Journal of Agrometeorology 16 (2) : 219-221 (December 2014)

Short Comminucation

Influence of weather variables on morphological structures of *Pseudoperonospora cubensis* in cucumber

S. HEMBRAM[1], S. DUTTA*[2], I. BHATTACHARYA[1], A. SAHA[3] and D. MAJUMDER[4]

[1]Department of Plant Pathology, [2]AICRP on Vegetable Crops, [3]Department of Agricultural Meteorology, [4]Department of Agricultural Statistics, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur-741252, Nadia, West Bengal, India

**E-mail: subrata_mithu@yahoo.co.in*

Downy mildew, powdery mildew, gummosis, anthracnose, *Phytophthora* blight, *Cercospora* leaf spot, root knot nematode and watermelon bud necrosis virus are becoming the most destructive diseases of cucurbits in India. Among these diseases, downy mildew, a foliar disease caused by the Oomycetous fungus, *Pseudoperonospora cubensis* (Berk and Curt) Rostow is one of the most destructive pathogens of cucurbits (Palti and Cohen, 1980). Weather variables, greatly influence the outbreaks of cucurbit downy mildew epidemics. The degree of infection of cucurbits by *P. cubensis* is greatly influenced by temperature and leaf wetness. Environmental conditions greatly influence sporangial production, liberation, dispersal, and survival. Sporangial production is affected by temperature, moisture, and light (Reuveni and Raviv, 1997; Rotem, et al. 1978). Morphology of *Pseudoperonospora cubensis* seems to be reliant on several factors viz., weather variables, hosts and nutritional factors (Cohen & Eyal, 1977; Kulkarni et al.2009). Variability in morphological dimensions of *P. cubensis* may have some major impact on downy mildew disease and epidemic development. Thus, the objectives of this study were to identify the influence of weather variables on sporangial production and variation in morphological parameters of *P. cubensis*.

The field experiment was laid out in C-Block farm, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal under new alluvial zone (22.9^{0}N latitude, 89^{0}E longitudes at an elevation of 9.75 mamsl) in a cucumber field for 12 months during the growing season of 2009-10. The weather variables were collected from nearby observatory.

The cucumber crop (local cultivar) was sown in February, May, September and December, 2009 and standard agronomic and plant protection techniques were followed except use of any fungicides. For this experiment infected lesions were collected from the downy mildew infected leaves of cucumber field and teased on glass slide with a drop of lacto phenol and mounted on the microscope throughout the year. The morphological characters examined were the length of the sporangiophores (n= 20), the height of the first branching (n= 20), the number of branching (n= 20) and the length and the width of the sporangia (n =20). The morphological parameters of *P. cubensis* isolates of different host were observed through micrometric measurement in different season of the year and their average values were presented. The sporangial production was evaluated from the sporulating area of the infected leaf through haemocytometer as expressed as number of sporangia per cm^2 area. Correlation and regression analysis were carried out to find out the association between weather parameter and morphological structure of *P. cubensis.*

The significantly maximum length of sporangiophore of *Pseudoperenospora cubensis* on cucumber host was observed in the month of January and significantly minimum length of sporangiophore was recorded in the month of May. Significantly higher numbers of branches and spores per spot were observed during November to January and lower numbers of branches and spores per spot were observed during April-May (Table 1). The present findings, thus suggested that environmental factors had strongly influenced on the variation of morphological dimensions of *Pseudoperonospora cubensis.* The significantly lowest spore concentration of *P. cubensis* was observed during April- May period and lower sporulation during this period may be associated with hot and dry climatic spell and consequently low disease severity was recorded during this period. Higher temperature with dry spell during April-May months may affect the sporangiophore and sporangial developmental stages of *P. cubensis.* Sporangia and sporangiophores are greatly affected by changes in temperature and humidity. Temperature has been stated to be the most important external factors affecting the growth and development of sporangiophores (Iwata, 1953).

Table 1: Morphological structures of *Pseudoperenospora cubensis* on cucumber host during 2009-2010

Months	Total length of sporsngiophore (A)(µm)	Height of branching started (B)(µm)	Ratio of B:A	Total number of branches	Spore size (Length µm)	Spore size (Breath µm)	Spore concentration per spot (in $10^4/cm^2$)	
							Minimum	Maximum
January	323	245	0.76	15.04	28.29	18.41	2.19	2.64
February	312	228	0.73	13.67	28.09	18.2	1.99	2.28
March	309	223	0.72	12.76	27.93	18.58	1.75	2.14
April	286	206	0.72	12.40	28.06	18.56	1.42	1.92
May	265	201	0.76	12.46	28.04	18.58	1.47	2.03
June	257	202	0.79	12.57	28.04	18.58	1.69	2.15
July	270	205	0.76	12.75	28.06	18.61	1.75	2.24
August	277	208	0.75	12.94	28.06	18.6	1.84	2.27
September	286	213	0.74	13.41	28.04	18.58	1.92	2.29
October	287	216	0.75	13.49	28.94	18.17	1.98	2.34
November	299	221	0.74	14.74	29.68	18.91	2.01	2.42
December	312	229	0.73	14.87	28.06	18.15	2.07	2.49
SEm±1	3.65	4.27	0.00	0.07	0.11	0.14	0.09	0.09
CD(5%)	10.72	12.51	0.01	0.20	0.31	0.41	0.27	0.27

Table 2: Correlation analysis between morphological characteristics of *Pseudoperonospora cubensis* and weather variables

Weather Parameter	Total length of sporangiophore	Height of branching started	Total no of branch	Spore concentration
Max. Temp.	-0.703*	-0.821**	-0.928**	-0.934**
Min. Temp.	-0.902**	-0.912**	-0.837**	-0.684*
Max. RH	0.267	0.360	0.540*	0.726**
Min. RH	-0.631*	-0.483	-0.188	0.112
Wind Speed(WS)	-0.338	-0.445	-0.694**	-0.846**
Sun Shine hour	0.327	0.229	0.054	-0.248
Rainfall (RF)	-0.674*	-0.602*	-0.514*	-0.244
Evaporation	-0.527	-0.644*	-0.812**	-0.932**

**Significant at 1% level, *Significant at 0.5% level

Table 3: Multiple regressions equation using stepwise technique

Total length of sporangiophore	=	362.197-3.342(min. temp.)	R^2=0.813
Height of branching started	=	262.594-2.145(min. temp.)	R^2=0.832
Total no of branch	=	21.961-0.258(min. temp.) – 0.002(RF)	R^2=0.921
Spore concentration	=	4.629-0.008(max. temp.) – 0.02(WS)	R^2=0.922

Morphological variations of the oomycete appear to be correlated with host and environmental conditions (Lebeda and Widrlechner, 2003).

Correlation and multiple regression analysis

The results of correlation analysis presented in Table 2 revealed that total length of sporangiospore was found to be significantly negatively correlated with maximum temperature (r=-0.70), minimum temperature (r=-0.90), minimum RH(r=-0.63) and rainfall (r=0.67), whereas branch length was found to be significantly negatively correlated with maximum temperature (r =-0.82), minimum temperature (r=-0.91), rainfall (r=0.60) and evaporation (r=-0.64). Also total number of branches was significantly negatively correlated with maximum temperature (r=-0.93), minimum temperature (r=-0.84), wind speed (r=-0.69), rainfall (r=0.51), and evaporation (r=-0.81) whereas total number of branches was found to be significantly positively correlated with maximum relative humidity (r=0.54) whereas spore concentration was significantly negatively correlated with maximum temperature (r=-0.93), minimum temperature (r=-0.68), maximum relative humidity (r =-0.73), wind speed (r =-0.85) and evaporation (r =-0.93). However, step-wise regression by considering all the weather variables as predictors to explain total length of sporangiophore, height of branching, total number of branches revealed that an increase in minimum temperature, rainfall and wind speed resulted in decrease in the respective morphological characteristics (Table 2&3). Temperature and rainfall were found to be the two most important weather variables associated with the variation in the morphological characteristics and sporulation of *P. cubensis* on cucumber. These identified weather variables may be further exploited under in field condition for development of cucumber downy mildew disease prediction model.

ACKNOWLEDGEMENT

The authors are gratefully acknowledged Indian Council of Agricultural Research, New Delhi, India for providing financial assistance under National Fund for Basic and Strategic Research for carrying out the research programme.

REFERENCES:

Cohen, Y. and Eyal, H. (1977). Growth and differentiation of sporangia and sporangiophores of Pseudoperonospora cubensis on cucumber cotyledons under various combinations of light and temperature. *Physiol Plant Pathol.* 10: 93–103.

Iwata, Y. (1953). Specialization in Pseudoperonospora cubensis (Berk. et Curt.) Rostov. IV. Studies on the fungus from Oriental pickling melon (*Cucumis melo* var. *conomon* Makino). Bulletin of the Faculty of Agriculture, Mie University 1: 30-35.

Kulkarni, S. Hegde Y.R, Kota, R.V. (2009). Pathogenic and morphological variability of *Plasmopara halstedii*, the causal agent of downy mildew in sunflower. *Helia.* 32: 85-90.

Lebeda, A. and Widrlechner, M. P. (2003). A set of Cucurbitaceae taxa for differentiation of *Pseudoperonospora cubensis* pathotypes. *J. Plant Dis. Protect.*, 110:337-349.

Palti, J. and Cohen, Y. (1980). Downy mildew of cucumbits (*Pseudoperonospora cubensis*): the fungus and hosts, distribution, epidemiology and control. *Phytoparasitica*, 8: 109-147.

Reuveni, R. and Raviv, M. (1997). Control of downy mildew in greenhousegrown cucumbers using blue photoselective polyethylene sheets. *Plant Dis.* 81:999-1004.

Rotem, J. Cohen, Y. and Bashi, E. (1978). Host and environmental influences on sporulation *in-vivo*. *Annu. Rev. Phytopathol.* 16:83-101.

Received : October, 2013; Accepted: June 2014