



**Study of downy mildew (*Pseudoperonosporacubensis*(Berk. & Curt.) Rostov.)
of cucumber (*Cucumis sativus* L.) under polyhouse in relation to weather parameters**

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Abstract

Cucumber is one of the major vegetables cultivated under polyhouse in Kerala and downy mildew is one of the most devastating diseases affecting the crop inside the polyhouse. It is found that there is incidence of downy mildew in polyhouses irrespective of the season. Hence a survey was conducted to assess the influence of major weather parameters viz., relative humidity (RH) and temperature on the disease. It was found that the disease severity varied from 11.33 to 35.75 per cent when the RH inside the polyhouse varied from 79 to 97 per cent. Moreover at the same time, temperature inside the structure varied from 24.70 to 33.80°C respectively. Correlation analysis proved that there is a significant positive correlation between disease incidence and severity with relative humidity (RH) inside the polyhouse and negative correlation with temperature. It was also found that there is a chance of incidence of downy mildew inside the structure if the RH \geq 79 per cent.

Keywords- cucumber, downy mildew, polyhouse, temperature, relative humidity

I. INTRODUCTION

Cucumber, *Cucumis sativus*(L.) is one of the most preferred vegetables grown under protected conditions in the developed world. In India it is traditionally grown during two seasons viz., January-March and September-December. Compared to open field, very high yield of cucumber have been reported under naturally ventilated polyhouse^[1]. But sometimes, the crop is devastated by diseases and among them the major one is downy mildew caused by the oomycete, *Pseudoperonosporacubensis*(Berk. and Curt.)(Rostov.). Cucumber downy mildew is a widely distributed and devastating disease of cucurbitaceous crops in the open field and polyhouse^[2]. Downy mildew decreases flower set and fruit development by killing the foliage and thus causes heavy crop loss^[3].

Protected cultivation provides ideal weather conditions for downy mildew^[4]. Consistent environment, moderate temperature, high humidity, less air movement, overcrowded conditions and lush growth of the crop in the polyhouse favours disease outbreak^[5]. At normal greenhouse temperature, if relative humidity exceeds 70-75 per cent there is chance of occurrence of downy mildew^[6].

II. MATERIALS AND METHODS

A. Survey for assessment of incidence and severity of downy mildew of cucumber in polyhouses in Thrissur district, Kerala, India.

Survey was conducted in Thrissur district during January-December of 2015 by selecting nine polyhouses located at six different locations in Thrissur district. The incidence and severity of downy mildew in polyhouse were assessed using standard score chart and procedures. Percentage of disease incidence was calculated using the formula

$$\text{Percentage disease incidence (PDI)} = \frac{\text{Number of plants infected} \times 100}{\text{Total number of plants}}$$

In each poly house, 10 plants were selected randomly, and a total of five leaves, two each from bottom and middle and one from the top of the plant were observed. Disease severity was assessed using 0-5 scale as mentioned below.

Disease rating	Percentage of leaf area infected
0	No infection
1	Below 10 % infection
2	>10-25% infection
3	>25-50% infection
4	>50-75%infection
5	Above 75% infection

Based on the percentage of leaf area affected, per cent disease severity (PDS) was calculated using the following formula^[7].

$$\text{PDS} = \frac{\text{Sum of all numerical ratings} \times 100}{\text{Total number of leaves observed} \times \text{Maximum disease score}}$$

The major meteorological factors *ie*, temperature and relative humidity (RH) influencing the crop and the pathogen prevailing in the structures and open condition were recorded using a whirling psychrometer.

B. Correlation analysis of incidence and severity of downy mildew with meteorological factors

Data collected during the survey was subjected to correlation analysis using SPSS v16.0 data editor to assess the influence of meteorological factors on incidence and severity of downy mildew in protected structures.

III. RESULTS

A. Survey for assessment of incidence and severity of downy mildew of cucumber polyhouses in Thrissur district, Kerala, India.

Incidence of downy mildew was noticed in all the polyhouses where cucumber is cultivated (Table1). Percent disease incidence (PDI) varied from 4.67 to 15.45 and percent disease severity (PDS) varied from 11.33 to 35.78 in different poly houses surveyed. Incidence and severity of the disease were found to be high during rainy season *i.e*, 15.45 and 35.75 respectively as observed in the polyhouse (1) at Chentrapinni. It is clear from the table that there is occurrence of cucumber downy mildew inside the polyhouse irrespective of the season. Meteorological data showed a wide variation among the polyhouses. It varied mainly with the season, irrigation schedule, type of the structure, location *etc*. In general, temperature and RH are higher inside the polyhouse compared to outside. However, out of the nine polyhouses visited, in polyhouse (1) at Peringotukara outside temperature was higher than

inside. Similarly, a low RH was observed in the polyhouse at Manaloor compared to outside. The temperature inside the polyhouse varied from 24.7 to 33.8°C and the increase in temperature inside the polyhouse compared to outside varied from 0.6 to 3.9°C. The RH inside the polyhouse varied from 79 to 97 per cent and the increase in RH inside the polyhouse varied from 1 to 8 per cent. Data presented in the table shows that high humidity and low temperature influences the development of downy mildew of cucumber inside polyhouse.

Table 1. Incidence and severity of downy mildew of cucumber under polyhouse in Thrissur district.

Sl. No	Place	Area (m ²)	Location (2015)	PDI	PDS	Inside polyhouse		Outside polyhouse	
						Temp. (°C)	RH	Temp. (°C)	RH
1	Peringottukara -1	220	January	12.70	24.56	30.50	93	31.10	93
2	Manaloor	400	March	4.67	11.33	29.40	79	28.00	81
3	Thanniyam -1	365	May	13.34	25.00	31.60	87	30.50	86
4	Chenthrapinni-1	420	June	15.45	35.75	24.70	97	23.30	91
5	Chenthrapinni -2	400	July	12.67	28.90	26.40	95	24.60	93
6	Thanniyam -2	400	August	5.33	15.67	33.80	81	32.70	80
7	Peringottuka-2	180	September	6.98	16.17	32.00	83	28.10	81
8	Vellanikkara	200	November	11.33	14.67	32.70	83	31.20	82
9	Chavakkad	400	December,	9.75	22.39	30.00	87	26.10	79

PDI-Per cent disease incidence PDS-Per cent disease severity RH-Relative humidity

B. Correlation analysis of incidence and severity of downy mildew with meteorological factors

Correlation analysis of disease incidence and severity with major meteorological parameters inside the polyhouse was performed (Table 2).

Table 2. Correlation analysis of disease incidence and severity with major meteorological parameters.

Correlation coefficients	PDS	PDI	RH
PDI	0.859**		
RH	0.956**	0.845**	
Temperature	-0.757*	-0.546*	-0.768*

*Correlation is significant at 0.05 level ** Correlation is significant at 0.01 level

It is observed that there is a significant positive correlation between PDI/PDS with RH inside the polyhouse whereas they are negatively correlated with temperature. There is a significant positive correlation between PDI and PDS also.

IV. DISCUSSION

A. Survey for assessment of incidence and severity of downy mildew of cucumber polyhouses in Thrissur district, Kerala, India.

During the survey, incidence of downy mildew was noticed in all the polyhouses where cucumber is cultivated irrespective of the season. It was also noticed that, in all these polyhouses RH was found to be ≥ 79 per cent. It is well documented that, if the RH is >75 per cent, there is chance of occurrence of downy mildew inside the polyhouse^[6]. Both PDI and PDS of downy mildew were found to be high in the rainy season when the RH is high both inside and outside the structures.

Data collected during the survey shows that, high humidity and low temperature influences the development of downy mildew of cucumber in polyhouse. During the survey it was found that, temperature and RH are higher inside the polyhouse compared to outside. The reason for high temperature inside the polyhouse is greenhouse effect brought about by the polythene roof *ie* increase in temperature due to retention of major part of reflected radiation from the earth's surface by the polythene roof of the structure. Thus, most of the energy which is transmitted into the polyhouse is retained inside and causes increase in atmospheric temperature^[8]. Use of foggers and increased plant transpiration due to high atmospheric temperature inside and outside the structure are the major reasons for high RH in polyhouses. Studies also revealed that the closed environments enable the sporangia to stay inside the polyhouse for longer period and the microclimate prevailing in the structure provide ampie atmosphere for the sporangia to multiply and survive on healthy leaves so as to cause more infection. Hence, downy mildew develops in devastating proportions in cucumber under protected cultivation if microclimate is not maintained properly so that RH is less than 75 per cent^[2].

B. Correlation analysis of incidence and severity of downy mildew with meteorological factors

During the survey highest disease severity was observed in polyhouse (1) of Chentrapinni where PDI and PDS of downy mildew were 15.45 per cent and 35.75per cent respectively. It was also observed that RH was 97 per cent during this period. Correlation analysis of disease incidence and severity with major meteorological parameters showed that there is a significant positive correlation between PDI/PDS with RH inside the polyhouse whereas they are negatively correlated with temperature. The result confirms the findings which already documented^[2].

V. CONCLUSION

During the survey, incidence of downy mildew was noticed in all the polyhouses where cucumber is cultivated irrespective of the season. There is chance of occurrence of downy mildew if RH is ≥ 79 per cent. Temperature and relative humidity was higher inside the polyhouse compared to outside. The increase in temperature and RH inside the polyhouse varied from 0.6 to 3.9°C and 1 to 8 per cent compared to outside. It was also found that there is a significant positive correlation between disease incidence and severity of downy mildew with relative humidity (RH) inside the polyhouse whereas it is negatively correlated with temperature.

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