winter, Gold Strike with high disease incidence of 34.72% and

Fig. 5. Mycelium and cleistothecia on the leaf (A); Cleistothecium of a powdery mildew (B); Conidia of a powdery mildew (C) fungus in typical shape and arrangement in chains

Table 1. Percentage of Disease Incidence during two seasons on eight cultivars in Greenhouse-I

Cultivar	During Autumn Season *(Qewi)* (%)	During Winter Season *(Hagay)* (%)	Mean (%)
Aqua	100	29.44	64.72
Marie Claure	96.66	7.77	52.21
Poisson	95.83	12.22	54.02
Upper Class	96.38	15.55	55.96
High And Magic	95.55	25	60.27
Tropical Amazone	95.55	12.77	54.16
Bordeaux	84.72	22.5	53.61
Avalanche	81.94	8.61	45.27
MEAN	93.32	16.73	55.03
LSD	7.39		14.78
CV	11.4		11.4

Table 2. Percentage of Disease Severity during two seasons on eight cultivars in Greenhouse-I

Cultivars	During Autumn Season *(Qewi)* (%)	During Winter Season *(Hagay)* (%)	Mean (%)
Aqua	86.81	5.88	46.34
Marie Claire	53.33	1.55	27.44
Poisson	44.88	2.44	23.66
Upper Class	44.22	3.11	23.66
High and Magic	42.77	5	23.88
Tropical Amazone	40	2.55	21.27
Bordeaux	26.05	4.5	15.27
Avalanche	25.83	1.72	13.77
MEAN	45.48	3.34	24.41
LSD	15.44		30.89
CV	53.5		53.5

Table 3. Percentage of Disease Incidence during two seasons on eight cultivars in Greenhouse-II

Cultivar	During Autumn Season *(Qewi)* (%)	During Winter Season *(Hagay)* (%)	Mean (%)
Gold Strike	78.15	34.72	56.43
Contrast	78.7	30.83	54.76
Poisson	62.22	33.05	47.63
Upper Class	43.05	27.5	35.27
Top Secrete	37.5	18.33	27.91
Wham	26.11	10	18.05
Avalanche	23.33	34.44	28.88
MEAN	49.86	26.98	38.42
LSD	16.7		31.23
CV	33.2		0.81

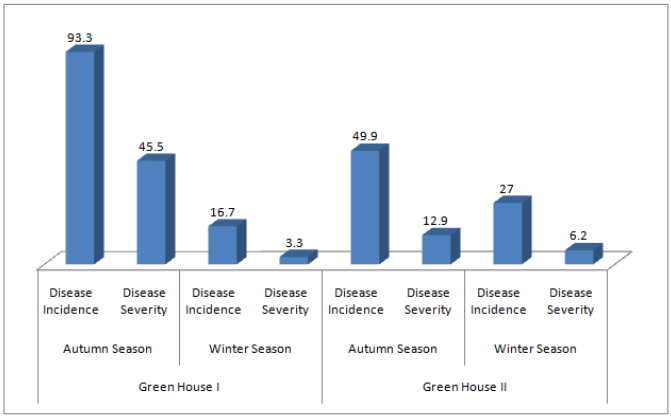
Wham with least disease incidence of 10% was noticed (Table 3). During the first and second sample period disease severity was not significantly different among the cultivars. In the samples collected from autumn season, Gold strike cultivar was with a high disease severity of 25.11% and Avalanche cultivar with least disease severity of 4.66% and during the samples collected from winter season, Poisson was with the highest disease severity of 8.11% and Wham with least disease severity of 2% (Table 4).

Table 4. Percentage of Disease Severity during two seasons on eight cultivars in Greenhouse-II

Cultivars	During Autumn Season *(Qewi)* (%)	During Winter Season *(Hagay)* (%)	Mean (%)
GoldStrike	25.11	6.94	16.02
Contrast	23.74	7.55	15.64
Poisson	15.18	8.11	11.64
Upper Class	8.61	6.27	7.44
Top Secrete	7.72	4.05	5.88
Wham	5.22	2	3.61
Avalanche	4.66	7.55	6.10
MEAN	12.89	6.06	9.47
LSD	7.1		13.29
CV	57.3		1.39

According to the obtained results of this present survey, in the autumn period disease severity and incidence was very high. This was because of high relative humidity and temperature. However, during the winter period both disease incidence and severity was low due to relative humidity (RH) rate and temperature decrease. Based on the visual observation during the survey period, it is noticed that, between the two greenhouses, greenhouse-II was found more favorable than greenhouse-I in cultivating rose flower with less disease incidence and severity. This was because the greenhouse-II type was designed to be used in tropical countries, which is covered with colored plastic and has the ability to reflect some of the excessive sun light, to maintain optimum temperature inside. Despite this, greenhouse-I was designed to be used in temperate countries and has high absorbing ability of sun light. Since Greenhouse-I built with white and transparent plastic covering; this causes high transpiration, temperature and relative humidity. For the control of powdery mildew disease, fungicides like Mystic (tebeconazole), Difference (diferconazole), Collis (boscalide+kresoximmethyl), Bellis (boscalid+pyraclostrobin) and Bavistin (carbendazim) were used to spray in both the seasons at an interval of 5-7 days. As a result, during the first sample period the fungicides didn't brought a measurable change on the disease incidence and severity.

This could be because of poor maintaining for RH rate, temperature range, wind speed, and rate of radiation. Chilling period which is favorable for the pathogen might be another reason to cause disease. Despite, during the winter period using the above fungicides almost all the cultivars in both the greenhouses started to recover. As a result, incidence and severity of powdery mildew decreased, although the maintenance was poor. In this season the climatic condition was less favorable for the pathogen to cause the disease in the greenhouses. Several cultural practices, such as foggers to reduce RH and cutting the flower heads to increase the plant height thereby increase resistance of the plant against the diseases are used by the agricultural experts to reduce the disease incidence and severity. This was found practically effective in short flowers with less resistance to disease like Aqua. The graph 1 clearly indicating that disease incidence in greenhouse-I during the autumn and winter seasons were found with mean of first and second at 93.3% and 16.7% respectively, and least significance difference of mean (5% level) 7.39% and coefficient of variance 11.4%. Therefore, disease incidence was found significantly different between the two seasons (at 5% level) of significance.



Graph 1. Percentage of Disease Incidence and Disease Severity in Greenhouses I and II during Autumn and Winter Seasons

According to the result disease severity during autumn and winter seasons was found with mean of 45.5% and 3.3% respectively. At a grand mean of 24.4%, and least significance difference of mean (at 5% level) is 15.44% and coefficient of variance 53.5%. Therefore disease severity was found significantly different between the two seasons (at 5% level) of significance.

It is estimated that disease incidence in greenhouse-II of autumn and winter periods at a mean level of 49.9% and 27% respectively and grand mean of 38.4%, least significant difference of mean (at 5% level), and coefficient of variance was also found 16.7% and 33.2% respectively, therefore disease incidence was found significantly different between the two seasons (at 5% level). According to this survey, disease severity in the two seasonal periods was found with a mean of 12.9% and 6.2% respectively and grand mean of 9.5%.Coefficient of variance was found 57.3% and least significance difference of mean (at 5% level) 7.1%. Therefore, disease severity was found significantly different between the two seasons (at 5% level).

Conclusion

It is concluded and recommended that based on the obtained results of this survey are: The overall yield and yield quality of rose in all the seasons is lowered due to disease problem, this shows that the disease is more prevalent in the greenhouses, which needs study on fungicides which can control powdery mildew effectively. Identify alternative control methods of disease such as cultural practices and biological control methods. Disease incidence and severity was high in the Greenhouse-I than Green house-II, hence it is recommended to cultivate in the Greenhouse-II.

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REFERENCES

Nelsen, V. Paul, 1998. Green house operation and management, 5th edition, Pruntie hill, pp56.

Kroll Raymond, 1995. The tropical agriculturalist: "cut flower", London, pp6-46.

Fitwi, Y. et al. 2003. Assessment of cut flower production in and around Asmara, Senior Research Project, College of Agriculture, Asmara, Eritrea.

Jeger, M. J. 1984. Relating disease progress to cumulative no. of trapped spores: Rose Powdery Mildew.Plant pathology, 33:517-523.

Agrios, N. 2005. Plant pathology, Fifth Edition, Department of plant pathology university of Florida, Elsevier Acadamic Press 30 Corporate Drive, Suite 400, Burlington, MA 01803, USA.

Ministry of Agriculture-MoA. 2015. Assessment of flower farms in Eritrea, Eritrea.

Biniam Mesfn, 2010. HAC.Dept. of Hosc., Protected Cultivation of Roses, p.4-6.

Zoba Maekel Administration 2014. *Report on Flower Production*, Asmara, Eritrea.

Aneja, K.R. 2004. Experiment in microbiology, Plant Pathology and Biotechnology.4th Ed, New International (P) Limited Publisher, India, 121-128.

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